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Approved for EDF by: A. MARECHAL *Name/Initials* *Date 22/10/2012*	Approved for AREVA by: G. CRAIG *Name/Initials* *Date 22/10/12*

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For information address:

AREVA NP SAS
Tour AREVA
92084 Paris La Défense Cedex
France

EDF
Division Ingénierie Nucléaire
Centre National d'Equipement Nucléaire
165-173, avenue Pierre Brossolette
BP900
92542 Montrouge
France

CONTENTS CHAPTER 12

SUB-CHAPTER 12.1 – IMPACTS ON TERRESTRIAL ECOSYSTEM

LIST OF TABLES

1. DURING CONSTRUCTION PHASE

During the construction phase of the EPR, the following potential impacts on terrestrial ecosystems have been identified.

1.1. IMPACT ON TOPOGRAPHY AND GEOLOGY

The local topography and geology will play an important role in the plant siting and visual impact assessment for a new reactor. The general location and local topography will be studied along with the terrestrial and sub-marine geology.

During the preparatory works phase, detailed studies of the site geology and topography will be carried out and the impact of the layout of the site and potential effects will be assessed.

1.2. IMPACT ON NATURAL RESOURCES

The construction of the UK EPR will require a large quantity of raw material. During the planning and design phases, the specification of construction materials will be determined, together with a prediction of waste arisings.

Where possible, primary aggregates will be sourced locally or onsite, with a preference towards sustainable use of secondary aggregates, also sourced locally or onsite.

1.3. IMPACT ON AIR QUALITY AND CLIMATE

This section deals with the requirement 3.3 of the Environment Agency (EA) Process and Information (P&I) Document [Ref-1].

The potential sources of gaseous non radioactive emissions are the following (see PCER Chapter 4):

- EPR gaseous chemical non radioactive discharges;
- dust emissions; and
- exhaust emissions from vehicles movements.

The impact on climate linked to these emissions is also presented below.

1.3.1. Impact of gaseous chemical non radioactive discharges

During the testing phase, the first time the temperature of equipments rises, formaldehyde and carbon monoxide may be produced and discharged via the stack by operating the Reactor Building ventilation system (Containment Sweep Ventilation System (EBA [CSVS])). The assessment of the impact of gaseous non radioactive species on air quality is undertaken in accordance with the procedures described in the H1 guidance [Ref-1] and summarised below.

a) Methodology

First of all, the inventory of gaseous non radioactive emissions is presented. It is used as the basis for the subsequent evaluation of the effects of gaseous emissions to air. A two staged approach is then adopted to determine the potential significance of processes related to emissions in the UK:

- The initial screening to identify the emissions which require further more detailed assessment and to allow screening out of insignificant emissions; and
- For emissions identified as being potentially significant, further more detailed dispersion modelling is required.

For the initial screening using the H1 model, the maximum ground level concentrations of emitted substances as dispersed into air are estimated. These concentrations are called Process Contributions (PC). Both short-term and long-term Process Contributions of all substances released to air are estimated using a simplified calculation method which assumes worst case dispersion with no allowance for thermal or momentum plume rise. These short-term and long-term process contributions are compared against the relevant short-term and long-term environmental benchmarks for emissions to air. These relevant environmental benchmarks are selected from a list provided within the EA IPPC H1 Guidance Note. The following criteria are applied to determine whether the emissions of a substance are considered significant:

- The long-term process contribution is greater than 1% of the long-term environmental benchmark; and
- The short-term process contribution is greater than 10% of the short-term environmental benchmark.

If the emissions are considered insignificant, the emissions are unlikely to cause a significant impact on the air quality and a more detailed assessment need not be undertaken. However, if the emissions are considered significant, a second step should be carried out to determine whether detailed modelling is required for any of the emissions not screened. This includes the addition of background concentrations to the calculated process contributions to obtain a Predicted Environmental Concentration (PEC). The PEC is then compared with the environmental benchmark. The EA IPPC H1 Guidance Note suggests that further modelling may be required in the following circumstances:

- The long-term PEC is above 70% of the relevant benchmark; and
- The short-term PC is more than 20% of the difference between the long-term background concentration and the relevant short-term environmental benchmark.

If a more detailed modelling is undertaken, it enables to determine new values for long-term PEC and short-term PEC. Then, these values must be respectively compared to long-term and short-term environmental benchmarks.

The environmental benchmarks which are used to compare Process Contributions (and PEC in the second step) are based on UK National Air Quality Objectives, WHO Guidelines and Occupational Exposure Limits. Environmental Quality Standards (EQS) are prescribed for certain substances and are used to define the upper bound of a concentration of substance in the air that is considered tolerable. At present, statutory EQS exist only for a limited number of substances. However, the EA has derived provisional benchmarks for substances released to air from a variety of published UK and international sources. These are known as 'Environmental Assessment Levels' (EAL). Generally, the long-term EAL is converted from an 8 hour reference period to annual mean and the short-term EAL from a 15 minute reference period to hourly mean.

During construction phase, potential sources of odorous emissions come from exhaust gases from vehicles and site machinery and from formaldehyde during the testing phase. Water spraying of roads and conveyors of crusher units will be used to minimise impacts. Moreover, formaldehyde emissions are periodic emissions that occur over short time periods. Consequently, this is unlikely that these odorous emissions will lead to significant impact. If a situation where odour is a problem arises, an appropriate assessment shall be carried out.

b) Inventory of gaseous non radioactive emissions

Using a worst case scenario, the maximum quantities produced in the containment in the Reactor Building are approximately 1230 g of formaldehyde and 1152 g of carbon monoxide. The operating time required to evacuate these quantities is estimated at 10 hours at normal flow and 52 hours at low flow. Considering the normal flow rate, the release rates are the following (Sub-chapter 12.1 - Table 1):

Sub-chapter 12.1 - Table 1: Formaldehyde and carbon monoxide release rates during construction phase

	Formaldehyde	**Carbon monoxide**
Release rate (g s^{-1})	3.42 x 10^{-2}	3.20 x 10^{-2}

The EPR Reactor Building is of the order of 60 m high, and the stack protrudes a few metres above the building.

c) Process contributions of emitted substances

Both long-term and short-term process contributions are estimated using the following simplified calculation method:

$$PC_{air} = DF \times RR$$

Where: PC_{air} is the process contribution (µg m^{-3});

RR is the release rate of substance in g s^{-1}; and

DF is the dispersion factor, expressed as the maximum average ground level concentration per unit mass release rate (µg m^{-3} per g s^{-1}). It is based on annual average for long-term releases and hourly average for short-term releases. These dispersion factors depend on the effective height of release. A table of dispersion factors is provided by the H1 guidance [Ref-1].

As this calculation method significantly overestimates ground level concentrations, it can be assumed that the effective release height is equal to the physical release height. Consequently, the effective height of release is considered to be equal to 60 m for formaldehyde and carbon monoxide emissions. As dispersion factors for this height are not presented in the EA IPPC H1, linear interpolation has been applied. The results are the following (Sub-chapter 12.1 - Table 2):

Sub-chapter 12.1 - Table 2: Dispersion factors used during construction phase

Effective height of release (m)	Long-term dispersion factor ($\mu g\ m^{-3}$ per $g\ s^{-1}$)	Short-term dispersion factor ($\mu g\ m^{-3}$ per $g\ s^{-1}$)
60	0.38	23.5

Afterwards, two conversion factors are applied:

- For long-term process contributions, as the release is only for few hours per year, annual average concentrations will only be a very small fraction of the concentrations from a full year (8766 hours) running of the equipment. The considered emissions are evacuated during 52 hours at low flow, the first time the temperature of equipments rises. The long-term factor used is then equal to 0.0059.

- For short-term process contribution, for carbon monoxide emissions, the short-term EAL is an 8 hour average. In order to be comparable with this EAL, the short-term PC are multiplied by 0.7. This conversion factor is published in H1 [Ref-1]. For formaldehyde emissions, as the short-term EAL is an hourly average, no conversion factor has to be applied.

d) Significance test

Assessments of the significance of formaldehyde and carbon monoxide emissions are summarised below. According to the H1 methodology, for long-term impacts (respectively short-term), the threshold for significance is equal to 1% (resp. 10%) of the relevant EAL.

Long-term Impacts (see Sub-chapter 12.1 - Table 3 below):

Sub-chapter 12.1 - Table 3: Long-term impacts during construction phase

	PC ($\mu g\ m^{-3}$)	EAL ($\mu g\ m^{-3}$)	Threshold for significance ($\mu g\ m^{-3}$)	Significant?
Formaldehyde	0.0001	5	0.05	No
Carbon monoxide	0.0001	350	3.5	No

Short-term Impacts (see Sub-chapter 12.1 - Table 4 below):

Sub-chapter 12.1 - Table 4: Short-term impacts during construction phase

	PC ($\mu g\ m^{-3}$)	EAL ($\mu g\ m^{-3}$)	Threshold for significance ($\mu g\ m^{-3}$)	Significant?
Formaldehyde	0.80	100	10	No
Carbon monoxide	0.53	10,000	1000	No

Consequently, according to the H1 methodology, during construction phase, formaldehyde and carbon monoxide emissions are unlikely to cause a significant impact on air. No further modelling is required.

1.3.2. Impact of dust emissions

Construction activities such as earthworks, concrete batching and the stockpiling of loose materials have the potential to generate dust. Dust suppression techniques are available to prevent this, including water spraying of roads and conveyors of crusher units. A dust management plan will be implemented in order to minimise the impacts of dust, as part of the Construction Environmental Management Plan.

The impact of dust will be assessed once the specific site will be selected. The impact assessment will determine and appraise existing air quality with respect to particulate concentrations in the locality of the site and establish qualitatively the probable additional contribution that could be made from site construction activities. If existing air quality is already impacted by particulate emissions from other sources or if there is a realistic probability that sensitive receptors in the vicinity of the construction site could be affected by dust generated from the site, then a detailed modelling of dust dispersion from the site will be undertaken.

1.3.3. Impact of exhaust emissions from vehicles movements

During construction phase, vehicle movements to and from the site will occur. These shall comprise vehicles delivering equipment and materials and those associated with the transportation of the workforce. The main emissions associated with vehicles and diesel run facilities are carbon monoxide, particulates, hydrocarbons and oxides of nitrogen (PCER Chapter 4). In order to take into account local factors, the impact of exhaust emissions will be assessed once the specific site will be selected. In a first step, the potential significance of impact upon air quality will be assessed through a desk based assessment of existing air quality to determine whether pollutant concentrations exceed, or are close to, Air Quality Objective (AQO) concentrations. If this is the case, then a screening assessment will be undertaken in a second step, using appropriate methodologies (the Design Manual for Roads and Bridges (DMRB 11)) to determine the additive contribution to pollutant concentrations that may result from construction phase traffic.

1.3.4. Impact on climate

Potential effects on climate relate to the generation of greenhouse gas emissions, principally carbon dioxide. Nuclear Power Plants (NPPs) do not produce carbon dioxide directly from electricity generation. These emissions are produced as a result of the construction, operation and decommissioning of the plant. Nuclear has emissions associated with energy use during mining, and also with fuel extraction, enrichment, and the manufacture of its fuel. Energy is also used in management of waste products from generation.
As a consequence, nuclear power generation has a relatively small carbon footprint at about 5 g CO_2-equiv. per kWh(e). Operational emissions from nuclear generation account for less than 1% of the total with most emissions occurring during mining, enrichment and fuel fabrication. Decommissioning accounts for 35% of lifetime CO_2 emissions.

1.4. NOISE AND VIBRATION IMPACTS

1.4.1. Construction works

The primary noise sources during construction of an EPR are those typical of an industrial construction site. The main site activities that cause noise and vibration are described in PCER Chapter 4.

Certain construction methods and/or processes are likely to cause a greater impact over a wider area, including blasting and piling. Noise impacts associated with the construction of the EPR will be assessed using indicative noise levels for representative mobile plant presented in the “Updated noise database for prediction of noise on construction and open sites” released by DEFRA in July 2005 [Ref-1]. Noise predictions for the construction phase will be undertaken with reference to BS5228 Part 1:1997 [Ref-2]. Limits on construction noise may be set by the local authority and on-site monitoring during the construction phase, if required, should accord with Annex E of BS5228: Part 1 [Ref-2]. A formal Noise Management Plan will be implemented through the Construction Environmental Management Plan if there are particularly sensitive receptors requiring a high level of active management.

1.4.2. Traffic changes

Noise and vibration associated with construction traffic will also be assessed. The potential volume of construction related traffic will be compared to the current background traffic flows. Depending on the volumes of traffic associated with the construction phase, a qualitative assessment may be sufficient. If a substantial increase in traffic volumes is likely, traffic noise for each impacted route will be predicted in accordance with the Calculation of Road Traffic Noise (CRTN) and with appropriate significance criteria.

Depending on the access arrangements for the site, it may be necessary to implement a formal Traffic Management Plan during construction, to ensure that site traffic is routed away from local roads that are not suitable for heavy goods traffic. If required, this would be implemented through the Construction Environmental Management Plan.

1.5. IMPACT ON FAUNA AND FLORA

During the construction phase, terrestrial flora and fauna around the site could be temporarily disturbed by pollutions such as noise, vibration, traffic and emissions of dust.

The level of potential impact will depend on the site location as a consequence, it is not possible to accurately predict the impact of construction works on terrestrial fauna and flora. A detailed assessment will be undertaken during the site specific phase. The necessary mitigation measures will be specified and implemented through the Construction Environmental Management Plan.

1.6. LANDSCAPE AND VISUAL IMPACTS

1.6.1. Concept

This section assesses the impacts of the EPR upon the coastal landscape and analyses the extent of its visibility and the direct impacts upon key views and visual amenity.

Visual effects result from changes in the landscape or seascape. They are defined as changes in the appearance of the landscape or seascape, and the effects of these changes on people. Hence, visual impact assessment is concerned with the impacts of the development on views of the landscape through intrusion, obstruction or changing the content or focus of views, the reactions of viewers who may be affected and the overall change in visual amenity.

1.6.2. Potential effects

The landscape impact will take the following potential effects into account.

The construction phase of the UK EPR is expected to take approximately six to seven years and will involve the creation of a construction platform that will form the base for the reactor and associated buildings. In addition, there will be infrastructure requirements to service the operation, including access roads, overhead electricity cables and pipework associated with discharges, cooling, etc. All these building operations may have effects on landscape. Potential effects are listed below:

- Site clearance

  For the UK EPR, the clearance of the site will inevitably have an impact on existing landscape features and habitat. This will range from impacts on geological features associated with coastal cliffs and beaches to removal of grassland habitat, trees and natural shrub vegetation. Impacts may also apply to agricultural land and hedgerows.

- Construction works

  The construction works themselves may well be more visible from the surrounding area in the short-term than the finished development will be. Tower cranes will have to be used to lift and position elements of the buildings into place and this has implications for views from the surrounding area.

- Traffic movements

  During construction, vehicle movements to and from the site will occur. These shall comprise vehicles delivering equipment and materials and those associated with the transportation of the workforce. It is considered probable that a Traffic Impact Assessment (TIA) will be required to determine the volume of construction phase traffic and to evaluate what effect, if any, the additional traffic during this project phase will have on overall traffic flows and capacity on the road network serving the site.

1.6.3. Potential mitigation measures

Construction traffic and haulage movements will inevitably increase the level of local road traffic and its consequent impact on visual amenity. For the UK EPR, a temporary jetty for materials and equipment delivery could minimise the impacts linked with transportation.

A detailed construction management plan would need to be established for the construction works of any development in the UK. This could define strict working hours that are reasonably consistent with the local working population and could limit traffic and construction disturbance to the less sensitive times of the day.

The alignment of haulage roads should make use of local topography to reduce visual prominence from key viewpoints. Ground modelling and landscaping also has the potential to screen access routes and integrate them into the landscape. Local public footpaths may need to be similarly screened or potentially re-aligned in agreement with interested parties.

2. DURING OPERATIONAL PHASE

During the operational phase, the following potential impacts on terrestrial ecosystems have been identified.

2.1. IMPACT ON AIR QUALITY AND CLIMATE

This section deals with the requirement 3.3 of the EA P&I Document [Ref-1].

Potential sources of gaseous non radioactive emissions are the following (see PCER Chapter 3):

- Gaseous chemical non radioactive discharges; and
- Exhaust emissions from vehicles movements.

The impact on climate linked to these emissions is also presented below.

2.1.1. Impact of gaseous chemical non radioactive discharges

The assessment of the impact of gaseous non radioactive species on air quality is undertaken in accordance with the procedures described in the H1 guidance [Ref-1] and summarised above, in section 1.3.

2.1.1.1. Inventory of gaseous non radioactive emissions

The potential sources of non radioactive air emissions during operational phase include (see PCER Chapter 3):

- Sulphur and nitrogen dioxides in the exhaust gases from engines of the back-up electricity generators;
- Formaldehyde and carbon monoxide emitted by the insulation when installations go back into operation after maintenance; and

- Ammonia discharged as the temperature rises in the steam generators during start-up.

For these releases to air, it is necessary to present the effective height of release and the release rate. As it is said above, it can be assumed that the effective release height is equal to the physical release height.

a) Sulphur and nitrogen dioxides

Using Flamanville 3 data, each main back-up electricity generator set is operational for 20 hours per year and each emergency back-up set for 4 hours per year only. Sulphur and nitrogen dioxides are then released during 88 hours per year.

The maximum quantities produced are approximately 827 kg of sulphur dioxide and 8680 kg of nitrogen dioxide. The estimated release rates are the following (Sub-chapter 12.1 - Table 5)[1]:

Sub-chapter 12.1 - Table 5[1]: Sulphur and nitrogen dioxides release rates during operational phase

	Sulphur dioxide	Nitrogen dioxide
Release rate (g s^{-1})	2.61	27.40

The physical height of release is approximately equal to 30 m.

b) Formaldehyde and carbon monoxide

Restarting the installation produces approximately 700 g of formaldehyde and 660 g of carbon monoxide in the containment in the Reactor Building. The operating time required to evacuate these quantities is estimated at 8 hours at normal flow and 42 hours at low flow. Considering the normal flow rate, the release rates are the following (Sub-chapter 12.1 – Table 6):

Sub-chapter 12.1 - Table 6: Formaldehyde and carbon monoxide release rates during operational phase

	Formaldehyde	Carbon monoxide
Release rate (g s^{-1})	2.43×10^{-2}	2.29×10^{-2}

The physical release height is approximately equal to 60 m (EPR Reactor Building height).

[1] These values do not include any potential additional diesel as a result of the design changes considered for implementation in the light of lessons learnt from the Fukushima event.

c) Ammonia

Ammonia will be produced during the restarting process. For an EPR unit, the maximum release rate for ammonia is estimated to be 0.78 g s^{-1} per steam generator. The ammonia emissions from the entire steam generator are released during 83 hours. As there are four steam generators, the release rate which is considered is equal to 3.12 g s^{-1}.

The physical height of release is approximately equal to 30 m.

2.1.1.2. Process contributions of emitted substances

Both long-term and short-term process contributions are estimated using the following simplified calculation method:

$$PC_{air} = DF \times RR$$

Where: PC_{air} is the process contribution (µg m^{-3});

RR is the release rate of substance in g s^{-1}; and

DF is the dispersion factor, expressed as the maximum average ground level concentration per unit mass release rate (µg m^{-3} per g s^{-1}). It is based on annual average for long-term releases and hourly average for short-term releases. These dispersion factors depend on the effective height of release which is considered to be equal to the physical height of release (explanation above). A table of dispersion factors is provided by the H1 guidance [Ref-1].

The effective heights of release are considered to be equal to 30 m for sulphur and nitrogen dioxides and ammonia, and to 60 m for formaldehyde and carbon monoxide. The dispersion factors are the following (Sub-chapter 12.1 - Table 7):

Sub-chapter 12.1 - Table 7: Dispersion factors used during operational phase

Effective height of release (m)	Long-term dispersion factor (µg m^{-3} per g s^{-1})	Short-term dispersion factor (µg m^{-3} per g s^{-1})
30	1.7	77
60	0.38	23.5

Afterwards, two conversion factors are applied:

- For long-term process contributions, as the release is only for few hours per year, annual average concentrations will only be a very small fraction of the concentrations from a full year (8766 hours) running of the equipment.
  - For sulphur and nitrogen dioxides, the emissions are evacuated during 88 hours per year. The long-term factor used is then equal to 0.0100;
  - For formaldehyde and carbon monoxide, it is assumed that the installation is restarted two times per year. The emissions are then evacuated during 84 hours per year. The long-term factor used is then equal to 0.0096; and

- For ammonia, as it is assumed that the installation is restarted two times per year, the emissions are then evacuated during 664 hours (there are four steam generators). The long-term factor used is then equal to 0.0757.

➢ For short-term process contributions, according to the H1 guidance [Ref-1], the following conversion factors are used:

- For sulphur dioxide emissions, the short-term EAL is for a 15 minute averaging period. In order to be comparable with this EAL, the short-term PC are multiplied by 1.34 [Ref-1];
- For carbon monoxide emissions, the short-term EAL is an 8 hour average. In order to be comparable with this EAL, the short-term PC are multiplied by 0.7 [Ref-1]; and
- For nitrogen dioxide, formaldehyde and ammonia emissions, as the short-term EAL are hourly averages, no conversion factor has to be applied.

2.1.1.3. Significance test

Assessments of the significance of gaseous non radioactive emissions are summarised below. According to the H1 methodology, for long-term impacts (respectively short-term), the threshold for significance is equal to 1% (resp. 10%) of the relevant EAL.

a) For sulphur and nitrogen dioxides

Long-Term Impacts (see Sub-chapter 12.1 - Table 8 below):

Sub-chapter 12.1 - Table 8[2]: Long-term impacts for sulphur and nitrogen dioxides emissions during operational phase

	PC ($\mu g\ m^{-3}$)	EAL ($\mu g\ m^{-3}$)	Threshold for significance ($\mu g\ m^{-3}$)	Significant?
Sulphur dioxide	0.0444	50	0.5	No
Nitrogen dioxide	0.4658	40	0.4	Yes

Short-Term Impacts (see Sub-chapter 12.1 - Table 9 below):

Sub-chapter 12.1 - Table 9[2]: Short-term impacts for sulphur and nitrogen dioxides emissions during operational phase

	PC ($\mu g\ m^{-3}$)	EAL ($\mu g\ m^{-3}$)	Threshold for significance ($\mu g\ m^{-3}$)	Significant?
Sulphur dioxide	269	267	26.7	Yes
Nitrogen dioxide	2110	200	20	Yes

[2] These values do not include any potential additional diesel as a result of the design changes considered for implementation in the light of lessons learnt from the Fukushima event.

b) For formaldehyde and carbon monoxide

Long-term Impacts (see Sub-chapter 12.1 - Table 10 below):

Sub-chapter 12.1 - Table 10: Long-term impacts for formaldehyde and carbon monoxide emissions during operational phase

	PC ($\mu g\ m^{-3}$)	EAL ($\mu g\ m^{-3}$)	Threshold for significance ($\mu g\ m^{-3}$)	Significant?
Formaldehyde	0.0001	5	0.05	No
Carbon monoxide	0.0001	350	3.5	No

Short-term Impacts (see Sub-chapter 12.1 - Table 11 below):

Sub-chapter 12.1 - Table 11: Short-term impacts for formaldehyde and carbon monoxide emissions during operational phase

	PC ($\mu g\ m^{-3}$)	EAL ($\mu g\ m^{-3}$)	Threshold for significance ($\mu g\ m^{-3}$)	Significant?
Formaldehyde	0.57	100	10	No
Carbon monoxide	0.38	10,000	1000	No

c) For ammonia

Long-term Impacts (see Sub-chapter 12.1 - Table 12 below):

Sub-chapter 12.1 - Table 12: Long-term impacts for ammonia emissions during operational phase

	PC ($\mu g\ m^{-3}$)	EAL ($\mu g\ m^{-3}$)	Threshold for significance ($\mu g\ m^{-3}$)	Significant?
Ammonia	0.4	180	1.8	No

Short-term Impacts (see Sub-chapter 12.1 - Table 12 below):

Sub-chapter 12.1 - Table 13: Short-term impacts for ammonia emissions during operational phase

	PC ($\mu g\ m^{-3}$)	EAL ($\mu g\ m^{-3}$)	Threshold for significance ($\mu g\ m^{-3}$)	Significant?
Ammonia	240	2500	250	No

2.1.1.4. Impacts of emissions to air

According to the H1 methodology, the formaldehyde, carbon monoxide and ammonia emissions are unlikely to cause a significant impact on air. No further modelling is required.

Using the conservative assumptions of the H1 guidance, the emissions of sulphur and nitrogen dioxides are above the thresholds of significance and require consequently a further assessment. The detailed assessment will be provided at the site specific stage. In order to give confidence that a PPC application will be successful at the site specific phase, information has been provided in PCER Chapter 3.

During operational phase, the only chemical substances discharged from the EPR unit that may produce an odour are formaldehyde, ammonia and diesel exhaust gases during periodic tests. These emissions are periodic emissions that occur over short time periods. Consequently, this is unlikely that these odorous emissions will lead to significant impact. If a situation where odour is a problem arises, an appropriate assessment shall be carried out.

2.1.2. Impact of exhaust emissions from vehicles movements

During operational phase, additional road traffic will be generated. This traffic will be associated with the transportation of the site workforce and with the delivery of materials. The impact of the exhaust emissions associated with additional vehicle movements on the local road network will be assessed once the specific site will be selected. If the proportion of development related traffic is small in comparison to existing traffic flows and if existing air quality is of a high standard, then a qualitative assessment only will be undertaken to demonstrate that operational phase traffic will have no significant effect upon air quality. If these conditions are not met, then the methodology defined in DMRB 11 will be utilised to determine the additional contribution to existing baseline pollutant concentrations made by development related traffic.

2.1.3. Impact on climate

Potential effects on climate relate to the generation of greenhouse gas emissions, principally carbon dioxide. NPPs do not produce carbon dioxide directly from electricity generation. These emissions are produced as a result of the construction, operation and decommissioning of the plant. Nuclear has emissions associated with energy use during mining; and also with fuel extraction, enrichment, and the manufacture of its fuel. Energy is also used in management of waste products from generation.
As a consequence, nuclear power generation has a relatively small carbon footprint at about 5 g CO_2-equiv. per kWh(e). Operational emissions from nuclear generation account for less than 1% of the total with most emissions occurring during mining, enrichment and fuel fabrication. Decommissioning accounts for 35% of lifetime CO_2 emissions.

2.2. NOISE AND VIBRATION IMPACT

2.2.1. UK EPR operation

While operating, primary sources of noise are stacks discharge, air inlet and outlet, turbo generator set, cooling water systems, steam pipes, Pumping Station and transformers units.

Soundproofing will be implemented at primary noise sources to reduce or eliminate the sound effects of the EPR. Soundproofing of equipment includes covers, insulating walls, silencers, etc. Site specific factors such as building design and layout will be controlling factors in noise levels created by the development as much of the (noise producing) machinery will be contained within the building structures. Given the nature of the development, it is likely that the buildings themselves will offer significant noise attenuation.

Detailed computer modelling will be required to predict operational noise levels emitted by the site as a whole. This modelling should take into account the layout of the buildings, structural details of the buildings including inherent sound insulation properties of the materials utilised in the construction, sound power levels of the sound sources contained within the building, dominant frequencies of sound sources, ground effects and topographic features.

The predicted noise levels at the nearby noise-sensitive receptors due to the operation of the EPR is compared to the current background levels in order to determine the potential audibility and disturbance caused by the new noise sources.

As the data required to assess the impact of noise is site specific, the detailed assessment is postponed to the site specific phase.

For information, modelling of the EPR unit such as Flamanville 3 with an acoustic modelling code (EDF code TYMPAN 3) and taking into account the sound sources referenced in PCER Chapter 3, has indicated that the noise due to the operation, without including the background sound level and specific topography, will not exceed 45 dB(A) at a distance of 350 metres from the primary sources of noise.

According to the noise assessment from the computer model, the operation of the EPR unit such as Flamanville 3 will not significantly increase the environmental noise level.

The use of the above methodologies will enable noise contours to be created which will allow noise impact zones to be defined.

Limits on operational noise may be set by the local authority as a planning condition.

2.2.2. Traffic changes

The potential impact on local residents due to changes in the traffic flow and composition will be predicted. It is recognised that the proposed EPR is likely to be located away from major towns and settlements and hence is likely to be accessed from minor roads, which have a low background traffic flow associated with them. Depending on the volumes of traffic associated with the operational phase, a qualitative assessment may be sufficient. If a substantial increase in traffic volumes is likely, traffic noise for each impacted route will be predicted in accordance with the Calculation of Road Traffic Noise (CRTN).

If necessary, mandatory access routes to the site will be specified to operational staff, contractors and suppliers, to ensure that site traffic is routed away from any local roads that are not suitable for the mix and level of operational traffic.

2.3. LANDSCAPE AND VISUAL IMPACTS

2.3.1. Concept

This section assesses the impact of the EPR upon the coastal landscape and analyses the extents of its visibility and the direct impacts on key views and visual amenity.

Visual effects result from the changes in the landscape or seascape. They are defined as changes in the appearance of the landscape or seascape, and the effects of those changes on people. Hence, visual impact assessment is associated with the impacts of the development on views of the landscape through intrusion, obstruction or changing the content or focus of views, the reactions of viewers who may be affected and the overall change in visual amenity.

The introduction of a major industrial development into the landscape inevitably has potential for impacts on the existing landscape or seascape character.

2.3.2. Potential effects

The landscape impact will take the following potential effects into account.

- Landscape and/or Seascape character

  The potential for impact on landscape character will depend to a large degree on the landscape's capacity to accommodate change. A coastal landscape with uniform character and lacking complexity is often less able to accommodate development than one that exhibits irregular topography and landform that can potentially screen views and provide a natural setting for the built form.

  The development will have the potential to impact on the seascape character by interrupting views out to sea from the land and also views of the coastal landscape from the sea. The UK EPR development may have the potential to impact on the pattern of the coastal landscape, particularly when viewed from the sea and the materials and colours adopted will be important in terms of harmonising with the wider setting.

- Landscape and/or Heritage designations

  Significant areas of the UK coastline are designated as heritage coastline, particularly within the south east of England and along the north east coast. Historic buildings and fortifications are an important cultural asset and are often associated with tourism. The setting of these coastlines and the cultural heritage that is associated with them should be considered once a specific UK site is selected.

  Other areas of the coastline are designated for their landscape or scenic value, including National Parks and Areas of Outstanding Natural Beauty. The particular character and value of these landscapes can potentially be impacted upon by any development and this would be a highly important issue in the siting of the EPR within the UK.

- Visual receptors

  There are a range of potential visual receptors that could be impacted by the development.

  - Occupiers of residential properties - Local residents would be sensitive to visual impacts which could potentially impact on views and visual amenity.

- Road users - Local traffic may potentially have views of the main development. Wider infrastructure development, particularly electricity pylons are likely to be clearly visible.

- Footpath users – Large parts of the UK's coastline have footpath access, including significant long-distance coastal walks. There is potential for intrusive views of the development from the public footpath network.

- Users of local beaches - Areas of the coastline provide a recreational resource for visitors and locals.

- Boat Users - Most of the clearest views may well be from the sea and can potentially be perceived by boat users. This may include ferry travellers, cruise ship users and people in sailing yachts or other pleasure craft. The development could potentially impact on commercial craft and have implications for navigation and landmarks.

- Lighting impacts

  There is a potential for night time visual impacts from the lighting associated with the development. There may be issues relating to sky glow that could be perceived from inland and there may be more direct visual impact of lighting on shipping at night. In relation to shipping, this may have implications for navigation and has the potential to either interfere with, or possibly assist, coastal navigation.

- Traffic movements

  During operational phase, vehicle movements to and from the site will occur. These shall comprise vehicles delivering equipment and materials and those associated with the transportation of the workforce. It is considered probable that a Traffic Impact Assessment (TIA) will be required to determine the volume of operational phase traffic and to evaluate what effect, if any, the additional traffic during this project phase will have on overall traffic flows and capacity on the road network serving the site.

2.3.3. Potential mitigation measures

The development of UK EPR will employ the services of an experienced architectural group to guide the architectural design and input into the siting of the installation and infrastructure. A thorough process of analysis and assessment will be used to inform the design, including input from urban planners and landscape professionals. This will cover:

- Site Location - The siting of the development and arrangement in relation to the wider coastal landscape will be considered as far as practicable in order to reduce visual intrusion of the proposals and to provide a natural setting that is able to accommodate the built form with an acceptable impact on landscape / seascape character.

- Architectural Form and Relationship - A contemporary architectural design will be established for the built form that ensures a visual homogeneity of the buildings and integrates the development with existing buildings on the site.

- Choice of Materials and Colours - Materials and colours for the built form will be selected when possible to integrate the new development into the wider landscape setting and the family of buildings in the vicinity.

- Landscaping - Landscape works have the potential to screen or integrate elements of the development, in particular roads and other infrastructure. Site clearance works will inevitably remove existing landscape features and habitat and a considered approach to landscape design will be able to mitigate for this.

Conditions covering the operation of lighting associated with the development could be introduced to ensure that their design minimises light spillage. Lighting levels would need to be agreed that satisfy the operational requirements but use levels that minimise external impact.

SUB-CHAPTER 12.1 – REFERENCES

External references are identified within this sub-chapter by the text [Ref-1], [Ref-2], etc at the appropriate point within the sub-chapter. These references are listed here under the heading of the section or sub-section in which they are quoted.

1. DURING CONSTRUCTION PHASE

1.3. IMPACT ON AIR QUALITY AND CLIMATE

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

1.3.1 Impact of gaseous chemical non radioactive discharges

[Ref-1] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. July 2003. (E)

1.4. NOISE AND VIBRATION IMPACTS

1.4.1. Construction works

[Ref-1] Updated noise database for prediction of noise on construction and open sites. DEFRA. July 2005. (E)

[Ref-2] British Standard (BS) 5228: Noise and vibration control on construction and open sites. (E)

2. DURING OPERATIONAL PHASE

2.1. IMPACT ON AIR QUALITY AND CLIMATE

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

2.1.1. Impact of gaseous chemical non radioactive discharges

[Ref-1] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT, Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. July 2003. (E)

2.1.1.2. Process contributions of emitted substances

[Ref-1] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. July 2003. (E)

SUB-CHAPTER 12.2 – IMPACTS ON AQUATIC ECOSYSTEM

LIST OF TABLES

1. DURING CONSTRUCTION PHASE

This section deals with the requirement 3.1 and 3.2 of the Environment Agency (EA) Process and Information (P&I) Document [Ref-1].

During the construction phase, the following potential impacts upon the aquatic ecosystem have been identified.

The data required to assess these impacts are site specific. As a consequence, the detailed assessment will be provided during site specific investigations.

1.1. IMPACT ON MARINE HYDROLOGY

This section deals with the requirement 3.2 of the EA P&I Document [Ref-1].

Hydraulic changes due to the construction of the nuclear unit are principally caused by the large earth-moving works needed to build the various elements such as: the general platform levelling, the buildings excavation, the seawalls, the intake and discharge structures.

This section will address:

- The impact of the off-shore works. For example, the potential impact on overall regime of sea currents will be analysed; and
- The impact of materials produced as a result of excavations.

Note: with regards to marine navigation, it should be considered to install appropriate beaconing to new underwater structures. Any artificial reef created with materials produced by the excavations for example, may eventually feature on marine maps.

1.2. IMPACT ON SEDIMENTOLOGY

This section deals with the requirement 3.2 of the EA P&I Document [Ref-1].

This section would address the short-term and long-term effects of the discharge of suspended matter into the sea. Investigations of local seabed sediment type and volume will take place and appropriate consideration given to the volume and proposed discharge location of the suspended matter.

As these effects depend on site specific environmental conditions, the impact assessment will be undertaken at the site specific stage.

The effect of suspended solids on water quality is analysed in section 1.6.

1.3. IMPACT ON HYDROGEOLOGY

This section deals with the requirement 3.2 of the EA P&I Document [Ref-1].

A temporary dewatering system will be installed in order to drain the surface water and collect the groundwater entering excavations and other ground works. The water will be pumped out and filtered. Discussions will take place with the relevant Local Water Authorities in order to limit the impact.

During the preliminary works, groundwater samples will be collected from available piezometers in order to monitor the groundwater quality and to detect any contaminants that inadvertently may reach the water table.

In case of lack of adapted piezometer, a network of piezometers will be placed around and on the site.

If accidental releases occur, this monitoring system could allow the detection of the contaminants in the groundwater. It is anticipated that some of the piezometers will remain in place when the plant is in operation.

Moreover the network of piezometers could be used to determine the impact of buildings on hydrogeology at local scale (modifications of groundwater flows around the buildings).

During the construction phase, temporary chemical storages will be placed on hard surfaces and the activities with potential impact on the environment will be undertaken with all the necessary measures to prevent soil and groundwater pollution. Therefore, unless unexpected accident occurs, the construction phase will have no impact on the soil and groundwater quality.

In case of any accidental contaminant release, an emergency procedure could be implemented to find and treat the sources and the contaminated soil and to protect groundwater from pollution.

1.4. WATER ABSTRACTION IMPACT

This section deals with the requirement 3.1 of the EA P&I Document [Ref-1].

Freshwater may be provided during construction phase by surface water sources such as rivers or groundwaters, or from a desalination unit depending on the site characteristics. When a possible site location is confirmed an assessment of the water resource availability will be made by the Water Authorities and the EA using the EPR needs analysis results, in order to define the most sustainable means of sourcing the water both for raw water and for drinking quality water. The applicable Catchment Abstraction Management Strategy (CAMS) and River Basin Management Plan that apply to the candidate water courses and groundwater will form the starting point for this assessment. An abstraction license will be obtained if a viable water source is identified. The alternative will be a mains water supply.

As a consequence, the potential impact of water abstraction will be studied at the site specific phase once the Local Water Authorities consulted and the process related with water supply defined.

1.5. THERMAL DISCHARGES IMPACT

This section deals with the requirement 3.1 of the EA P&I Document [Ref-1].

No thermal discharges will be released during construction phase.

1.6. LIQUID NON RADIOACTIVE SPECIES IMPACT

This section deals with the requirement 3.2 of the EA P&I Document [Ref-1].

Chemicals discharged into the sea corresponding to the various activities on the construction site fall into two categories:

- Discharge associated with the preparatory work and the main building erection and the presence of staff on site. It contains suspended solids, hydrocarbons and marine substances; and has a five day biochemical oxygen demand; and
- Discharge associated with the start-up testing, which involves other chemicals required for the operating of the EPR.

The impact of the first category of discharge depending upon the type of operation performed will be studied at the site specific phase.

For the second one, the following sections describe the methodology used for the impact assessment. The methodology is based on EA Technical Guidance note IPPC H1 [Ref-2] [Ref-3].

A discharge consent will be obtained for any discharges to controlled waters during the construction phase.

1.6.1. Emissions inventory and discharge concentrations

The chemicals discharged into the sea during the construction are described in PCER Sub-chapter 4.3 with respect to the following:

- chemical substances such as: iron, phosphates, lithium hydroxide, hydrazine, boric acid, morpholine or ethanolamine, sodium, sulphates, bromoform and ammonia;
- mixtures of chemical substances: residual oxidants; and
- physical-chemical characteristics: suspended solids.

The only substances discharged during the EPR construction phase that have Environmental Quality Standards (EQS) are boron, iron and ammonia. These substances are discharged during the commissioning tests phase:

- Boron is a chemical required to condition the various circuits. Effluents containing boron result from the primary side hot test.
- Iron is a product resulting from the chemicals circuits conditioning and from the demineralised water production itself.
- Ammonia is a product resulting from the chemicals circuits conditioning. Unionised ammonia is considered as 3.2% of total ammonia (EIFAC 1986) [Ref-1]. This fraction is based on the following conditions: 23 to 27 ppt salinity, 20°C water temperature and pH 8. Actual unionised ammonia fraction will vary with local site conditions.

The quantity of effluents produces during the commissioning tests, including the demineralised water production, is presented in Sub-chapter 12.2 - Table 1 below (see also Table 5 in PCER Sub-chapter 4.3); the table presents early estimates of chemical effluents **before treatment** and disposal for annual flow and flow over 24 hours during the 2 years period of the commissioning tests for FA3.

Sub-chapter 12.2 - Table 1: Early estimates of chemical effluents before treatment and disposal during electromechanical erection and start-up testing for FA3

Substances	Conditioning the circuits (kg y^{-1})	Producing demineralised water (kg y^{-1})	Annual quantity (kg)	Daily quantity (kg)
Iron	777	314	1091	135
Boric acid/Boron	8050/1407	-	8050/1407*	4120/720
Ammonia (unionised) (as N)	8.2	-	8.2	- **

*: These are quantities produced before any potential treatment takes place

**: Unionised ammonia fraction highly depends on pH, temperature and salinity. Thus, it is not relevant to calculate the daily quantity of discharged unionised ammonia, especially during the construction phase. Indeed, unionised ammonia fraction will vary with local site conditions, and the daily discharges during the construction phase are too variable.

The discharge concentration will be calculated in consideration of chemical annual flow and a discharge flow **after treatment**. Due to a wide range of site specific factors, it is not possible to accurately predict liquid discharge flow. The discharge methodology is not chosen.

1.6.2. Assessment methodology

The methodology used to assess chemical liquid discharge impact is the following:

1. Discharges are quantified by taking into account the emissions inventory and dilution in the water flow

$$DC(Discharge\ Concentration) = \frac{\left(Annual\ \ flow \times 10^6 \times 10^3\right)}{\left(discharge\ \ flow \times 365 \times 24 \times 3600 \times 10^3\right)}$$

with DC in µg l^{-1};
Annual flow in kg; and
Discharge flow in m^3 s^{-1}.

2. Process contribution is calculated by taking into account a near field dilution factor of 0.2. This factor has been determined in accordance with EA.

$$PC(Process\ Contribution) = \frac{\left(Annual\ \ flow \times 10^6 \times 10^3\right)}{\left(discharge\ \ flow \times 365 \times 24 \times 3600 \times 10^3\right)} \times 0.2$$

with PC in µg l^{-1};

Annual flow in kg; and

Discharge flow in $m^3 s^{-1}$.

3. DC and PC of individual chemicals are compared against EQS. The EQS that are used are presented in the following table (Sub-chapter 12.2 - Table 2).

   The only substances discharged during the EPR construction phase that have EQS values are iron and boron.

Sub-chapter 12.2 - Table 2: Environmental Quality Standards (EQS)

Chemicals	EQS type	EQS ($\mu g\ l^{-1}$)
Iron	Dissolved Annual Average	1000
Boron	Total Annual Average	7000
Ammonia (unionised) (as N)	/	21*

* Value proposed in IPPC H1 guidance July 2003 [Ref-1]

   If emissions are less than 1% of the environmental benchmark, then the substance is screened out.

4. More detailed assessment is carried out if the PC is more than 1% of the relevant environmental benchmark.

   Predicted Environmental Concentration (PEC) is calculated by summing the background concentration and the PC.

   Emissions will require detailed modelling if the PEC is above 70% of the relevant environmental benchmark.

1.6.3. Assessment of emissions to water

The Discharge Concentrations and the Process Contributions can't be calculated at this stage, given that the discharge flow is unknown.

The choice of discharge method will take into account the Environmental Impact Assessment (EIA). The concentration of the discharge should be lower than 1% of the EQS value.

Effluent could be collected first in a tank to dilute chemical species and then be stored temporarily before being discharged to minimise environmental impact.

1.7. IMPACT ON FAUNA AND FLORA

During the construction phase, impacts on marine flora and fauna may arise via chemical discharges in the test phase, materials discharge produced by construction of offshore pits, vibrational impacts, etc. If possible, the effect of suspended solids and anticipated sedimentation on benthic population will be analysed specifically.

Due to a wide range of site specific factors such as geological conditions, material selection and construction methodology, it is not possible to accurately predict the impact of discharges to the marine environment during the construction phase. Assessments will be carried out following selection of a specific site. Management and monitoring will be implemented through the Construction Environmental Management Plan.

2. DURING OPERATIONAL PHASE

2.1. HYDROLOGY AND SEDIMENTOLOGY IMPACTS

This section deals with the requirement 3.2 of the EA P&I Document [Ref-1].

The impact of water abstractions on hydrology and sedimentology is described in the section 2.3.

With regards to the discharge impact, the impact on hydrology will be assessed by comparing exit speeds and volumes with background current movements. The impact on sedimentology will be also studied based on local sedimentogy data.

The data required to assess these impacts are site specific. As a consequence, the detailed assessment will be undertaken during the site specific phase.

2.2. IMPACT ON HYDROGEOLOGY

This section deals with the requirement 3.2 of the EA P&I Document [Ref-1].

Structures, plant and machinery will be built to strict building control standards, Pollution Prevention and Control (PPC) Regulations regulatory specifications and Best Available Techniques (BAT) standards which will minimise the potential for unplanned discharges to ground.

The 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. Retention areas will be designed in order to prevent communication with the soil and then groundwater.

Therefore, unless unexpected accident occurs, the operational phase will have no impact on the soil and groundwater quality. During normal operation, there is no likelihood of direct or indirect discharge of a List I[1] or List II[2] substance (cf Groundwater Regulations 1998) to groundwater.

In case of any accidental contaminant discharge, an emergency procedure will be implemented to find and treat the sources and the contaminated soil and to protect groundwaters from pollution.

Depth of groundwater will be surveyed by a network of piezometers. Groundwater samples will be collected from the remaining piezometers (some of them will be no more available after construction) in order to monitor the groundwater quality and to detect any contaminants that inadvertently reach the water table.

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[1] Presence on site of List I substances: hydrazine hydrate, bromoform and hydrocarbons.
[2] Presence on site of List II substances: metals, phosphates, ammonia and nitrates.

Moreover the network of piezometers could be used to determine the impact of buildings on hydrogeology at local scale (modifications of groundwater flows around the buildings).

2.3. WATER ABSTRACTION IMPACT

This section deals with the requirement 3.1 of the EA P&I Document [Ref-1].

This section addresses the methodology to assess the impact of seawater and freshwater abstraction.

The monitoring programme (see Sub-chapter 12.6) will allow changes to biological systems to be evaluated.

The data required to assess these impacts is site specific. As a consequence, the detailed assessment will be undertaken during the site specific phase.

2.3.1. Seawater abstractions

During the operational phase, seawater is abstracted for cooling the steam turbine condensers (Circulation Water System (CRF)) and auxiliary systems. Cooling water is entirely returned to the sea or the estuary after having passed through the system. The necessary abstraction and discharge licences under the Water Resources Act 1991 will be obtained for the cooling water system.

The analysis will focus on the impacts of abstracted and discharged seawater and the impact of sediment deposits.

To assess the impact of water abstractions on marine hydrology, velocities linked to suction outside of the discharge structure and exit speeds at the discharge point are compared with the velocity of the tidal currents, and general current movement.

The main mitigation measures to minimise impacts of water abstractions on fish are the following:

- A location of the intake far from zones of ecological importance;
- A design of the intake, position and depth adapted to the environmental conditions;
- The use of recirculation cooling systems;
- The use of a filter mesh that is as large as possible because mortality rate by entrainment in circuit is generally less important than mortality by impingement;
- The use of removal systems: fish pump, low pressure washing system; and
- The use of deterrent systems to divert fish from intakes such as light (deterrent for eels in particular), sound, bubble curtains, etc.

Captured species depend on specific physical, meteorological and biological conditions. Moreover, the pumphouse is dimensioned to reduce the intake of algae and the associated risk of clogging; in the same way, the intake structure will be designed using the most effective method of fish deterrent scheme taken into account the site characteristics.

As an example, for Flamanville 3, due to the area's changing hydrology, the region does not attract gregarious species; moreover, few organisms, in quantity, are brought into the intake channel:

- During spring tides, due to the significant increase in suction currents, small sedentary organisms are brought in such as amphipode crustaceans, decapod crustaceans (shrimps, juvenile crabs, etc.) and bottom-dwelling fish (blennies, gobies, etc.);
- During storms, it is mostly algae that is brought in after having been transported by strong winds and the swell; and
- When migrating to the coast, species with a limited swimming capacity are occasionally, such as fish during the spring, molluscs at night, crustaceans (spider crab) when the tidal range is high and cnidaria during the summer.

2.3.2. Freshwater abstractions

Freshwater may be provided during operational phase by surface water sources such as rivers or groundwaters, or from a desalination unit depending on the site characteristics. When a possible site location is confirmed an assessment of the water resource availability will be made by the Water Authorities using the EPR needs analysis results, in order to define the most sustainable means of sourcing the water both for raw water and for drinking quality water.

As a consequence, the potential impact of water abstraction will be studied at the site specific phase once the Local Water Authorities consulted and the process related with water supply defined. The applicable CAMS and River Basin Management Plan that apply to the candidate water courses and groundwater will form the starting point for this assessment.

2.4. THERMAL DISCHARGES IMPACT

This section deals with the requirement 3.1 of the EA P&I Document [Ref-1].

The effect of the thermal discharge will be modelled using a 3D model.

Given that thermal impact studies are complex calculations based on site specific data and that simplified calculations will not provide meaningful results, only a site specific assessment can be carried out in order to determine the impact of thermal discharges upon the local marine environment.

The site specific assessment will deal with the localised effects of thermal discharges close to the discharge point and the distant effects on the ambient sea water temperature.

The 3D modelling will be used to evaluate various potential configurations for the discharges and various hydrodynamical conditions (several tide coefficients will be studied: at least an average neap tide and an average spring tide).

Data required for 3D modelling includes: ambient temperature data, outfall temperature and flow rate data, discharge point's localisation and geometry data, tidal data and bathymetric data.

The assessment will confirm that:

- The maximum temperature rises are reached under neap tide conditions;

- As warm water is discharged into cool water, warm water rises and its effects are localised at or near the surface of the receiving water body. It is therefore the surface which is most affected by the highest rises in temperature; and

- The thermal plume sweeps a limited surface area.

Moreover the aquatic ecosystem monitoring (see Sub-chapter 12.6), which will be carried out in the first years of the EPR unit's operating lifetime, will confirm the potentially very low impact of the heated surface area on the ecosystem.

The example of the thermal impact study for the French coastal site of Flamanville is presented in the appendix of this sub-chapter. This study was undertaken using the 3D model Telemac 3D (French model) for the specific marine conditions of the Flamanville site, therefore the conclusions presented should not be extended to other sites.

2.5. LIQUID NON RADIOACTIVE SPECIES IMPACT

This section deals with the requirement 3.2 of the EA P&I Document [Ref-1].

This section describes the methodology that is used for impact assessment of liquid non radioactive species. The methodology is based on EA Technical Guidance note IPPC H1 [Ref-2] [Ref-3].

2.5.1. Emissions inventory and discharge concentration

The chemicals discharged into the sea during the EPR operation are described in chapter 3 with respect to the following:

- Chemical substances such as: boric acid, lithium hydroxide, hydrazine, morpholine, ethanolamine, phosphates, sodium, sulphates, bromoform, chlorides, iron;

- Mixtures of chemical substances: total metals(*), nitrogen, excluding hydrazine, morpholine and ethanolamine, residual oxidants; and

- Physical-chemical characteristics: suspended solids, COD, BOD_5 and Dispersants.

(*) In total metals, we can distinguish between, iron from the demineralisation and desalination plants (if any), and metals from the T(0KER [LRMDS]) and Ex(0SEK [SiteLWDS]) tanks (system erosion) which comprise chromium, copper, nickel, zinc, manganese, iron, lead and aluminium. A distribution spectrum for these metals is given in PCER Chapter 3. The impact assessment therefore takes into account corrosion products coming from both primary and secondary circuits.

The substances discharged during the EPR operation phase that have EQS are ammonia (unionised), boron, iron, copper, chromium, nickel, zinc, lead and Total Residual Oxidants (TRO). These substances are detailed below:

- Ammonia is injected into the secondary circuit in order to obtain a pH where minimum levels of corrosion occur. Unionised ammonia is considered as 3.2% of total ammonia (EIFAC 1986) [Ref-1]. This fraction is based on the following conditions: 23 to 27 ppt salinity, 20°C water temperature and pH 8. Actual unionised ammonia fraction will vary with local site conditions;

- Boron is a chemical required to condition the various circuits to utilise its neutron-absorbing properties;
- Metals arising from wear in the circuits are found in the discharged liquids associated with radioactive effluent. These metals are those used to manufacture either the circuits or some of the equipment (iron, nickel, zinc, copper, chromium and lead). Proper chemical conditioning is a major factor in limiting the amount produced. Although the effluent is filtered and treated with ion exchange resins, small quantities of these metals are found in the discharge tanks;
- Iron is a product resulting from the chemicals circuits conditioning as explained above and from the demineralised water production itself; and
- TRO result from treatment of the cooling water circuit against biological fouling.

The quantity of discharged substances with EQS values (plus the metals aluminium and manganese) related to the operation tests, including the demineralised water production, is presented in Sub-chapter 12.2 - Table 3. The table presents the maximum values for annual flow. More information on TRO is presented in section 2.5.3.1.

Sub-chapter 12.2 - Table 3: annual additional discharge for chemicals during operation phase for substances with EQS values and all metals arising from circuit wear.

Substances	Conditioning the circuits (kg y^{-1})	Producing demineralised water (kg y^{-1})	Annual quantity (kg)
Ammoniac (unionised) (as N)	167	/	167
Boric acid	7000	/	7000
Boron*	1224	/	1224
Iron	16.3	848	864.3
Copper	0.2	/	0.2**
Nickel	0.2	/	0.2**
Zinc	2.8	/	2.8**
Lead	0.1	/	0.1**
Chromium	3.88	/	3.88**
Aluminium	2.46	/	2.46***
Manganese	1.54	/	1.54***

* $$weight_{Boron} = \frac{atomic\ weight_{Boron} \times weight_{Boric\ acid}}{atomic\ weight_{Boric\ acid}}$$

** For the metals with EQS values, the discharges are not significant for copper, nickel, zinc and lead. Nevertheless the impact assessment is done.

*** The discharges are not significant for the metals without EQS values (aluminium and manganese).

The impact study carried out here is based on the hypothesis that the discharge is diluted in the cooling water of one EPR unit which is operating at a rate of 67 $m^3 s^{-1}$.

2.5.2. Assessment methodology

The methodology used to assess chemical liquid discharge impact is the following:

1. Discharges are quantified taking into account emissions inventory and dilution in the cooling water flow of one EPR unit of 67 $m^3 s^{-1}$.

$$DC(Discharge\ Concentration) = \frac{\left(Annual\ \ flow \times 10^6 \times 10^3\right)}{\left(discharge\ \ flow \times 365 \times 24 \times 3600 \times 10^3\right)}$$

with DC in µg l^{-1};
Annual flow in kg; and
Discharge flow in $m^3 s^{-1}$.

2. Process contribution is calculated taking into account a near field dilution factor of 0.2. This factor has been determined in accordance with EA.

$$PC(Process\ Contribution) = \frac{\left(Annual\ \ flow \times 10^6 \times 10^3\right)}{\left(discharge\ \ flow \times 365 \times 24 \times 3600 \times 10^3\right)} \times 0.2$$

with PC in µg l^{-1};
Annual flow in kg; and
Discharge flow in $m^3 s^{-1}$.

3. DC and PC of individual chemicals are compared against EQS. The EQS that are used are presented in the following table (Sub-chapter 12.2 - Table 4).

   The only substances discharged during the EPR operation phase that have EQS values are ammonia (unionised), boron, iron, copper, nickel, zinc, lead, chromium and TRO. There are no EQS for aluminium and manganese.

   Only the substances for which there is an EQS value (statutory or not) are considered in the present impact assessment. The impact of other substances will be considered in site specific applications.

Sub-chapter 12.2 - Table 4: Environmental Quality Standards (EQS)

Chemicals	EQS type	EQS ($\mu g\ l^{-1}$)
Ammonia (unionised) (as N)	/	21*
Boron	Total Annual average	7,000
Iron	Dissolved Annual Average	1,000
Copper	Dissolved Annual Average	5
Nickel	Dissolved Annual Average	30
Zinc	Dissolved Annual Average	40
Lead	Dissolved Annual Average	25
Chromium	Dissolved Annual Average	15
TRO	Maximum allowable concentration	10

* Value proposed in IPPC H1 guidance July 2003 [Ref-1]

If emissions are less than 1% of the environmental benchmark, then the substance is screened out.

4. More detailed assessment is carried out if the PC is more than 1% of the relevant environmental benchmark.

   Predicted Environmental Concentration (PEC) is calculated by summing the background concentration and the PC.

2.5.3. Assessment of emissions to water

The results of assessment for the seven chemicals studied are shown in Sub-chapter 12.2 - Table 5, which gives:

- annual additional discharge;
- annual average discharge concentration (DC);
- process contribution (PC); and
- DC divided by EQS (i.e. DC/EQS) and PC divided by EQS (i.e. PC/EQS) as a percentage.

For all metal species, the concentration discharged is the total mineral content and not just the dissolved fraction. The impact assessment of metal discharges is thus conservative as all of the metal EQS are based on dissolved fractions.

Sub-chapter 12.2 - Table 5: Assessment of liquid non radioactive discharge

Chemicals	Annual flow (kg)	DC (µg l^{-1})	EQS (µg l^{-1})	DC/EQS (%)	PC (µg l^{-1})	PC/EQS (%)
Ammonia (unionised) (as N)	167	0.08	21	0.4	0.015	0.075
Boron	1224	0.58	7000	0.008	0.12	0.002
Iron	864	0.41	1000	0.04	0.08	0.008
Copper	0.19	0.0001	5	0.002	0.00002	0.0004
Nickel	0.21	0.0001	30	0.0003	0.00002	0.00007
Zinc	2.78	0.0013	40	0.0033	0.0003	0.0007
Lead	0.14	0.00007	25	0.0003	0.00001	0.00005
Chromium	3.88	0.002	15	0.0122	0.0004	0.002
TRO (estimated, see assumptions below)	/	500	10	5000	100	1000

The Discharge Concentration and the Process Contribution are predicted to be less than 1% of the corresponding EQS for all of the substances considered with the exception of TRO, rendering their impact on the receiving water as generally insignificant. Therefore, more detailed assessment is not necessary, with the exception of TRO.

2.5.3.1. Total Residual Oxidant

TRO results from treatment of the cooling water circulation circuit against biological fouling. The estimated maximum concentration of TRO in the discharge pond is 0.5 mg l^{-1} (PCER Sub-chapter 3.4 - Table 8). The assumed value of EQS is 10 µg l^{-1} (although this is not a statuary value).

As a result of dilution of the cooling water and additional demand on the chlorine produced oxidants, the level of TRO is considerably reduced in the receiving waters. The estimation in the PCER of the maximum concentration of TRO in the discharge pond does not take into account these dilution and degradation processes.

The area exposed to TRO concentrations > 10 µg l^{-1} is likely to be limited to the immediate vicinity of the discharge point. In addition, marine organisms are unlikely to experience significant negative effects resulting from TRO discharge. Organisms close to the sea floor are not in the discharge plume, fish (and other mobile organisms) are unlikely to remain for significant periods of time in the discharge plume, and plankton spend a limited amount of time in the discharge plume before substantial dilution occurs.

Chlorine addition processes and estimations of TRO discharges are very site specific, requiring information on local water quality and thermal plume modelling. Therefore, a site specific impact assessment of TRO discharges will be performed in the future.

2.5.3.2. Other dangerous substances

The bulk liquid raw materials used as conditioning products may contain impurities such as mercury, cadmium and arsenic. EDF has established specifications for the level of impurities in the conditioning products that suppliers must comply with. These specifications are operator specific.

Cadmium and arsenic are prohibited by EDF as basic product components in the reactor water, to prevent corrosion and activation. Therefore, they are only present as traces in conditioning products such as sulphuric acid.

The effluent is filtered and treated with ion exchange resins before being sent to the storage tanks. It can be assumed that only a small proportion of the impurities introduced in the circuits is to be found in the discharge tanks and in the discharge to the sea (PCER Sub-chapter 3.4 section 5.3.). Therefore it is reasonable to conclude that these substances, introduced as minute traces in the circuits, will be found only as traces in the liquid discharge.

2.5.3.3. Silver

Silver can only be found as traces arising from corrosion of control rods in Silver-Indium-Cadmium (“Argent-Indium-Cadmium” (AIC)) in the form of Silver-110m (Ag-110m). The impact of these discharges is assessed with the radioactive discharges.

Regarding bulk liquid raw materials, no silver is expected to be found. Chemical specifications for other impurities (e.g. arsenic in boric acid) serve as indicators of the overall level of impurities in the conditioning products (including silver). Analyses of ‘indicator’ impurities with impurity levels within the chemical specifications have indicated no measurable traces of silver in the conditioning products.

2.6. IMPACT OF DREDGING

This section will address the impact of dredging and discharges on the nature and quality of seabeds, quality of seawater (especially regarding discharges of suspended matter which could create a turbid plume, releasing metals or other components that are present in the sediments) and marine biology, everywhere that sediment discharge could occur.

The data required to assess these impacts is site specific. As a consequence, the detailed assessment will be undertaken during the site specific phase.

2.7. FLOOD RISK

This section will address the risk of flooding from the sea, estuary or any other land drainage system.

The requirement related to the protection of the EPR against external flooding are to:

- Keep the buildings housing safety classified equipment dry, by setting the platforms at a level at least equal to the Maximum Design Flood Level; and
- Prevent as far as possible any water present on the platforms, from flowing into these buildings.

The different external flooding hazards that are taken into account along with additional cases of combinations are described in Chapter 13 of PCSR.

An EPR development and its infrastructure could also increase the flood risk in a determined environment and therefore, further site specific assessments will be required.

The identification, management and mitigation of flood risk will be addressed in a Flood Risk Assessment (FRA) report as part of the planning application for an EPR development on a UK specific site.

APPENDIX - FLAMANVILLE 3 THERMAL IMPACT STUDY

1. INTRODUCTION

The following sections present a summary of the results of a thermal impact study. It is an extract from the application for authorisation to create a third nuclear power unit at the French coastal site of Flamanville.

The thermal impact study focuses on the impact of this new unit as well as the entire Flamanville electricity production site comprising the two existing nuclear units.

Given that the Flamanville site is subject to specific marine conditions (tides, currents, seawater temperature, etc.) and that the study is undertaken using Telemac 3D (French model), the conclusions presented in the following paragraphs should not be extended to other sites.

2. FLAMANVILLE THERMAL IMPACT STUDY

2.1. IMPACT OF THE BUILDING SITE

Construction of the new EPR unit does not produce any thermal discharges.

2.2. IMPACT OF THE PLANT WHILE OPERATING

2.2.1. Impact of the EPR unit alone

Propagation of the thermal plume has been modeled by EDF - Research and Development (R&D) using the Telemac 3D model.

Two tide coefficients were studied: an average neap tide (coefficient of 45) and an average spring tide (coefficient of 95). The simulations were performed based on the upper limit temperature increase value (14°C) and a minimum discharge rate of 58 $m^3 s^{-1}$.

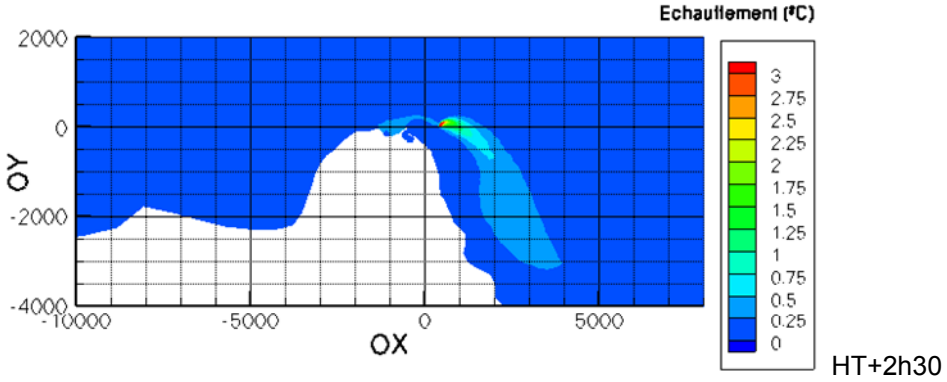
The results of the modelling (Sub-chapter 12.2 - Figure A) show that:

- The residual heating at the water intake point and on the shore is around 0.5°C; maximum heating values are obtained in neap tide conditions;
- The plume is vertically stratified (buoyancy effect due to the temperature difference between the ambient environment and the discharge). As one moves away from the discharge points, the plume becomes vertically homogeneous; it is therefore the surface which is affected by the highest rises in temperature;
- In average spring tide conditions, the thermal plume, corresponding to a residual heat increase of 1°C at the surface, covers an area of around 0.4 km² over a full tide cycle. 50 m away from the discharges, the maximum residual heat increase is less than 6.3°C; and

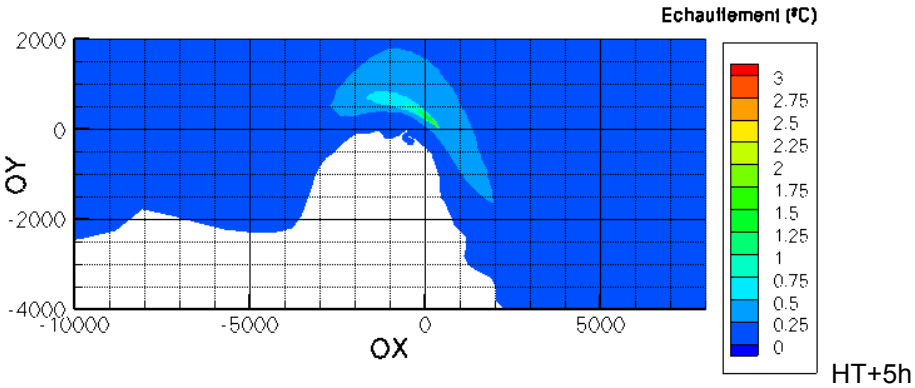
- In average neap tide conditions, the thermal plume, corresponding to a residual heat increase of 1°C at the surface, covers an area of around 0.6 km² over a full tide cycle. 50 m away from the discharges, the maximum residual heat increase is less than 6.2°C.

Thus the EPR unit alone does not heat a significant volume of water.

Sub-chapter 12.2 - Figure A: Maximum expansion of the 1°C plume, neap tide, EPR unit alone



HT+2h30



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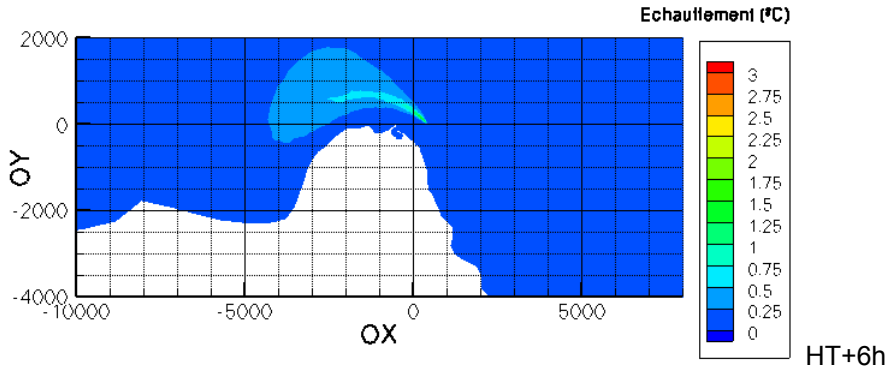

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2.2.2. Impact of units 1 and 2, and the EPR unit

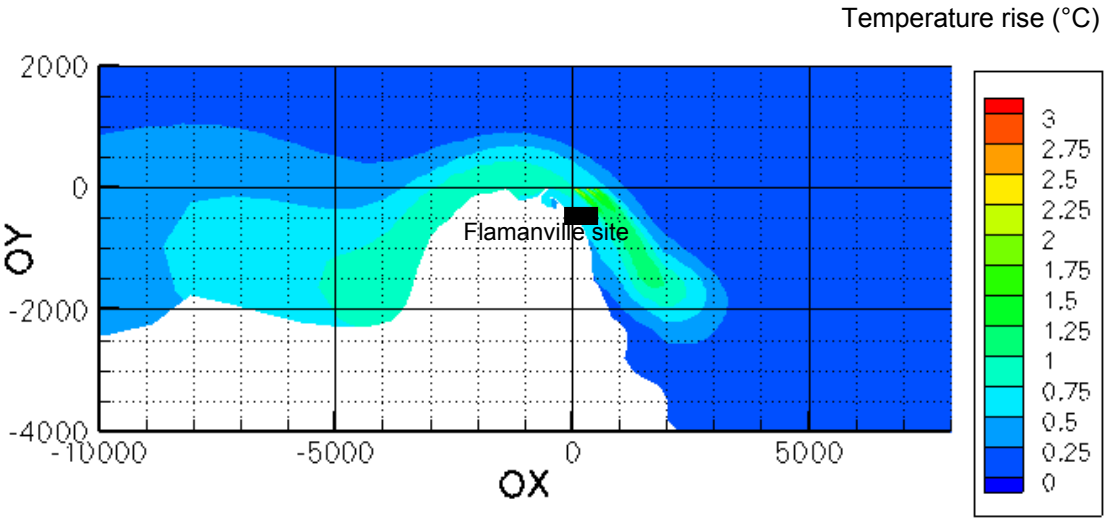
Two tide coefficients were studied: an average neap tide (coefficient of 45) and an average spring tide (coefficient of 95). Simulations were carried out:

- For units 1 and 2, on the basis of the temperature increase threshold (15ºC) and a nominal discharge rate of 45 m^3 s^{-1} per unit; and
- For the EPR unit, on the basis of the temperature increase threshold (14ºC) and a minimum discharge rate of 58 m^3 s^{-1}.

Results from the model show that:

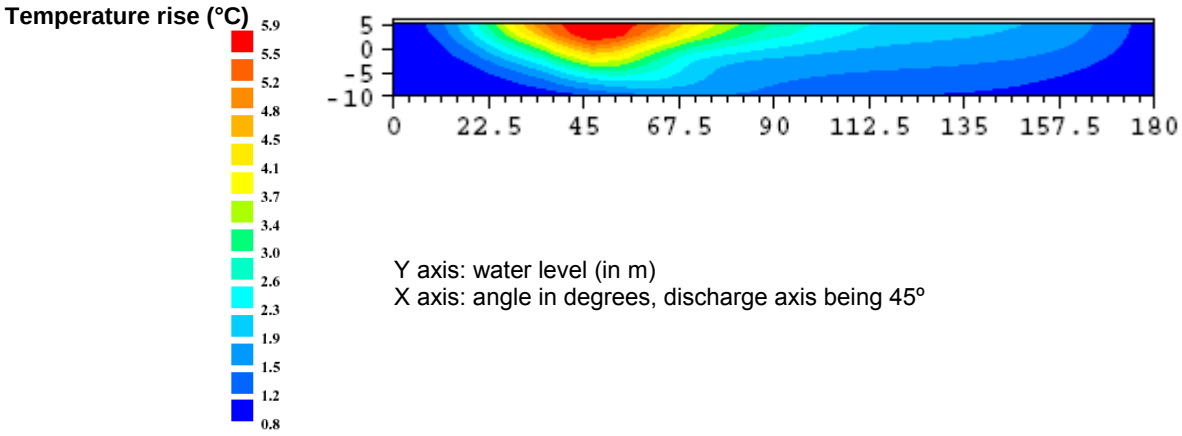
- The distinct plumes from the three discharge points quickly merge into one: less than 500 m from the discharge points (at coordinates [0,0] on Sub-chapter 12.2 – Figure B) the plumes have merged (the Flamanville site is located on the white headland);
- The residual temperature increase at the water intake point and on the shore is approximately 1.2°C (on Sub-chapter 12.2 – Figure B); the maximum temperature increases are reached under neap tide conditions;

Sub-chapter 12.2 - Figure B: Residual maximum temperature rise in the cove of Sciotot, average neap tide, units 1 and 2 and the EPR unit



- The plume is vertically stratified (buoyancy effect due to the temperature difference between the ambient environment and the discharge), see Sub-chapter 12.2 – Figure C; as one moves away from the discharge points, the plume becomes vertically homogeneous; it is therefore the surface which is most affected by the highest increases in temperature;

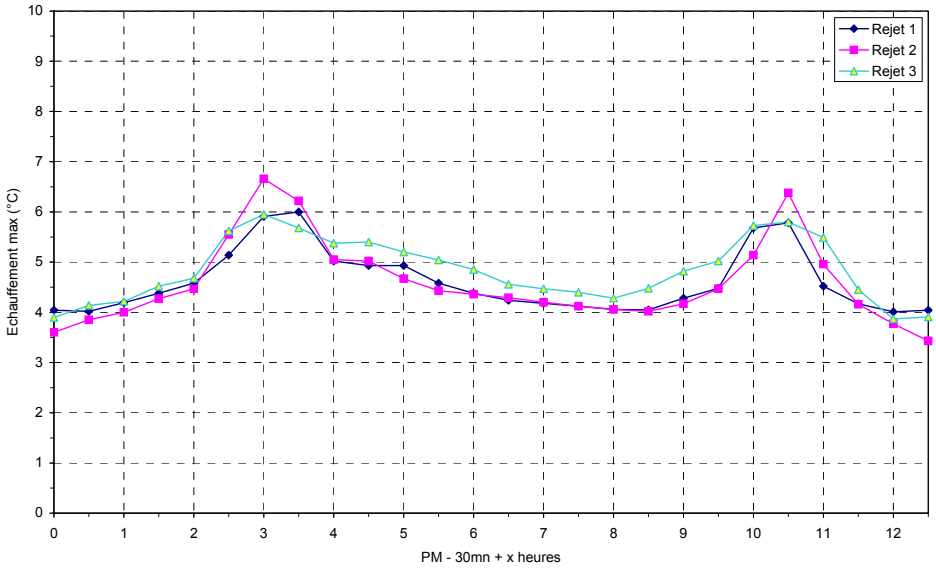
Sub-chapter 12.2 - Figure C: Temperature rise at 50 m from discharge point 3 (EPR), cross section, HT+3h30



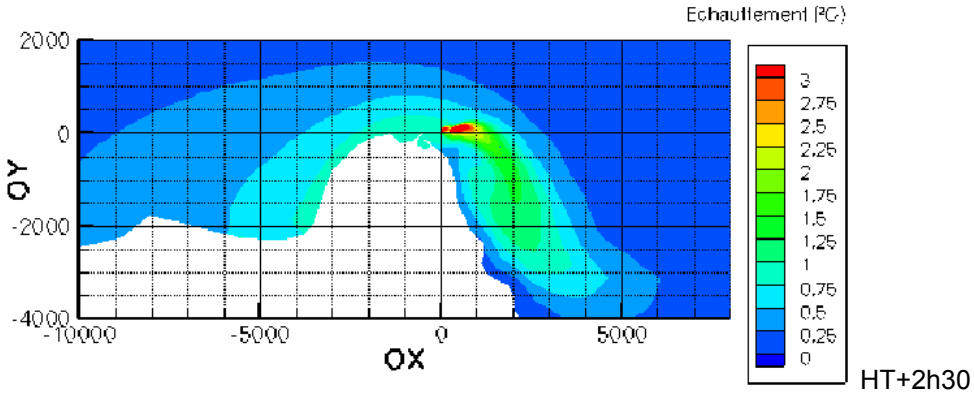
- At average spring tide, the thermal plume, which corresponds to a residual temperature rise of 1ºC on the surface, covers a surface area of approximately 2.5 km² over a complete tidal cycle. At 50 m from the discharge points, the maximum residual temperature increase reached at the surface is less than 6.7ºC; this temperature rise is reached at the discharge point of unit 2, which is partially influenced by discharges from the EPR unit; and

- At average neap tide, the thermal plume, which corresponds to a residual temperature increase of 1ºC on the surface, covers a surface area of approximately 8.5 km² over a complete tidal cycle (Sub-chapter 12.2 – Figure E). At 50 m from the discharge points, the maximum residual temperature rise (reached at the discharge point of unit 2) is less than 7ºC (Sub-chapter 12.2 – Figure D).

Sub-chapter 12.2 - Figure D: Residual temperature rise at 50 m from the discharge points, neap tide, units 1 and 2 and the EPR unit



Sub-chapter 12.2 - Figure E: Plume's maximum expansion with a 1ºC rise, neap tide, units 1 and 2 and the EPR unit



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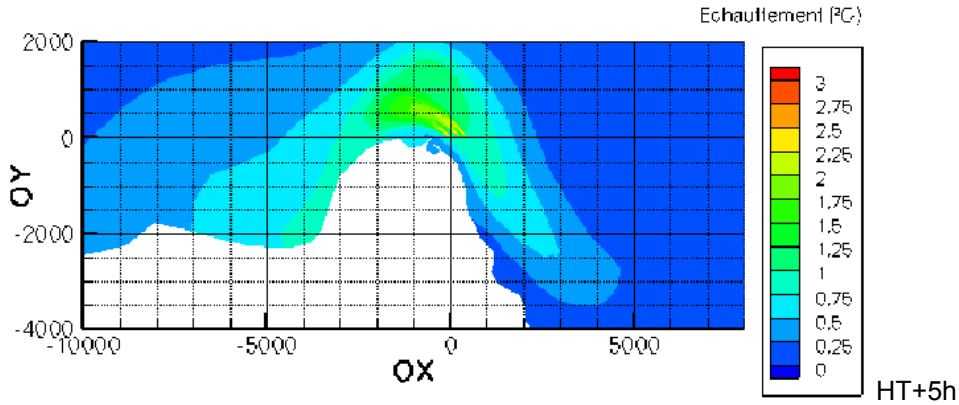

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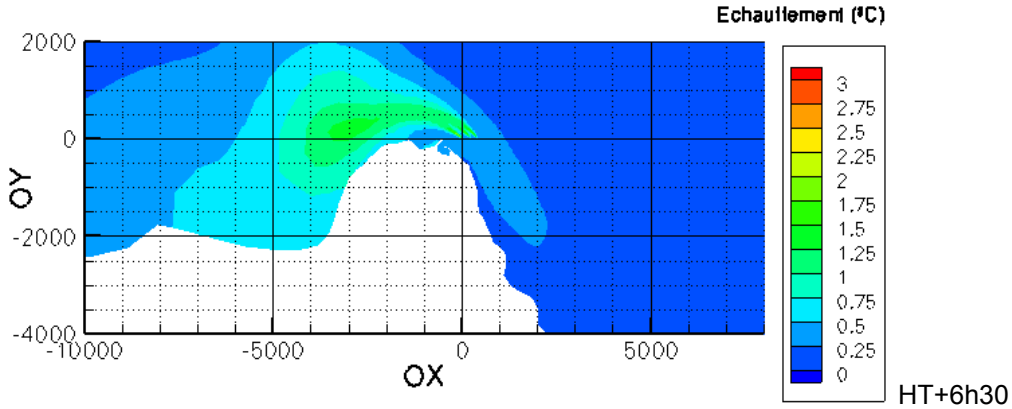

HT+6h30

The analysis of these results leads us to the following conclusions:

- Residual temperature increases at the water intake points and at the shoreline due to the functioning of the three units, as well as maximum temperature rises on the surface 50 m from the discharge points, are of the same order of magnitude as when the two 1300 MW(e) units are functioning. Unit 2 discharges are partially affected by those of the EPR unit. However, the latter does not contribute a temperature rise of more than 0.3ºC (at the water intake point, at the shore or 50 m from the discharge points). This is negligible and remains within the order of magnitude of the seawater's natural temperature fluctuations. Therefore, adding an EPR unit to the Flamanville site does not significantly change residual temperature rises in the sea (at the water intake point, on the shore or 50 m from the discharge points);

- The main effect of the EPR unit's discharges is to increase the surface area concerned by the thermal discharges: the surface area increases from 2.5 km² to 8.5 km² for a 1ºC temperature rise at average neap tide. Nevertheless, this situation must be put into perspective:

    - Temperature rises which are mainly observed on the surface, have a minimal impact on the marine ecosystem which is largely composed of bottom-dwelling species. Fish, which live in open water, can avoid the heated water plume due to their swimming capacity,

    - Hydro-biological monitoring undertaken over the past 20 years for the nuclear plants of Paluel and Gravelines, with four and six units in operation respectively, has not revealed that thermal discharges have had any effect. It is therefore likely that adding an EPR unit to the Flamanville site will not noticeably disturb the ecosystem.

The aquatic ecosystem monitoring studies, which will be carried out in the first few years of the EPR unit's operating lifetime, will allow us to confirm the limited impacts of an increased heated surface area.

EDF-R&D has also simulated, for the two tide conditions under consideration, the operation of the EPR unit in nominal mode, that is with an activity rate of 67 $m^3 s^{-1}$ and a temperature difference of 12°C, with the other two 1300 MW(e) units still operating at their limits with a discharge rate of 45 $m^3 s^{-1}$ and a temperature difference of 15°C. The variances shown in the results are not large and remain approximately equal in size. This is due to the fact that the thermal load released into the sea by the EPR unit is approximately equal (58 x 14 = 812°C $m^3 s^{-1}$ when operating to the limits and 67 x 12 = 804°C $m^3 s^{-1}$ when operating in nominal mode).

2.2.3. Conclusion

The new unit’s thermal discharges will not affect the residual temperature increases in the sea. The temperature increase is reduced by half at 50 m from the discharges. The surface area affected by the temperature rises will be slightly greater but no additional impacts are expected given past experience from the four unit coastal plants in operation and the fact that the maximum temperature increases are localised at the surface, thus limiting the impact on the water column.

SUB-CHAPTER 12.2 – REFERENCES

External references are identified within this sub-chapter by the text [Ref-1], [Ref-2], etc at the appropriate point within the sub-chapter. These references are listed here under the heading of the section or sub-section in which they are quoted.

1. DURING CONSTRUCTION PHASE

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

1.1. IMPACT ON MARINE HYDROLOGY

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

1.2. IMPACT ON SEDIMENTOLOGY

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

1.3. IMPACT ON HYDROGEOLOGY

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

1.4. WATER ABSTRACTION IMPACT

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

1.5. THERMAL DISCHARGES IMPACT

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

1.6. LIQUID NON RADIOACTIVE SPECIES IMPACT

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

[Ref-2] Integrated Pollution Prevention and Control (IPPC) –. Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. July 2003. (E)

[Ref-3] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. March 2008. (E)

1.6.1. Emissions inventory and discharge concentrations

[Ref-1] Report of the working group on terminology, format and units of measurement as related to flow-through and recirculation system. European Inland Fisheries Advisory commission. Tech. Pap., 49. 100 pp. EIFAC (1986). (E)

1.6.2. Assessment methodology

[Ref-1] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. July 2003. (E)

2. DURING OPERATIONAL PHASE

2.1. HYDROLOGY AND SEDIMENTOLOGY IMPACTS

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

2.2. IMPACT ON HYDROGEOLOGY

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

2.3.WATER ABSTRACTION IMPACT

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

2.4.THERMAL DISCHARGES IMPACT

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

2.5. LIQUID NON RADIOACTIVE SPECIES IMPACT

[Ref-1] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. July 2003. (E)

[Ref-2] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. March 2008. (E)

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2.5.2. Assessment methodology

[Ref-1] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT, Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. July 2003. (E)

SUB-CHAPTER 12.3 – IMPACT ON DESIGNATED AREAS, SENSITIVE HABITATS AND PROTECTED SPECIES

LIST OF TABLES

LIST OF FIGURES

This sub-chapter deals with the requirements 2.10 and 3.2 of the Environment Agency (EA) Process and Information (P&I) Document [Ref-1].

It contains six main sections and a number of sub-sections:

- Description of assumptions made for the assessment;
- Methodology: how the analysis was undertaken, including:
    - An introduction to the identification of ecological sensitivities for a representative site;
    - A table providing a list of identified sensitive ecological receptors for a representative site, including a list of the appropriate regulation and guidance for each receptor, a qualitative assessment of the likelihood of finding that receptor at a representative site around the coastline or the estuaries of England and Wales and brief notes on survey requirements;
    - An introduction to the proposed Ecological Impact Assessment methodology;
    - A set of tables which provide a generic impact assessment for a representative site;
    - A set of tables which address the possible mitigation measures to reduce generic impacts to acceptable levels for the project; and
    - An assessment of the limitations of the approach.
- A description of interactions with other environmental elements; and
- A summary of the main points of the analysis and a discussion and conclusion of the results.

1. SCOPE

This sub-chapter describes the methodology used to assess impacts on designated sites, sensitive habitats and protected species.

Designated Sites

There are three levels of designated sites:

- European protected sites: Special Areas of Conservation (SACs), designated under the UK's implementation of the EC 'Habitats' Directive 92/42/EEC (the Conservation (Natural Habitats, &c.) Regulations (1994) (as amended) and Special Protection Areas (SPAs), designated under the EC Wild Birds Directive (In the UK, the provisions of the Birds Directive are implemented through the Wildlife & Countryside Act 1981 (as amended) and The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended)). The UK implementation of the EC 'Habitats' Directive 92/42/EEC apply to the UK land area and its territorial sea (to 12 nautical miles from the coast).

- UK protected sites:

    - Statutorily designated sites: Sites of Special Scientific Interest (SSSI), designated under the Wildlife and Countryside Act, (1981) as amended, Ramsar sites, designated under the Ramsar Convention and National Nature Reserves (NNR); and

    - Non-statutorily designated sites: such as local nature reserves (LNR), sites of biological interest (SBI) and wildlife nature reserves.

Sensitive Habitats

Habitats identified as being rare or threatened in the UK, listed as priority habitats in the UK Biodiversity Action Plan.

Protected Species

Species of fauna and flora listed in Schedules 1, 5 and 8 of the Wildlife and Countryside Act (1981) as amended.

The level of an ecological impact assessment depends on the kind of operation and the actual location of areas:

- If the project is situated in a designated site of any type, an Appropriate Assessment will be required, prepared by the Competent Authority. The ecological assessment will be sufficiently detailed to address all issues required in the Appropriate Assessment. This will include all extended Phase 1 Habitat and any Phase 2 (protected species) surveys.

- If the construction phase and the operational phase do not take place in a designated site, effects of the project must still be assessed via an extended Phase 1 Habitat survey which will be used as a reconnoitre survey to determine if any Phase 2 protected species surveys are required. Where any sensitive habitats or protected species are found, a full ecological impact assessment must be carried out.

For both kinds of studies, the analysis deals with impacts both during the construction phase and during operational phase. All abstractions, discharges and nuisances are assessed; in particular, impact of radionuclides on habitats and species is evaluated using the results of radiological impacts studies (see PCER Chapter 11). Direct and indirect impacts are also evaluated.

2. ASSUMPTIONS

This sub-chapter provides details of the methodology used and the assessment of ecological impacts for a generic design EPR facility located on a representative site in the UK.

It is extremely difficult to assess the potential ecological impacts of a development when its location is unknown in detail. This is because the geography of a particular location is so important in determining whether the site is designated (and hence protected) for its nature conservation value and whether there are any protected habitats or species present and if so – what they are. Thus, for this assessment, a number of key assumptions are made. These assumptions are explained briefly below:

- The site is coastal or estuarine;
- The ecological characteristics of the representative site are chosen as they represent the “typical data” of potential sites where a new EPR reactor could be located. These sites are representative from potential coastal and estuarine sites in the UK with a good geographic distribution; and
- It is thus assumed that the representative site has the sum of all the ecological characteristics found at these typical sites.

3. METHODOLOGY AND ASSESSMENT

This section is divided into six parts and provides information about the methodology used at each step of the analysis as well as the results of the analysis.

Section 3.1: Description of how the sensitive receptors for the representative site were identified, the regulation and guidance appropriate for each, an indication of the likelihood of occurrence of each ecological receptor and notes relating to likely survey effort required for each. This is summarised in Appendix A.

Section 3.2: Description of the methodology to be used for Ecological Impact Assessment (EcIA). Sub-chapter 12.3 - Table 1 provides the matrix explaining how the degree of significance is determined.

Section 3.3: A generic assessment of potential impacts and associated tables (Sub-chapter 12.3 - Tables 2 and 3) for the representative site.

Section 3.4: A set of generic mitigation measures and associated tables (Sub-chapter 12.3 – Tables 4 and 5) for the representative site.

Section 3.5: Description of the method of cumulative impact assessment.

Section 3.6: Description of the limitations of the ecological GDA assessment method.

The data required to assess these impacts is site specific. As a consequence, the detailed assessment will be undertaken during the site specific phase.

At the generic stage, sensitive habitats and protected species potentially impacted are identified; then, an overall qualitative assessment is performed for the construction and operational phases.

3.1. INTRODUCTION TO THE IDENTIFICATION OF ECOLOGICAL VALUE

3.1.1. Introduction to Rationale

The characteristics of the ecological receptors for a representative site are chosen as they represent the 'typical data' of potential sites where an EPR reactor could be located. These sites are representative of potential coastal and estuarine sites in the UK.

3.1.2. Methodology to Identify Ecological values

A number of publicly available resources are used to determine the nature conservation and ecological characteristics of the sensitive sites. These are listed below:

Sequence:

- Inspect the UK Government's MAGIC (Multi-Agency Geographic Information for the Countryside) website (www.magic.gov.uk) interactive maps of several sites – to determine if the site is within an European or UK statutory or UK non-statutory designated sites or whether there are any sites within 2-3 km of a site;

- Assess designated site status top-down according to: European protected (Natura 2000), UK protected (SSSI and National Nature Reserves) and non-statutory (LNRs, SBIs, etc.);

- Inspect aerial imagery and available photography of several sites (using internet search engines such as Google) – to identify landscape types, agriculture, forestry and ecological habitats present within the site and around a 1-2 km radius of the site;

- Assess presence or proximity of European priority habitats (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (EC Habitats Directive)) and UK BAP priority habitats (judged from available imagery and knowledge of the UK coastline and coastal habitats); and

- Assess presence or proximity of European protected species (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (EC Habitats Directive) and UK protected species (Wildlife and Countryside Act 1981 (as amended)) (again, judged from past experience and knowledge of UK coastline or coastal habitats plus use of the NBN (National Biodiversity Network) Gateway website (www.nbn.org.uk).

After the above process is completed, a spreadsheet of characteristics is created, with rows representing all possible ecological receptors present at the site and columns listing the appropriate regulation and guidance for each receptor, a qualitative assessment of the likelihood of finding that receptor at a representative site around the coastline and the estuaries of England and Wales and brief notes on survey requirements.

The completed spreadsheet is reproduced in Appendix A of this sub-chapter, together with a diagrammatic and tabulated explanation of coastal and near shore habitat descriptions and classifications.

3.2. ECOLOGICAL IMPACT ASSESSMENT METHODOLOGY

There is no statutorily required methodology for carrying out environmental impact assessment in the UK, but more general guidance on the EIA process is provided in ODPM (2004) 'Environmental Impact Assessment: Guide to Procedures'. (www.odpm.gov.uk). Thus, the methodology used for ecological impact assessment (EcIA) is derived from more general environmental impact assessment (EIA) methodology, including that piloted by the Institute of Ecology and Environmental Management (IEEM).

There are three clear stages in the impact assessment:

- impact assessment;
- proposed mitigation measures; and
- assessment of residual impacts after implementation of mitigation.

The Ecological Impact Assessment process is applied to all site preparation stages (such as site investigation works, soil stripping, tree felling, etc.), construction works, including offshore elements, operation and maintenance of the facility. The methodology is described briefly in the following sections.

3.2.1. Methodology for Assessment of Potential Ecological Impacts.

An outline of the proposals for construction is compared with the findings of the baseline ecological survey to predict the impacts that may result from the development. Then the following assessments are made:

- Step 1: Standard set of descriptions for each identified impact;
- Step 2: Assessment of the scale of impact and the sensitivity of the receiving environment; and
- Step 3: Determination of the degree of significance of the impact.

Thus, each identified impact is first *described*, and then its significance is *rated*. The description provides a qualification of the impact in the context of the site.

Step 1: Ecological Impact Description

The following criteria are considered when describing each impact:

- direct or indirect;

- spatial extent: localised (within a few metres) and widespread (e.g. over a whole catchment area);
- temporal extent: short term (few days), medium term (months) and long term (years); and
- reversible or irreversible.

Step 2: Assessing the Value of the Receptor and the Magnitude of the Impact

Once identified and described, the evaluation of the degree of significance of each impact is based on (1) assessment of the value and sensitivity of the ecological receptor and (2) the magnitude of the impact. This evaluation provides a level of significance for each impact.

- The value of the receptor is assessed according to whether the habitat or species is of international, national, regional, county, district or parish importance. In addition, the value is determined by habitat integrity, coherence and intactness. Consideration is given to nature conservation and ecological contexts of affected receptors including species, populations, communities, habitats and ecosystems.
- The magnitude of the impact is assessed according to spatial and temporal extent, combined with the probability of occurrence. Also taking into account the vulnerability of the habitat or species to the change caused by the development, and its ability to recover.

Habitats are valued according to widely accepted criteria of which the most important are naturalness, extent, rarity and diversity; these and others are described in extensive literature. These factors are used to determine the conservation status of protected habitats, which, in turn determines their suitability to support protected species. Existing statutory and non-statutory designations for nature conservation and amenity value are also taken into consideration.

Species are similarly valued according to accepted criteria and the extent to which they are under threat. The importance of species to wider communities is considered. Protection of species by the relevant legislation, including the *Wildlife and Countryside Act (1981)* as amended, *Countryside and Rights of Way Act (2000), Natural Environment and Rural Communities Act (NERC) (2006) the Conservation (Natural Habitats &.c) Regulations (1994)* as amended, and non-statutory guidance including the UK Biodiversity Action Plan (UKBAP) and Local Biodiversity Action Plans (LBAPs) are taken into account.

Step 3: Assessing the Degree of Significance of the Ecological Impact

Using receptor value and magnitude characteristics, together with an assessment of the probability of occurrence, the significance of each impact is determined. Significance is determined by the interaction of these factors. In this EcIA, following the IEEM pilot scheme, there are four degrees of significance.

The *rating* of an impact is the assessment of its degree of significance. The significance of an impact is a direct combination of:

- the probability of occurrence;
- the magnitude of change (spatial and temporal); and
- the value and sensitivity of the receptor or receiving environment.

The degree of impact significance is determined from the relationship between the impact's magnitude and the value and sensitivity of the ecological receptor. The probability of an event occurring is determined by professional judgement, based on past experience of similar projects, environments and ecological receptors. This assessment adopts the approach recommended by IEEM, with four grades of probability. The IEEM Guidance suggests a scale that is meaningful in normal language: Certain, Probable, Unlikely, Extremely Unlikely. This is indicated below:

- **Certain or near Certain**: probability estimated at 95% or higher;
- **Probable**: probability estimated above 50% but below 95%;
- **Unlikely**: probability estimated above 5% but less than 50%; and
- **Extremely Unlikely**: probability estimated at less than 5%.

Example Definitions of Ecological Receptor Value

- **International** – sites, habitats and species of significance in an international or European context;
- **National** – sites, habitats and species of significance in the context of England and Wales;
- **Regional** – habitats and species of significance in context of a region or County;
- **Local** – sites, habitats and species of significance in the context of an administrative area;
- **Low** – habitats and species of less than Local significance, but of some value; and
- **Negligible** – Less than low conservation value, i.e. not significant.

Indicative Description of Impact Magnitude

Low – Noticeable effects, but either of sufficiently small scale or short duration to cause no harm to the conservation status of the site, habitat or species. Detectable in short-term but not in medium-term.

Medium – Significant effect on the nature conservation status of the site, habitat or species, but would not threaten the long-term integrity of the system. Detectable in short-term and medium-term.

High – Significant effect on the nature conservation status of the site, habitat or species, likely to threaten the long-term integrity of the system. Detectable in short-term, medium-term and long-term.

Very High – Highly Significant effect on the nature conservation status of the site, habitat or species. Integrity of the system irreversibly damaged. Detectable in short-term, medium-term and long-term.

Using the magnitude of the impact and the value and/or sensitivity of the receptor, the degree of significance of a negative impact is determined from the Impact Assessment Matrix given below (Sub-chapter 12.3 – Table 1).

Sub-chapter 12.3 - Table 1: Impact Assessment Matrix

		Value and Sensitivity of Receptor			
		Low	**Medium**	**High**	**Very High**
Magnitude	**Low**	**Negligible**	**Minor**	**Moderate**	**Moderate**
	Medium	**Negligible**	**Minor**	**Moderate**	**Major**
	High	**Minor**	**Minor**	**Moderate**	**Major**
	Very High	**Minor**	**Moderate**	**Major**	**Major**

It is important to stress that assessment of degree of significance of ecological impacts for a representative site cannot be carried out with the same level of confidence as for a specific site since the geographical conditions of every site play an essential part in determining these impacts. A discussion of the limitations of this approach for GDA is provided in section 3.6 of this sub-chapter.

Positive consequences are identified, but not rated. All positive consequences are identified as opportunities for project enhancement, to provide added value to the outcomes of the project.

3.2.2. Mitigation Measures

Once the impacts are evaluated and their significance determined, mitigation measures are proposed which are designed to prevent and minimise all effects. There are several potential types of mitigation:

- *Prevention*: avoid, relocate, modify the design or not to carry out the development;
- *Minimisation*: modify location, modify design, alter technology adopted, reduce the scale of the development, etc; and
- *Compensation*: provide replacement elements for any lost (e.g. open green spaces, road network, public facilities, enhancement of wildlife and nature conservation elements and habitat creation, etc.).

The optimum order of implementation of mitigation is prevention first, then minimisation and only as a final measure, compensation. National Planning Policy (PPS9) currently emphasises the need for measures to be put in place to ensure that there is no loss of a site's ecological value and biodiversity as a result of any development. Hence the majority of ecological mitigation plans require the inclusion of measures to enhance site ecological value.

Guidance on nature conservation planning policy is currently provided in the Office of the Deputy Prime Minister's Planning Policy Statement 9: Biodiversity and Geological Conservation (PPS9, 2005). This is concerned with protection through the planning system of statutory and non-statutory sites of biodiversity and/or geological conservation value, as well as species protection and biodiversity conservation in the wider environment.

PPS9 sets out a number of key principles, which include the need for up-to-date baseline information, the need for biodiversity to be taken into account at all scales of development planning, the need for appropriate weight to be attached to biodiversity in decision-making, the need to prevent harm to biodiversity and geological interests and the need to promote opportunities for enhancement.

3.2.3. Re-assessment of Residual Impacts

The rating of the impact's degree of significance is the most important step in the EcIA process since it is this rating, which is used to assess whether mitigation is required and also to determine whether mitigation measures have reduced the impact to an acceptable Residual Impact Rating. In the environmental impact assessment, impacts rated as being of negligible or minor significance are considered to be acceptable.

However, it is extremely difficult to re-assess the residual impacts for the study of the GDA because this assessment depends on the geographical location. Thus, the reassessment will be done for the site specific assessment phase.

3.2.4. Ecological Management Plan

It is good practice, as the last chapter of an ecological impact assessment, to include an Ecological Management Plan which brings together all proposed mitigation measures into a single document and, importantly, allocates timescales and responsibilities for their implementation.

3.3. ASSESSMENT OF ECOLOGICAL IMPACTS FOR A REPRESENTATIVE SITE

The assessment of ecological impacts is provided in the following tables (Sub-chapter 12.3 - Tables 2 and 3 for impacts during the construction and operational phases respectively). Each table provides, in a separate column, (a) a list of numbered potential impacts (C for construction and O for operational phase), (b) a note of the project activity to which the impact relates, (c) a description of the ecological receptor which would be affected by the activity, (d) text which describes in words the ecological impact, (e) bullet points describing the type of impact, (f) an assessment of impact magnitude, (g) an assessment of the sensitivity of the ecological receptor and (i) the final rating of the significance of the impact before mitigation.

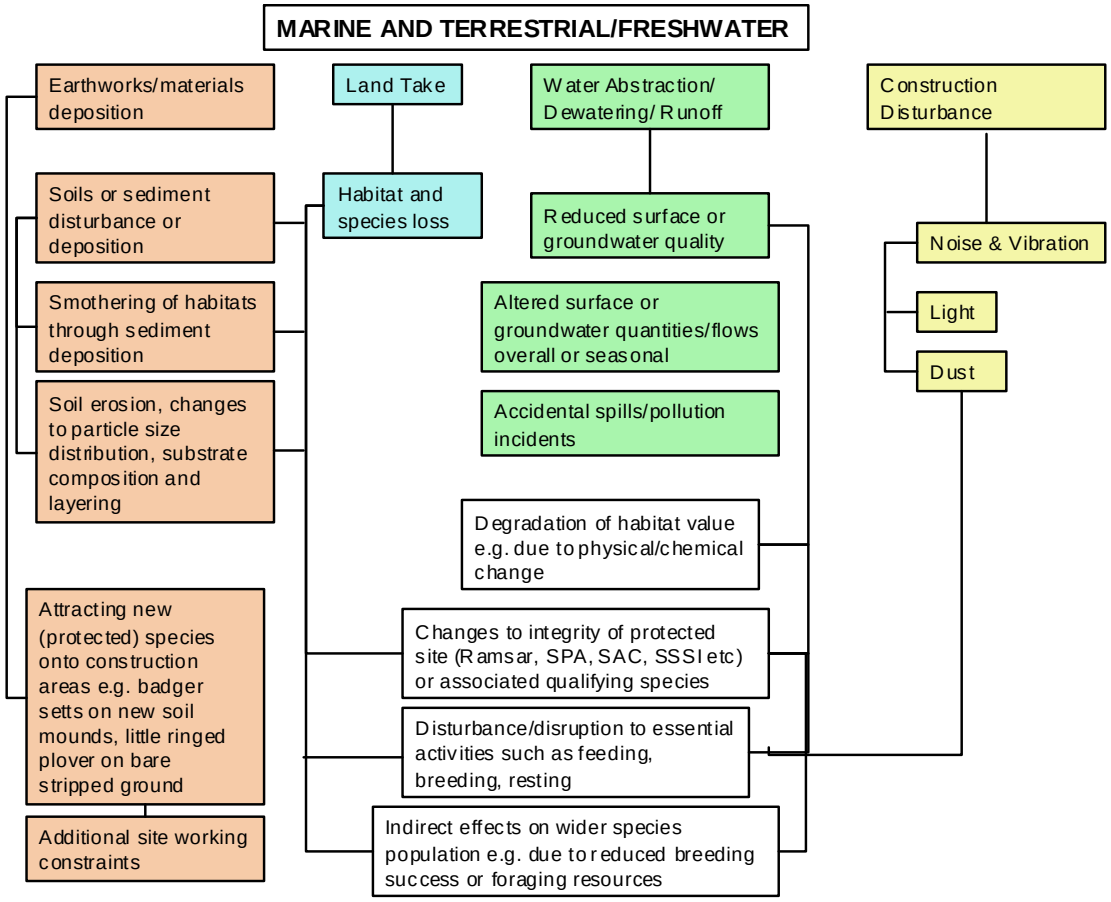
3.3.1. Definition of 'Acceptability' of Significant Impacts

In section 3.2, a statement of the "acceptability" of significant ecological impacts was provided as part of the Ecological Impact Assessment Methodology. Assessment of the acceptability or otherwise of an ecological impact is a matter of professional judgement. Objectivity demands that it cannot be stated if an impact is absolutely acceptable, but instead, what can be stated is the degree of the change that will be induced in an ecological receptor. In an EcIA, the degree of change is provided by the ecologist as guidance to a developer to indicate whether the level of mitigation proposed will be sufficient to satisfactorily minimise the identified impact.

3.3.2. Types of Ecological Impacts

An indication of generic types of ecological impacts caused by construction activities is illustrated in the flowchart below (Sub-chapter 12.3 - Figure 1).

Sub-chapter 12.3 - Figure 1: Illustration of potential generic ecological impacts as a result of construction activities



Notes to accompany Sub-chapter 12.3 - Tables 2 and 3:

1. These generic impact and mitigation tables provide an indication of potential impacts and possible mitigation measures. Detailed impacts can only be predicted and mitigation measures proposed once the specific site(s) are identified. Since affected habitats are assessed generically, a precautionary approach is taken and potential impacts may be higher than for any specific site).

2. These generic tables include potential impacts on freshwater and marine habitats and their associated species caused by both physical and chemical alteration of waters (changes in water quantity, water physical character (e.g. flowing water versus still water), water temperature, water chemical quality (due to sediments from (e.g.) soil erosion, chemicals from operational processes as well as incidental spillages).

3. The term 'Environmental Sensitivity' is used in these table to mean 'ecological receptor'. Key ecological receptors include European and UK protected sites, marine habitats, flora and fauna; terrestrial habitats, flora and fauna and freshwater habitats flora and fauna, whether these are present within a protected site or not.

4. Ecological Impacts are rated according to significance (see methodology in section 3.2). The significance of residual impacts is assessed after the implementation of mitigation measures. Acceptability of residual impacts is usually based on achieving a significance rating of Minor or less. For this GDA, a precautionary approach is adopted and for certain potential ecological impacts it has not been possible to achieve a rating of minor or less since (a) site specific environmental and ecological information is required and (b) insufficient information is currently available about the proposed construction and operational activities. In addition, negotiation is always required with SNCOs and Local Planning Authorities, as well as the developer's construction and operational teams to (i) design appropriate mitigation strategies and (ii) to ensure that proposed mitigation measures are feasible and appropriate.

Sub-chapter 12.3 - Table 2: Potential ecological impacts during the construction phase

Impact No.	Project Activity	Potential Environmental Sensitivity	Potential Impact	Description	Potential Magnitude	Sensitivity/ Value	Impact Rating (before mitigation)
C1	Land Take - Terrestrial and marine: - Permanent; and - Temporary (during construction phase). Including the following examples: (a) Land take for the construction of reactor, temporary and permanent buildings, associated plant and intake and outfall structures; (b) Land take for access road; (c) "Land" take for construction of marine off-loading facility (MOLF); (d) Land take for laydown of construction materials; and (e) Land take for site construction compound.	Any international, European or UK protected sites (Ramsar, SPA, SAC or SSSI) lying within or adjacent to the site. Terrestrial and near-shore marine habitats which make up the designated site as well as separate, non-statutory habitats, including: sand dunes, coastal neutral grasslands, ephemeral short perennial vegetation, agricultural land, hedgerow, deciduous or mixed woodland, wetland, saline lagoon, pond, freshwater stream or ditch; saltmarsh, mudflat, sandflat, littoral rock, littoral sediment habitats. Protected species within or adjacent to areas of land take.	Damage to the integrity of the designated site and/or its qualifying features. Loss of different vegetation communities and littoral sediment and rock communities, due to land take for the reactor, buildings, plant and structures, access road and MOLF. Loss or reduction in population of protected species due to loss of habitat used for foraging, breeding, etc. Reduction in future recruitment and breeding success.	• Negative; • Direct and/or indirect; • Local, regional or national; • Long term; and • Irreversible.	Very high	Medium to High	Moderate to Major

Sub-chapter 12.3 - Table 2: Potential ecological impacts during the construction phase (continued)

Impact No.	Project Activity	Potential Environmental Sensitivity	Potential Impact	Description	Potential Magnitude	Sensitivity/ Value	Impact Rating (before mitigation)
C2	Dumping or laydown of earthworks and construction wastes (terrestrial locations only). See also land take above.	Any international, European or UK protected sites (Ramsar, SPA, SAC or SSSI) lying within or adjacent to the site and their associated terrestrial and near-shore marine habitats, including: sand dunes, coastal neutral grasslands, ephemeral short perennial vegetation, agricultural land, hedgerow, deciduous or mixed woodland, wetland, saline lagoon, pond, freshwater stream or ditch; saltmarsh.	Smothering of natural vegetation communities (e.g. sand dune, coastal grassland, saltmarsh, and short ephemeral vegetation, etc.) due to uncontrolled dumping of construction wastes and earthworks excavation spoil.	• Negative; • Direct; • Local; • Long-term; and • Reversible or Irreversible.	Medium to High	High	Moderate to Major
C3	Generation of dust from construction activities such as earthmoving, handling of sediments and soil, building construction and road foundations, etc.	Any international, European or UK protected sites (Ramsar, SPA, SAC or SSSI) lying within or adjacent to the site. Flora and fauna of nearby vegetation communities, including potentially saline lagoon, freshwater ponds, streams or ditches, sand dune, coastal grassland and saltmarsh as well as near-shore marine habitats.	Deposition of dust on leaves of plants and on the surface of water bodies, leading to damage of plants, invertebrates and predators such as birds, bats, small mammals, amphibians, reptiles and fish.	• Negative; • Indirect; • Local; • Short-term; and • Reversible.	Medium	Medium to High	Minor to Moderate

Sub-chapter 12.3 - Table 2: Potential ecological impacts during the construction phase (continued)

Impact No.	Project Activity	Potential Environmental Sensitivity	Potential Impact	Description	Potential Magnitude	Sensitivity/ Value	Impact Rating (before mitigation)
C4	(a) Construction of buildings, access of roads, and parking areas (hard surfaces); and	Near-shore marine and on-shore freshwater biology (e.g. in ponds, streams or ditches) and saline communities of saltmarsh and mudflats, particularly where these communities lie within any international, European or UK protected area (SPA, SAC, Ramsar or SSSI) within or adjacent to the site.	Increased surface runoff from hard surfaces leading to soil erosion and changes in water quality, particularly sedimentation, with possible deposition of sediments into freshwater or near shore marine habitats erosion of saltmarsh and mudflat.	• Negative; • Direct; • Local; • Long-term; and • Irreversible.	High	Very high	Major
	(b) Drainage and runoff from earthworks and earthmoving activities.				Medium	High	Moderate
C5	Drainage and runoff from earthworks and earthmoving activities.	Vegetation communities (sand dune, coastal grassland, ephemeral short perennials and saltmarsh), particularly where these communities lie within ay international, European or UK protected area (SPA, SAC, Ramsar or SSSI) within or adjacent to the site.	Increased surface runoff and soil erosion, with possible damage to vegetation communities and possible deposition of sediments Possible pathway for polluted runoff including oils and chemicals with potential to damage the natural environment.	• Negative; • Direct; • Local; • Long-term; and • Reversible or Irreversible.	Medium	Medium to High	Minor to Moderate

Sub-chapter 12.3 - Table 2: Potential ecological impacts during the construction phase (continued)

Impact No.	Project Activity	Potential Environmental Sensitivity	Potential Impact	Description	Potential Magnitude	Sensitivity/ Value	Impact Rating (before mitigation)
C6	Creation of spoil from earthworks and excavation of underground facilities.	Potential use of fresh spoil and/or excavated soil by badger – creating new setts.	Creation of new setts in excavated spoil by badgers could lead to delays in construction activities while badgers are excluded and setts removed or translocated.	• Negative; • Direct; • Local; • Short-term; and • Reversible.	Low to Medium	High	Moderate to Major
C7	Water abstraction from the local environment, required for concrete making, vehicle, plant and equipment washing, etc. Dewatering for excavations.	Nearby ponds, streams or ditches, particularly where these habitats lie within an international, European or UK protected area (SPA, SAC, Ramsar or SSSI) within or adjacent to the site.	Impacts on surface and groundwater quality and quantity through localised lowering of water table, discharge of water from construction site/dewatering activities. Effects on flows in local watercourses indirectly damaging aquatic flora and fauna. Possible abstraction of water from local surface water bodies or abstraction of water from groundwater feeding these water bodies, to be used for concrete making, vehicle, plant or equipment washing. Subsequent discharge dirty washing waters into local surface waters. Possible water abstraction or discharge of dirty water into a European or UK protected site (SPA, SAC, and SSSI).	• Negative; • Direct; • Local; • Short-term; and • Reversible.	Low	Very high	Moderate

Sub-chapter 12.3 - Table 2: Potential ecological impacts during the construction phase (continued)

Impact No.	Project Activity	Potential Environmental Sensitivity	Potential Impact	Description	Potential Magnitude	Sensitivity/ Value	Impact Rating (before mitigation)
C8	Noise and vibration from construction activities, including, but limited to the following: (a) Noise and vibration from activities such as blasting, piling, drilling foundations, as well as tunnelling activities and/or pipe laying activities for the cooling water intake; (b) Noise and vibration from construction machinery, activities and workforce; and (b) Noise from construction vehicles and additional site traffic.	Qualifying species for international, European or UK protected area (Ramsar, SPA, SAC or SSSI) within or adjacent to the site. Offshore: marine mammals (including cetaceans, seals, otter), possibly fish and benthic invertebrates, wintering and feeding birds Onshore: breeding feeding and over-wintering birds, burrowing animals such as badger (Meles meles).	Disturbance offshore to breeding, feeding, loafing (birds) or migration routes, due to noisy and vibrating earthworks or construction activities for a range of species. Disturbance to marine mammals, possibly fish, and benthic invertebrates. Onshore disturbance to breeding, feeding activities For protected and biodiversity priority species. Disruption to established movement routes/flight lines.	• Negative; • Direct; • Local; • Short-term; and • Reversible.	Medium	High	Moderate
C9	Increased light levels and new light from construction activities (onshore and offshore).	Offshore wintering bird populations, possibly fish and marine mammals (including cetaceans, seals and otter) as well as onshore breeding birds and roosting bats, particularly where these species lie within a international European or UK protected area (Ramsar, SPA, SAC or SSSI) within or adjacent to the site.	Disturbance to roosting and foraging wintering birds offshore, disturbance to fish and possibly marine mammals, as well as breeding birds and roosting bats onshore due to light from construction activities including construction of the MOLF, and from vehicles.	• Negative; • Direct; • Local; • Short-term; and • Reversible.	Low to Moderate	High	Minor to Major

Sub-chapter 12.3 - Table 2: Potential ecological impacts during the construction phase (continued)

Impact No.	Project Activity	Potential Environmental Sensitivity	Potential Impact	Description	Potential Magnitude	Sensitivity/ Value	Impact Rating (before mitigation)
C10	Construction of marine off-loading facility (MOLF) and associated vehicle and/or boat activities.	Littoral and sub-littoral sediment and rock habitats and associated species, especially marine mammals, fish and possibly also benthic invertebrates, particularly where these habitats lie within an international, European or UK protected area (SPA, SAC, Ramsar or SSSI) within or adjacent to the site.	Loss of, or damage to, littoral and sub-littoral sediment and rock habitats and associated species, due to construction of MOLF.	• Negative; • Direct; • Local; • Long-term; and • Irreversible.	Medium	High	Moderate to Major
C11	Sediment discharge and/or disturbance due to excavations, piling, etc. associated with construction of the marine off-loading facility.	Littoral and sub-littoral sediment and rock habitats and associated species, including fish, marine cetaceans, seals, otter and benthic invertebrates, etc. particularly where these habitats and species lie within an international, European or UK protected area (SPA, SAC, Ramsar or SSSI) within or adjacent to the site.	Deposition of sediment leading to damage of littoral and sub-littoral sediment and rock habitats and associated marine species due to offshore 'earthworks' associated with the construction of the MOLF. Changes to sediment layers and/or particle size distribution indirectly impacting species of flora and fauna inhabiting sediments. Smothering of vegetation communities (e.g. sand dune, coastal grassland, saltmarsh, and short ephemeral vegetation, etc).	• Negative; • Direct; • Local; • Short to long term; and • Reversible.	Medium	High	Moderate to Major

Sub-chapter 12.3 - Table 2: Potential ecological impacts during the construction phase (continued)

Impact No.	Project Activity	Potential Environmental Sensitivity	Potential Impact	Description	Potential Magnitude	Sensitivity/ Value	Impact Rating (before mitigation)
C12	Incidental spillages of fuels, oils, chemicals, cement, concrete, etc. from equipment, heavy plant and vehicles.	Groundwater quality, surface water quality, near shore marine water quality, nearby vegetation communities (including sand dune, coastal grassland, ephemeral short perennial vegetation and saltmarsh), as well as their associated species (such as wintering and wading birds, marine mammals, fish, benthic invertebrates, terrestrial and aquatic species, including aquatic invertebrates, amphibians and reptiles, freshwater fish, ground burrowing animals such as mole, badger, etc.), particularly where these communities and species lie within an international, European or UK protected area (SPA, SAC, Ramsar or SSSI) within or adjacent to the site.	Damage to ground waters, surface waters (impaired water quality), damage (pollution) of vegetation communities (sand dune, saltmarsh, coastal grassland, ephemeral short perennial vegetation) and damage to freshwater biology and near shore marine biology, including their associated species, such as fish and marine mammals, wintering and wading birds due to incidental spillages of fuels, oils, chemicals and potentially polluting materials such as concrete.	• Negative; • Direct; • Local or more widespread; • Short to Long term; and • Reversible or irreversible.	Medium	High to Very high	Moderate to Major

Sub-chapter 12.3 - Table 3: Potential ecological impacts during the operational phase

Impact No.	Project Activity	Environmental Sensitivity	Potential Impact	Description	Magnitude	Sensitivity/ Value	Impact Rating (before mitigation)
O1	Intake of water from near shore estuarine or marine location for cooling purposes.	Near shore littoral and sub-littoral rock and sediment habitats (around the cooling water intake), plus associated marine species, especially fish, particularly where these habitats and species lie within an international, European or UK protected area (Ramsar SPA, SAC or SSSI) within or adjacent to the site.	Damage to littoral and sub-littoral habitats and associated marine species, particularly fish kills, as a result of water intake for cooling. Scour and localised changes to substrate and/or sediment composition causing indirect impacts on the flora and fauna therein.	• Negative; • Direct; • Local; • Long-term; and • Irreversible.	Medium to High	Medium to High	Moderate to Major
O2	Discharge of warm water (from reactor cooling). Temperature elevated to approximately 14-21°C.	Near shore littoral and sub-littoral rock and sediment habitats, plus associated marine species, especially fish, particularly where these habitats and species lie within an international, European or UK protected area (SPA, SAC, Ramsar or SSSI) within or adjacent to the site.	Possible alteration of the zonation and distribution of certain littoral and sub-littoral habitats and associated marine species, and possible alteration of distribution and routes taken by fish and marine cetaceans as a result of the discharge of warm water from cooling. Indirect impacts on marine food resources at a local level. Water quality changes due to inputs.	• Negative; • Direct; • Local; • Long-term; and • Irreversible.	Medium	High	Moderate to major
O3	Drainage and runoff from new areas of hardstanding (building roofs, roads and parking areas).	Increased surface water runoff and drainage into surface water bodies (ponds, streams, ditches) and near shore marine habitats, including saltmarsh and littoral or sub-littoral sediment and rocky habitats. Especially important where these habitats and species lie within an international, European or UK protected area (SPA, SAC, Ramsar or SSSI) within or adjacent to the site.	Increased surface runoff from hard surfaces leading to soil erosion, scour and erosion of saltmarsh and mudflat. Reduced water quality, particularly ponds, streams and ditches as well as near shore marine waters. Possible deposition of eroded sediment onto protected habitats and vegetation communities, potentially smothering protected species, such as sediment invertebrates.	• Negative; • Direct; • Local; • Medium to Long-term; and • Irreversible.	Medium	High	Moderate

Sub-chapter 12.3 - Table 3: Potential ecological impacts during the operational phase (continued)

Impact No.	Project Activity	Environmental Sensitivity	Potential Impact	Description	Magnitude	Sensitivity/ Value	Impact Rating (before mitigation)
O3			Effects of additional un-attenuated site runoff on local receiving watercourse flows during storm events causing bank erosion, substrate changes and indirect impacts on aquatic species composition.				
O4	Noise and possibly vibration disturbance from plant and site activities, site personnel and vehicles and the use of the MOLF should this be required during the operational phase.	Wintering bird populations roosting and foraging in adjacent saltmarsh and mudflat areas and possibly fish and marine mammal populations, particularly if the site lies within or adjacent to an international, European or UK protected area (SPA, SAC, Ramsar or SSSI).	Disturbance offshore to breeding, feeding, loafing (birds) or migration routes, due to noise from plant activities, MOLF activities, site deliveries, vehicles and personnel. Disturbance to marine mammals, possibly fish, and benthic invertebrates. Onshore disturbance to breeding, feeding activities for protected and biodiversity priority species. Disruption to established movement routes and/or flight lines.	• Negative; • Direct; • Local; • Long-term; and • Reversible.	Medium	High	Moderate
O5	Light from plant, vehicle and MOLF activities (possibly 24 hours).	Wintering bird populations and possibly also fish and marine mammal populations, particularly if the site lies within or adjacent to an international, European or UK protected area (SPA, SAC, Ramsar or SSSI).	Disturbance of roosting and foraging wintering birds and possibly also fish and marine mammal populations. Also terrestrial mammals due to light from plant, vehicle and MOLF activities.	• Negative; • Direct; • Local; • Long-term; and • Reversible.	Low	High	Moderate

3.4. ECOLOGICAL MITIGATION MEASURES AND RE-ASSESSMENT OF RESIDUAL IMPACTS FOR THE REPRESENTATIVE SITE

The description of mitigation measures for each identified impact is provided in the following tables (Sub-chapter 12.3 - Tables 4 and 5 for impact mitigation during the construction and operational phases respectively). Each table provides, in a separate column, (a) a list of numbered potential mitigation measure (MC for construction and MO for operational phase), (b) text which describes in words the potential ecological impact, (c) text which in words describes the possible mitigation measure for that impact.

However, within GDA it is extremely difficult to re-assess the residual impacts because this assessment depends on the geographical location. Thus, the re-assessment will be done for the site specific assessment phase.

Sub-chapter 12.3 - Table 4: Mitigation measures for the construction phase

Impact No.	Potential Impact	Possible Mitigation
MC1	Loss of different vegetation communities and littoral sediment and rock communities, due to land take for the new plant, access road and MOLF. Loss of terrestrial habitat. Loss of marine and/or shoreline habitat.	Adequate mitigation may require additional land take to be set aside as compensation habitat specifically managed to recreate or safeguard habitat similar to that lost. To compensate for land take and associated loss of vegetation communities, semi-natural plantings can be included within the site boundary of the new development. Plantings will be in keeping with the coastal and estuarine plant communities that are found along marine/estuarine coasts, particularly coastal grasslands. A degree of screening of the site will be provided using appropriate locally sourced native shrub and tree plantings along the new coastal path. Prior to the start of MOLF construction, a MOLF construction plan will be designed to address ways of minimizing the area of seabed space impacted and will plan tightly designated zones for transport of construction materials and personnel, thus minimizing the loss or damage of any littoral and sub-littoral habitats and species.
MC2	Smothering of natural vegetation communities (e.g. sand dune, coastal grassland, saltmarsh, and short ephemeral vegetation, etc.) due to uncontrolled dumping of construction wastes and earthworks excavation spoil.	Strict adherence to the Environmental Management Plan (and Construction Phase Environmental Management Plan) and agreement of mitigation measures with statutory bodies, will ensure that impacts are mitigated adequately. Mitigation is likely to include a range of different measures, including the following examples: An assessment of least sensitive areas will be made to allow the planning and designation of places specifically for the laydown of materials, construction wastes and spoil. These will be confined at all times to the designated areas. A strict code of good environmental working practices will be implemented on site. A key aspect of this code will be the responsible management of construction and other wastes, including designation of waste storage locations on site and careful containment of all waste types, together with detailed and regular logging of wastes exported from site and confirmation of deposition of these wastes in a properly regulated manner. These measures will prevent the uncontrolled dumping of construction materials/wastes on areas of existing vegetation. A monthly monitoring programme throughout the excavation and construction period will assess the status of all areas of protected habitats and vegetation communities, including littoral habitats. This monitoring programme will include inspections of community ‘condition’, including damage due to soil erosion, sediment deposition, incidental spillages of fuels, oils or chemicals, laydown or dumping of wastes, etc. A key aspect of the good working code will be the responsible management of construction and other wastes, including designation of waste storage locations on site and careful containment of all waste types, together with detailed and regular logging of wastes exported from site and confirmation of deposition of these wastes in a properly regulated manner. These measures will prevent the uncontrolled dumping of construction materials/wastes on areas of existing vegetation. Prior to commencement of construction activities, areas of protected habitats and vegetation will be fenced off, allowing at least 25 m buffer zone around each area. The purpose of this temporary fencing will be to prevent access of heavy plant, vehicles or the workforce into or around any protected areas (particularly any international European or UK protected site (Ramsar SPA, SAC, SSSI).

Sub-chapter 12.3 - Table 4. Mitigation measures for the construction phase (continued)

Impact No.	Potential Impact	Possible Mitigation
MC2		An assessment of least sensitive areas will be made to allow the planning and designation of places specifically for the laydown of materials, construction wastes and spoil. These will be confined at all times to the designated areas. The information on access routes, storage areas, excluded sensitive locations, etc. will all be set out on a Site Working Areas Plan. A monitoring programme (frequency to be agreed depending on receptor concerned) throughout the excavation and construction period will assess the status of all areas of protected habitats and vegetation communities, including littoral habitats. This monitoring programme will include inspections of community 'condition', including damage due to soil erosion, sediment deposition, incidental spillages of fuels, oils or chemicals, laydown or dumping of wastes, etc. Contingency plans will be drawn up and set in place, which will be activated should monitoring identify 'triggers' that show adverse impacts are in danger of occurring.
MC3	Deposition of dust on leaves of plants and on the surface of water bodies, leading to damage of plants, invertebrates and predators such as birds, bats, small mammals, amphibians, reptiles and fish.	Standard dust suppression measures will be agreed with the Local Planning Authority and statutory bodies as appropriate and will include water spraying, wheel washing, covering loads on lorries, wetting or stabilising spoil mounds, etc. such measures will be used during all dry and windy weather conditions. Dust suppression is also subject to controls from the Local Authority and controls would be included in a Construction Environmental Management Plan.
MC4	Increased surface runoff from hard surfaces and runoff from earthworks, and leading to soil erosion and changes in water quality, particularly sedimentation, with possible deposition of sediments into freshwater or near shore environments.	A strict code of good environmental working practices will be implemented on site. This will include a programme of appropriate mitigation measures which is recommended to prevent or minimise significant impacts in relation to drainage and impacts on watercourses, water bodies and the sea. During the construction phase, such measures as the strict enforcement of environmentally acceptable working practices, particularly the implementation of guidance provided in Environment Agency Pollution Prevention Guidance Notes (PPGs), Numbers 1-8 and 21, CIRIA Report C532: Control of Water Pollution from Construction Sites, CIRIA Report C502: Environmental Good Practice on Site, BS6031: 1981 Code of Practice for Earth Works, Good Practice Guide for Handling Soils (MAFF 2000), Local and Regional Land Drainage Byelaws, will minimise adverse effects to soils and waters. In addition, works will comply with a range of environmental legislation relevant for the protection of the water environment and both freshwater and marine biology, including the Control of Pollution Act 1974, EC Dangerous Substances Directive (76/464/EEC), EC Fisheries Directive (78/659/EEC), Environment Protection Act 1990, Land Drainage Act 1991, Environment Act 1995, Groundwater Regulations 1998, UK Water Quality (Water Supply) Regulations 2000 and the Water Framework Directive (2000/60/EC). Site activities during both construction and operation will adhere strictly to these regulations and the efficacy of mitigation measures will be checked by a robust environmental and ecological monitoring programme. Where any non-compliance is identified or any adverse impacts on terrestrial, aquatic or marine ecology observed, a reassessment will be made of the implemented mitigation and modifications made to ensure future compliance. A Drainage Management Plan will be agreed with the Environment Agency as required. Surface water runoff and pumped groundwater from the site will be controlled during the earthworks and/or excavation and construction activities. Discharge locations will be carefully planned to avoid sensitive habitats and species and to avoid discharging into European or UK protected sites.

Sub-chapter 12.3 - Table 4. Mitigation measures for the construction phase (continued)

Impact No.	Potential Impact	Possible Mitigation
MC4		A water quality monitoring programme will run throughout the pre-construction, excavation and construction periods. This monitoring programme will include near-shore marine water quality. As dictated by best practice, the water quality monitoring programme will include freshwater aquatic invertebrate monitoring and benthic invertebrate monitoring since populations of these organisms provide better indications of longer term water quality than one-off sampling and chemical analysis. The finished site will include areas of green open space and inclusion of SUDs elements where feasible (in line with EA guidance), with areas of high infiltration capacities to reduce runoff from these parts of the site and to retain soil moisture on site, particularly during periods of drought.
MC5	Increased surface runoff from hard surfaces leading to soil erosion and changes in water quality, particularly sedimentation, with possible deposition of sediments into freshwater or near shore marine habitats erosion of saltmarsh and mudflat.	The formal surface water drainage system will intercept surface runoff on site and route it to discharge away from any international, European or UK designated site and any of protected habitats and species. The formal surface water drainage system will prevent any runoff or discharge from causing erosion of saltmarsh, mudflat or other vegetation communities. The regular vegetation inspection programme (see mitigation proposals in C2) will check for any erosion damage or sediment deposition. Prior to the start of construction, a Construction Environmental Contingency Plan will be developed to address any potential need for remediation works such as re-vegetation, reinstatement of biodiversity etc. If any habitat damage is found during site inspections, the plan would be activated immediately.
MC6	Creation of new setts in excavated spoil by badgers (Meles meles) could lead to delays in construction activities while badgers are excluded and setts removed or translocated.	If badgers (Meles meles) have been shown to be present in the area, all areas of excavation and construction should be exclusion fenced to prevent access to the area by badgers. The fencing specification should be as required by the Statutory Nature Conservation Organisation (SNCO) (either Natural England (NE) or the Countryside Council for Wales (CCW)).

Sub-chapter 12.3 - Table 4. Mitigation measures for the construction phase (continued)

Impact No.	Potential Impact	Possible Mitigation
MC7	Possible abstraction of water from local surface water bodies or abstraction of water from groundwater feeding these water bodies, to be used for concrete making, vehicle, plant or equipment washing. Subsequent discharge dirty washing waters into local surface waters. Possible water abstraction or discharge of dirty water into a European or UK protected site (SPA, SAC, and SSSI).	Water for vehicle and equipment washing and for concrete mixing will be sourced from a sustainable source and agreed in advance with the appropriate Local Planning Authority, the Environment Agency and the appropriate Water Company. Water abstraction from any local surface water sources or from any source within a European of UK protected site will be prevented. All potentially polluted water from vehicle/equipment washing will be disposed of sustainable and agreed in advance with the appropriate Local Planning Authority, the Environment Agency, the appropriate SNCO and the appropriate Water Company. Dirty water discharge into any local surface water body or European of UK protected site will be prevented. The water quality monitoring programme (see mitigation proposed in MC4) will test for violation of acceptable water quality standards. If any exceedances are found, the Construction Environmental Contingency Plan will be invoked to address and implement remedial actions.
MC8	Disturbance offshore to marine mammals, possibly fish, benthic invertebrates and roosting wintering birds as well as onshore to breeding birds or burrowing animals such as badger (Meles meles), due to noisy and vibrating earthworks or construction activities.	A noise and vibration mitigation plan for the construction phase will be negotiated and agreed with the appropriate SNCO, the Environment Agency, and the Local Planning Authority to ensure that there are no unacceptable effects on fish, marine mammals and wintering birds, particularly where the site lies within or adjacent to a European or UK protected area (SPA, SAC or SSSI). A noise and vibration monitoring programme for both pre-construction and construction will be agreed with the relevant SNCO, the EA and the Local Planning Authority. Data collected will be compared to baseline monitoring data prior to development. Noise and vibration monitoring during the construction phase is likely to span the period of highest noise and vibration emissions – i.e. any on shore excavations, blasting, drilling, piling, etc. and any marine/offshore blasting, tunnelling, piling for the MOLF, etc. Action trigger levels will be set and action(s) required if triggers are hit (such as monitoring with a purpose to ensure acceptable levels are achieved) will be agreed with the relevant authorities (EA and LPA).
MC9	Disturbance to roosting and foraging wintering birds offshore, disturbance to fish and possibly marine mammals, as well as breeding birds and roosting bats onshore due to light from construction activities, including construction of the MOLF, and from vehicles.	A light mitigation plan for the construction phase will be negotiated with the appropriate SNCO, the Environment Agency and the Local Planning Authority to ensure that there is no unacceptable effects on fish, marine mammals and wintering birds, particularly where the site lies within or adjacent to a European or UK protected area (SPA, SAC or SSSI).

Sub-chapter 12.3 - Table 4. Mitigation measures for the construction phase (continued)

Impact No.	Potential Impact	Possible Mitigation
MC10	Loss of or damage to littoral and sub-littoral sediment and rock habitats and associated species, due to construction of MOLF.	Prior to the construction phase commencing, a construction management plan for the MOLF will be agreed with the appropriate SNCO, the Environment Agency and the Local Planning Authority to ensure that there is no unacceptable damage to any protected international, European or UK site or to any littoral and sub littoral habitats or species. The plan is likely to address avoidance of protected areas and habitats, sensitive areas and species, timescales for different construction activities, equipment to be used and selection of least damaging construction methodologies and materials.
MC11	Deposition of sediment leading to damage of littoral and sub-littoral sediment and rock habitats and associated marine species due to offshore 'earthworks' associated with the construction of the MOLF.	Prior to the construction phase commencing, a construction management plan for the MOLF will be agreed with the appropriate SNCO, the Environment Agency and the Local Planning Authority to ensure that there is no unacceptable damage to any protected European or UK site or to any littoral and sub-littoral habitats or species. The Plan will have included a series of sediment control measures and monitoring.
MC12	Damage to ground waters, surface waters (impaired water quality), damage (pollution) of vegetation communities (sand dune, saltmarsh, coastal grassland, ephemeral short perennial vegetation) and damage to freshwater biology and near shore marine biology, including their associated species, such as fish and marine mammals, wintering and wading birds, etc. due to incidental spillages of fuels, oils and chemical such as concrete, etc.	A code of good environmental working practices will be strictly implemented on site. These will be explicit within the EMP for the construction phase of the development. All guidance referred to in MC 4 will apply. Measures will include guidance on best working methods, waste management, activities of site personnel and regular inspections of vehicles and equipment. A key aspect of this code will be the careful storage on site of all fuels and chemicals in a designated area with appropriate containment, capable of containing a catastrophic spill. All vehicles will be refuelled in a designated refuelling area with impermeable hardstanding surface and peripheral interceptor drains with integral oil interceptors.

Sub-chapter 12.3 - Table 5: Mitigation measures for the operational phase

Impact No.	Impact	Possible Mitigation
MO1	Damage to littoral and sub-littoral habitats and associated marine species, particularly fish kills, as a result of water intake for cooling.	Using results of recent research studies into fish kills at the cooling water intakes for coastal nuclear power plants in the UK, a location and design for the intake will be agreed with the appropriate SNCO, the Environment Agency and the Local Planning Authority to ensure that there is no unacceptable damage to any protected European or UK site or to any littoral and sub-littoral habitats or species.
MO2	Possible alteration of the zonation and distribution of certain littoral and sub-littoral habitats and associated marine species, and possible alteration of distribution and routes taken by fish and marine cetaceans as a result of the discharge of warm water from cooling.	The design and location of the thermal water discharge point will be agreed in advance with the appropriate SNCO, the Environment Agency and the Local Planning Authority to ensure that there is no unacceptable damage to any protected European or UK site or to any littoral and sub-littoral habitats or species.
MO3	Increased surface runoff from hard surfaces leading to soil erosion, erosion of saltmarsh and mudflat and possible damaged water quality, particularly ponds, streams and ditches as well as near shore marine waters. Possible deposition of eroded sediment onto protected habitats and vegetation communities, potentially smothering protected species, such as sediment dwelling invertebrates.	The surface water drainage system for the new development will be designed to intercept all runoff waters and discharge them into the thermal water discharge point. This could cause potential water quality changes to discharged cooling and drainage water – salinity and chemical composition etc. As above, the design and location of the thermal water discharge point and any necessary pre-treatment such as interceptors or filters, as well as procedures to follow in event of incidental spillages, will be agreed in advance with the appropriate SNCO, the Environment Agency and the Local Planning Authority to ensure that there is no unacceptable damage to any protected European or UK site or to any littoral and sub-littoral habitats or species.
MO4	Disturbance offshore to breeding, feeding, loafing (birds) or migration routes, due to noise from plant activities, MOLF activities, site deliveries, vehicles and personnel. Disturbance to marine mammals, possibly fish, and benthic invertebrates. Onshore disturbance to breeding, feeding activities for protected and biodiversity priority species. Disruption to established movement routes and/or flight lines.	An Operational Environmental Management Plan will be drawn up and agreed with the appropriate SNCO, the Environment Agency and the Local Planning Authority for the operations of site and the MOLF in relation to noise, to ensure that there is no unacceptable damage to any protected international, European or UK site, terrestrial protected species or to any littoral and sub-littoral habitats or species.
MO5	Disturbance of roosting and foraging wintering birds and possibly also fish and marine mammal populations due to light from plant, vehicle and MOLF activities.	A management plan will be drawn up and agreed with the appropriate SNCO, the Environment Agency and the Local Planning Authority for the operations of site and the MOLF in relation to light, to ensure that there is no unacceptable damage to any protected international, European or UK site or to any littoral and sub-littoral habitats or species. The Plan is likely to include screening planting around the plant to assist in buffering light spillage from the terrestrial operations.

3.5. CUMULATIVE IMPACT ASSESSMENT

The significance of several impacts each of low magnitude may be cumulatively moderate or even high. The construction and/or operating activities of any development which exists at the time of the EPR Planning Application or whose Planning Application is in the planning process at the same as the construction and/or operational activities of the EPR new build, will be assessed in combination, using the same value/sensitivity evaluations for ecological receptors and professional judgement to evaluate magnitude of the combined effects. The Impact Assessment Matrix will be used as before to attribute a level of significance for each impact.

The interaction of impacts and additive impacts on ecological receptors are described in section 4.

3.6. LIMITATIONS OF THE GDA APPROACH FOR ECOLOGY

Since the geographical characteristics of the representative site location and the ecological characteristic and value of a representative site are unknown, it must be recognised that assessment of degree of significance of ecological impacts cannot be carried out with the same level of confidence as for a specific site.

Site characteristics such as climate and weather conditions, offshore water depth, tidal conditions and currents, topography, geology and soil types, etc. are all important factors which influence the impact assessment. The magnitude of ecological impact on certain receptors is also influenced by the time of year in which potentially damaging activities are carried out.

In addition, the likely presence of a protected habitat or species tells us nothing about the conservation status of the habitat or the abundance or population status of a protected species. These site specific characteristics are vital for a robust and confident assessment of ecological impact since the sensitivity of particular habitats or species to different impacts (and hence the potential magnitude of impacts) will vary in different environments. Accordingly, the impact assessment provided for the GDA study in this document frequently results in a range of impact significance ratings for a single impact. This is an unavoidable outcome of the precautionary approach adopted in this assessment of ecological impacts for the GDA.

For a specific site location, more confidence can be attached to impact assessment and the rating of significance. This allows more accurate specification of mitigation measures in order to prevent or minimise residual impacts and to reduce their significance to acceptable levels.

4. INTERACTION OF ECOLOGY WITH OTHER ENVIRONMENTAL STUDIES

4.1. OTHER EIA STUDIES

The assessment of ecological impacts will interact with a number of other EIA studies, including, but not limited to the following:

- assessment of hydrological impacts and water quality (onshore and coastal/marine);
- assessment of the effects of the thermal plume;
- assessment of the effects of water abstraction;
- assessment of the effects of dredging; and
- assessment of landscape and visual impacts.

In each case where interactions are identified, collaboration between studies will provide a coordinated and consistent approach to impact assessment and the development of compatible mitigation strategies to ensure that impacts are sufficiently mitigated without unnecessary overlap.

4.2. ASSESSMENT OF ADDITIVE IMPACTS ON ECOLOGICAL RECEPTORS

Importantly, there is the potential for additive (in-combination) effects of different subject-specific impacts to act on the same receptor.

The assessment will indicate the additive impact significance level on affected ecological receptor(s). Where two or more significant impacts affect a single receptor, an assessment will be provided of the additive impact significance rating for that receptor. The basic EcIA methodology and the IAM will be used as before, but the magnitude of the additive impact will be assessed by professional judgement, accompanied by appropriate justification.

It is impossible to carry out an assessment of cumulative or additive ecological impacts for the GDA since these will be site specific.

5. DISCUSSION AND CONCLUSION OF THE RESULTS

This ecological impact assessment for the GDA has provided a description of the methodology used and a series of tables describing the outcome of the impact assessment for a representative site during the construction and operational phases of a new nuclear power station based in the UK.

The main results of the impact assessment indicate that there could be potential impacts on habitat integrity and protected species, direct and indirect, temporary (construction phase) and permanent (operational phase), particularly in coastal and near-shore marine environments as a result of construction and operation of a new facility.

A programme of appropriate mitigation measures could be necessary to prevent or minimise significant impacts. Chief amongst them would be the preparation of a Management Plans, designed to manage and control.

During the construction phase, it will be a requirement to comply with all relevant environmental protection legislation and to adhere to the guidance set out by government and statutory agencies such as the Environment Agency, Natural England or the Countryside Council for Wales as well as the Local Authority. It will be necessary to set in place and strictly enforce environmentally acceptable working practices (for example Environmental Agency Pollution Prevention Guidelines (PPGs)), to assist in reducing identified impacts to acceptable levels. In addition, works must comply with a range of environmental legislation relevant for the protection of the water environment and both freshwater and marine biology. These regulations and guidance are provided in Sub-chapter 12.3 - Table 4, Row MC4.

APPENDIX A: IDENTIFICATION OF ECOLOGICAL RECEPTORS FOR A REPRESENTATIVE SITE

GDA ASSESSMENT OF IMPACT ON NATURE CONSERVATION

Notes:

* The third column of this table provides assessment of the likelihood of occurrence in an estuarine or shallow coastal location around the coast of England and Wales. This assessment is based on the comparison of (a) the known locations where these habitats and species exist around the UK coastline, compared to (b) the likelihood of a new nuclear power station being constructed there. This likelihood assessment has three levels: (a) likely, (b) possible, (c) possible but not likely. A brief definition of these levels are as follows:
(a) Likely: the habitat or species has a > 50% chance of being present, due to either its current existence at all known power station sites around the coast of England and Wales.
(b) Possible: the habitat or species has a 10-50% chance of being present.
(c) Possible but not likely: the habitat or species has < 10% chance of being present.

[#] Species receiving the highest protection under UK and European Law (Wildlife and Countryside Act (1981, as amended) and The Conservation (Natural Habitats, &c.) Regulations (1994), respectively. These species are indicated by superscript and are underlined.

[$] Natura 2000 codes are provided for Habitats and Species where appropriate. These are taken from the following web resources:
(a) Habitats: http://www.jncc.gov.uk/Publications/JNCC312/UK_habitat_list.asp
(b) Species: http://www.jncc.gov.uk/Publications/JNCC312/UK_species_list.asp

Colours are used to divide the table into subject areas

Sub-chapter 12.3 - Appendix A - Table 1: Identification of ecological receptors for a representative site

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*	Discussion and/or Comments
[$]Natura 2000 Codes / UK BAP HABITATS			
1150 (partially) otherwise no equivalents / Sub-littoral sands and gravels (including seagrass beds)	• UK BAP; and • Implicit in Statutory Instrument 1994 No. 2716 (The Conservation (Natural Habitats, & c.) Regulations 1994 (as amended) for the designation of Natura 2000 sites.	Likely	Habitat types and their maintenance in good condition is considered to the key to conservation of protected species. The Ecological Impact Assessment process would therefore involve three stages: Stage 1: 'Extended' Phase 1 Habitat survey and mapping (ideally mid April to mid September).
1160, 1170 / Sub-littoral rock (including Sabellaria reefs)		Likely	
1130, 1140, 1170, 1310, 1320, / Littoral sediment (including saltmarsh, mudflats, saline lagoons, etc.)		Likely	

Sub-chapter 12.3 - Appendix A - Table 1: Identification of ecological receptors for a representative site (continued)

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*	Discussion and/or Comments
1160, 1170, 1220 / Littoral rock		Likely	Stage 2: Specialist surveys for protected species (as flagged up by the Phase 1 Habitat survey). Stage 3: Ecological Impact Assessment, including (a) rating the significance of all identified ecological impacts, (b) recommending ecological mitigation measures, and (c) re-assessing residual ecological impacts.
1220, 1230 / Supra-littoral rock (including sea cliffs)		Likely	
1330 / Supra-littoral sediment (including Atlantic salt meadows)		Likely	
1210 / Coastal vegetated shingle		Likely	
2110, 2120, 2130, 2140, 2150, 2160, 2170, 2190 / Coastal sand dune		Likely	
1320, 1330, 1340 / Coastal floodplain grazing marsh		Possible	
1230, Semi-natural neutral grasslands		Likely	
Permanent grazed pasture (no Natura equivalents)		Likely	
Arable land and cultivated field boundaries (no Natura equivalents)		Likely	
Hedgerows (no Natura equivalents)		Likely	
91E0, Wet woodland		Possible	
9130, 9160, 9180, 9190, 91A0 / Deciduous woodland		Likely	
Coniferous woodland (no Natura equivalents)		Possible	
4040, Coastal (lowland) heathland		Possible	
3260 / Rivers and/or streams and types with no Natura equivalents)		Likely	
3130, 3140, 3150 / Pond or lake (and types with no Natura equivalents)		Likely	

Sub-chapter 12.3 - Appendix A - Table 1: Identification of ecological receptors for a representative site (continued)

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*	Discussion and/or Comments
EUROPEAN/UK PROTECTED SPECIES			
BIRDS			
Breeding birds	• WCA (1981) (as amended), Schedule 1; • EU Directive on the Conservation of Wild Birds (The Birds Directive) (Directive 79/409/EC); • BTO (British Trust for Ornithology): Red List of Birds of Conservation Concern, 2002-2007; • Bern Convention (1979); and • UKBAP.	If trees present, possibly moderate to good nesting habitat for farmland, coastal and other common breeding birds. If open coastal grasslands or agricultural fields, then potentially good habitat for roosting and foraging coastal bird species.	Standard survey methodology: minimum requirement would be three return visits between March and end July. For a sensitive site, up to 6 return visits could be required. Coastal species should take into consideration feeding grounds and roosting sites. Fieldwork should span all periods when target species are present during at least one full year. Bird survey method will depend on target species concerned. Guidance on appropriate methods is contained in Gilbert et al (1998) and Bibby et al (2000). Should use the approach of the Common Bird Census (CBC) but sticking to 3 visits. Woodland birds need a specific adapted method to cope with restricted visibility. Nocturnal species have their own methods (Gilbert et al 1998). For winter lowland birds can use transect walking approach over at least three visits. Vantage Point (VP) method may be appropriate when assessing behaviour (e.g. impacts on flight lines) especially raptors.

Sub-chapter 12.3 - Appendix A - Table 1: Identification of ecological receptors for a representative site (continued)

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*	Discussion and/or Comments
Wintering migrant birds		Possibly on mudflats, sandflats, saltmarsh coastal grasslands or inland agricultural fields.	Standard survey methodology: desk based study using existing WeBS data plus habitat appraisal. Minimum of three return visits between end November and early February, with up to 6 return visits for a sensitive site. Wintering and migratory wildfowl method use (Gilbert et al 1998). Survey over at least one winter. Survey should cover autumn migration (September – November) and spring migration (March to mid May) passage birds where they may use land for roosting - they may only stay a week or so, but the stop off point can be vital to a migration. This can include pond/wetland and coastal habitats. Counts should be every week in these cases.
BTO Red and Amber listed bird species		Possible lapwing (Vanellus vanellus), curlew (Numenius arquata), skylark (Alauda arvensis), bullfinch (Pyrrhula pyrrhula), etc.	Should include spring and autumn survey for passage birds where they may use land for roosting - they may only stay a week or so, but the stop off point can be vital to a migration. This can include pond/wetland and coastal habitats.

Sub-chapter 12.3 - Appendix A - Table 1: Identification of ecological receptors for a representative site (continued)

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*	Discussion and/or Comments
Natura 2000 Species Codes / EUROPEAN/UK PROTECTED SPECIES			
MAMMALS AND INVERTEBRATES			
1303, 1304, 1308, 1323 / Bats[#] and several species that do not have any Natura 2000 code.	• WCA (1981) (as amended), Schedule 5; • Statutory Instrument 1994 No. 2716 (The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended); • UK BAP; • The Agreement on the Conservation of Bats in Europe, Bonn 1992; and • Bern Convention (1979) Annexes II and III.	Possible roosts in mature trees (depending on age and condition).	• Survey for hibernation roosts: November to March; • Survey for normal roosts: May to September; • Survey for maternity roosts: August and September; and • Dusk and dawn activity surveys: May to September. The European Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora, 1992 (Habitat and Species Directive) gives the power to designate Special Areas of Conservation (SAC) for certain species which includes the lesser horseshoe bat Rhinolophus hipposideros found in Wales and some of the English border counties. All bats are protected by law (Wildlife and Countryside Act 1981, as amended and the Conservation (Natural Habitats, etc.) Regulations 1994, as amended.
Badger *(Meles meles)*	• Protection of Badgers Act (1992). Any development which involves destroying an active sett or handling animals requires a licence from Natural England or WAG/CCW; and • Some Local BAPs.	Possible	• Survey for foraging activity and territories (bait marking studies): January to March; and • General (screening) survey for presence of setts and activity any spring/summer month.

Sub-chapter 12.3 - Appendix A - Table 1: Identification of ecological receptors for a representative site (continued)

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*	Discussion and/or Comments
EUROPEAN/UK PROTECTED SPECIES			
MAMMALS AND INVERTEBRATES			
Water vole[#] *(Arvicola terrestris)* no Natura 2000 code	• WCA (1981) (as amended), Schedule 5; • Statutory Instrument 1994 No. 2716 (The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended); and • UK BAP.	Possible	• Survey for signs: April to September.
1355 / Otter[#] *(Lutra lutra)* no Natura 2000 code		Possible	• Survey for signs: April to September. It is possible to survey for otter all year round, but constrained in winter by high water flows rather than otter activity. Constrained in summer by density of vegetation growth.
Dormouse[#] *(Muscardinus avellanarius)* No Natura 2000 code		Possible	• Survey for signs: April to September.
Red squirrel[#] *(Sciurus vulgaris)* No Natura 2000 code		Possible	• Red squirrel can be surveyed for all year round, with March- May optimal for survey. July and September optimal for assessment of breeding dreys.
Adder *(Vipera berus)* no Natura 2000 code		Possible	• Survey for basking reptiles: May to June and August to September. Methods from Herpetofauna Workers Manual: generally 6-7 visits. Four Both natural and artificial refugia surveys.
Grass snake *(Natrix natrix)* no Natura 2000 code		Possible	
Slow worm *(Anguis fragilis)* no Natura 2000 code		Possible	

Sub-chapter 12.3 - Appendix A - Table 1: Identification of ecological receptors for a representative site (continued)

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*	Discussion and/or Comments
Common lizard *(Lacerta vivipara)* no Natura 2000 code		Possible	
Sand lizard[#] *(Lacerta agilis)* no Natura 2000 code		Possible	
Natterjack toad[#] *(Epidalea calamita)* no Natura 2000 code		Possible	• Survey for amphibians (particularly GCN): mid March to mid June. Four repeat surveys to determine presence/absence and a further two repeat surveys to determine population size.
1166 / Great crested newt[#] *(Triturus cristatus)*		Possible	
Leatherback turtle[#] *(Dermochelys coriacea)* no Natura 2000 code		Possible	Relatively new winter species to UK waters, possibly summer populations in SW shores (Cornwall and Devon). Will need to take advice from Natural England on appropriate survey techniques and timing.
EUROPEAN/UK PROTECTED SPECIES			
MARINE MAMMALS AND FISH			
	• WCA (1981) (as amended), Schedule 5; • Statutory Instrument 1994 No. 2716 (The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended); • UK BAP; • The OSPAR Convention (1998); and • Bern Convention (1979) Annex III.		Standard survey methodology for inshore fin fish will include trawl netting in August/September. Standard survey for marine mammals.
1106 / Atlantic salmon *(Salmo salar)*		Possible	

Sub-chapter 12.3 - Appendix A - Table 1: Identification of ecological receptors for a representative site (continued)

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*	Discussion and/or Comments
Common Eel *(Anguilla Anguilla)* no Natura code		Possible	
1103 / Twaite shad *(Alosa fallax)*		Possible	
1102 / Allis shad *(Alosa alosa)*		Possible	
1095 / Sea Lamprey *(Petromyzon marinus)*		Possible	
1096 / Brook Lamprey *(Lampetra planeri)*			
1099 / River Lamprey *(Lampetra fluviatilis)*		Possible	
1349 / Common bottlenose dolphin[#] *(Tursiops truncatus)*		Possible	
Striped dolphin[#] *(Stenella coeruleoalba)* No Natura 2000 code		Possible but not likely	
Short beaked common dolphin[#] *(Delphinus delphis)* No Natura 2000 code		Possible	
White beaked dolphin[#] *(Lagenorhynchus albirostris)* No Natura 2000 code		Possible but not likely	
Risso's dolphin[#] *(Grampus griseus)* No Natura 2000 code		Possible but not likely	
1351 / Harbour porpoise[#] *(Phocoena phocoena)*		Possible	
Sperm whale[#] *(Physeter macrocephalus)* No Natura 2000 code		Possible	
Basking shark[#] *(Cetorhinus maximus)* no Natura 2000 code		Possible but not likely	
Short snouted seahorse[#] *(Hippocampus hippocampus)*		Possible	
Spiny sea horse[#] *(Hippocampus guttulatus)*		Possible	

Sub-chapter 12.3 - Appendix A - Table 1: Identification of ecological receptors for a representative site (continued)

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*	Discussion and/or Comments
1364 / Grey Seal *(Halichoerus grypus)*		Possible	
1365 / Common Seal *(Phoca vitulina)*		Possible - characteristic of sandflats and estuaries	
EUROPEAN/UK PROTECTED SPECIES			
Invertebrates			
Starlet Sea anemone[#] *(Nematostella vectensis)*		Possible - associated primarily with saline lagoons on central south coast and Suffolk coast.	Standard survey methodology for benthic invertebrates will include two surveys in late spring/early summer and in late summer/early autumn using grab sampling of sediments. Brook Lamprey - is listed in Annexes IIa and Va of the Habitats Directive, Appendix III of the Bern Convention, and as a Long List Species in the UK Biodiversity Action Plan.
Lagoon sand shrimp *(Gammarus insensibilis)*		Possible	
Lagoon sea slug[#] *(Tenellia adspersa)*			
Fan mussel *(Atrina fragilis)*		Possible but not likely	
Sandbowl snail *(Catinella arenaria)*		Possible but not likely	
Tentacled lagoon-worm[#] *(Alkmaria romijni)*		Possible - associated with intertidal muddy sediments of lagoons and sheltered estuaries	
Lagoon sandworm[#] *(Armandia cirrhosa)*		Possible - only restricted to small number of coastal lagoons in Dorset region	
Pink sea fan (Coral) *(Eunicella verrucosa)*		Possible	

Sub-chapter 12.3 - Appendix A - Table 1: Identification of ecological receptors for a representative site (continued)

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*	Discussion and/or Comments
4035 / Fisher's estuarine moth[#] *(Gortyna borelii lunata)*		Possible but not likely - restricted only to north east Essex coast.	
EUROPEAN/UK PROTECTED SPECIES			
FLORA			
Bluebell *(Hyacinthoides non-scripta)* is the most likely protected plant - but Schedule 8 of the Countryside and Wildlife Act (1981) as amended, is attached as an Appendix to this spreadsheet.	• WCA (1981) (as amended), Schedule 8; • Statutory Instrument 1994 No. 2716 (The Conservation (Natural Habitats, &c.) Regulations 1994; • Bern Convention (1979) (Annex I); and • UK BAP.	Possible	Identified in Phase 1 Habitat surveys (even if carried out as late as June, dead heads will be identified). Protected species, if known in area, are likely to show up on local records databases and BSBI and therefore can be flagged up for survey. Survey would be done at the same time as Phase 1 habitat survey.

Sub-chapter 12.3 - Appendix A - Table 1: Identification of ecological receptors for a representative site (continued)

Identified Sensitive Receptor	Reference	Representative site (Estuarine/Marine)*	Discussion and/or Comments
EUROPEAN/UK DESIGNATED SITES			
DESIGNATED SITES			
European (Natura 2000) sites and SSSIs	• WCA (1981) (as amended), Schedule 8; • Statutory Instrument 1994 No. 2716 (The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended); • EU Directive on the Conservation of Wild Birds (The Birds Directive) (Directive 79/409/EC); and • Ramsar Convention (1975).	Site could be within or adjacent to a Ramsar site, SPA or SAC (international and European designated sites) or SSSI (UK designated sites). Reason for designation likely to be presence of protected habitats such as sand dunes, saltmarsh, sand and mudflats; and the presence of protected species such as wintering migrant birds or migrating fish (such as Atlantic salmon).	In Natura 2000 designated sites (i.e. Ramsar, SPA or SAC sites) an "Appropriate Assessment" is required. This needs to be compiled by the "relevant competent authority" which is usually the Local Planning Authority. The assessment usually is based on the ecological part of the Environmental Statement - but always requires much discussion/meetings (i.e. time). The Appropriate Assessment is very much meant to be a stand alone assessment specifically directed at the potential impact of the project on the integrity of the designated site and the features for which it has been designated (and qualifying species may not be confined to inside the boundary of the designated site).

Sub-chapter 12.3 - Appendix A - Table 2: Comparative classification of inter-littoral marine habitats

JNCC Broad Classification *	UK BAP Broad Habitats *	UK BAP Priority Habitats	Annex I Habitats Directive	Habitats Directive code
Supralittoral Sediment	Supralittoral sediment		Atlantic salt meadows *(Glauco-Puccinellietalia maritimae)*	1330
Supralittoral Rock	Supralittoral rock		Vegetated sea cliffs of the Atlantic and Baltic Coasts	1230
			Perennial vegetation of stony banks	1220
Littoral Sediment	Littoral sediment	Seagrass beds	Mudflats and sandflats not covered by seawater at low tide	1140
		Sabellaria alveolata reefs	Reefs	1170
		Coastal Saltmarsh	*Spartina* swards	1320
		Mudflats	Large shallow inlets and bays	1160
			Estuaries	1130
			Annual vegetation of drift lines	
			Salicornia and other annuals colonising mud and sand	1310
Sublittoral Sediment	Inshore sublittoral sediment	*Sabellaria spinulosa* reefs	Reefs	1170
		Sabellaria alveolata reefs	Large shallow inlets and bays	1160
		Serpulid reefs	Mudflats and sandflats not covered by seawater at low tide	1140
		Sheltered muddy gravels	Coastal Lagoons	1150
		Mudflats	*Salicornia* and other annuals colonising mud and sand	1310
		Saline lagoons	Estuaries	1130
		Sublittoral sands and gravels		
		Maerl beds		
Littoral Rock	Littoral rock	*Sabellaria spinulosa* reefs	Reefs	1170
			Perennial vegetation of stony banks	1220
			Large shallow inlets and bays	1160
Sublittoral *(Infralittoral)* Rock	Inshore sublittoral rock	*Sabellaria spinulosa* reefs	Reefs	1170
			Large shallow inlets and bays	1160
Sublittoral *(Circalittoral)* Rock		*Sabellaria spinulosa* reefs	Reefs	1170

(Habitat Directive Codes and comparative UK NVC communities are provide on the JNCC website: WWW.JNCC.GOV.UK+PAGE-2457)

Notes to Accompany Sub-chapter 12.3 - Appendix A - Table 2 (above):

1) * Refer to Figure 1 from the JNCC Marine Habitat Classification for Britain and Ireland Version 04.05;

2) The UK BAP habitats are cross-referenced with those in Annex I of the Habitats Directive; and

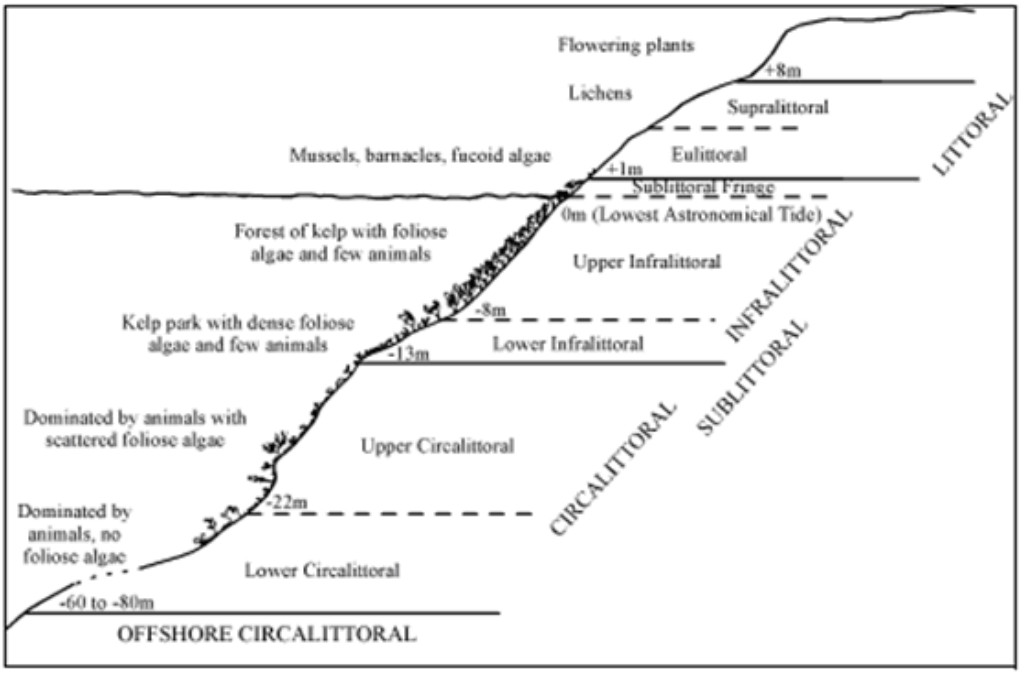
3) Column 1 is equal to column 1 of excel spreadsheet 'GDA - Assessment of Potential Impact on Nature Conservation'.

Brief explanation of UK BAP types and their comparative Natura 2000 Habitat types

The UKBAP broad habitat types divide all littoral habitats into substrate types rather than floral or faunal communities which grow in/on these substrates. The UKBAP priority habitat types are a combination of (a) substrates, (b) geographical feature (e.g. a lagoon) and species (e.g. *Sabellaria* sp). Natura 2000 Habitat types tend to describe the substrate, geographical feature and (occasionally) the relevant species.

Of key importance in both the UK BAP habitat classification and the Natura 2000 habitat classification is the relationship to seal level and inundation frequency. Natura 2000 Habitat types and codes are more clearly compared to UK NVC (National Vegetation Classification) types in the JNCC website (WWW.JNCC.GOV.UK+PAGE-2457) and this comparison is provided in Sub-chapter 12.3 – Appendix A – Table 3 below.

Sub-chapter 12.3 - Appendix A - Figure 1: Profile of a Rocky Shore and Seabed Illustrating the Biological Zones (modified from Hiscock ed. 1996)



Heights and depths given are typical values for south-west Britain. In sediment habitats a similar vertical zonation for the main zones is found.

Sub-chapter 12.3 - Appendix A - Table 3: Framework for the habitat classification - the primary matrix (EUNIS levels 2 and 3)

	Substratum	ROCK				SEDIMENT					
		High energy rock	Moderate energy rock	Low energy rock	Features on rock	Coarse sediment	Sand	Mud	Mixed sediment	Macrophyte dominated sediment	Biogenic reefs
		H x R	M x R	L x R	F x R	CS	Sa	Mu	Mx	Mp	BR
	ZONE	(wave exposed or very tide swept)	(moderately wave-exposed or tide swept)	(wave sheltered and weak tidal currents)	(rockpools, caves)	Mobile cobble and pebble, gravel, coarse sand	Clean sands and non cohesive muddy sands	Cohesive mud and muds	Heterogeneous mixtures of gravel, sand and mud		
LITTORAL	**LITTORAL [L]**	High energy littoral rock	Moderate energy littoral rock	Low energy littoral rock	Features on littoral rock	Littoral coarse sediment	Littoral sand	Littoral mud	Littoral mixed sediment	Littoral macrophyte dominated sediment	Littoral biogenic reefs
	(splash zone strandline and intertidal)	[HLR]	[MLR]	[LLR]	[FLR]	[LCS]	[LSa]	[LMu]	[LMx]	[LMp]	[LBR]
SUBLITTORAL [S]	**INFRA LITTORAL [I]**	High energy infralittoral rock	Moderate energy infralittoral rock	Low energy infralittoral rock	Features on infralittoral rock	Sublittoral coarse sediment	Sublittoral sand	Sublittoral mud	Sublittoral mixed sediment	Sublittoral macrophyte dominated sediment	Sublittoral biogenic reefs
	(shallow subtidal)	[HR]	[MIR]	[LIR]	[FIR]						
	CIRCA LITTORAL [C]	High energy circalittoral rock	Moderate energy circalittoral rock	Low energy circalittoral rock	Features on circalittoral rock						
	(nearshore deeper and offshore subtidal)	[HCR]	[MCR]	[LCR]	[FCR]	[SCS]	[SSa]	[SMu]	[SMx]	[SMp]	[SBR]

Letters in [ ] refer to codes; * indicates where various codes are inserted at a lower level in the hierarchy.

SUB-CHAPTER 12.3 – REFERENCES

External references are identified within this sub-chapter by the text [Ref-1], [Ref-2], etc at the appropriate point within the sub-chapter. These references are listed here under the heading of the section or sub-section in which they are quoted.

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

SUB-CHAPTER 12.4 – IMPACT ON SOCIO-ECONOMICS

1. DURING CONSTRUCTION PHASE

1.1. LOCAL AUTHORITIES CONSULTATION

A proactive approach will be undertaken in presenting the proposals to the Local Authorities and other key stakeholders. A programme of informal public presentations will be implemented through Local Councils as well as other organisations. Local Planning Officers will be a key contact in confirming the socio-economic status of the local area.

The cooperation of a number of agencies is required including the Local Authority directly affected by the Project. It is intended to establish a local Liaison Group to coordinate contacts with local stakeholders. The overall approach to the engagement of stakeholders will be to make contact as early as possible in the site specific process.

The assessment of socio-economic issues will be a key aspect of the Sustainability Appraisal that the UK Government will carry out as part of the development of the Strategic Site Assessment and National Planning Statement for nuclear power. The conclusions of these national and regional assessments will be used as the starting point for the site specific analysis of this topic.

1.2. SOCIO-ECONOMIC IMPACT OF THE BUILDING SITE

A building site of this size alters the local socio-economic situation through:

- the presence of a large and diverse workforce;
- the rise in the number of inhabitants due to the displaced workforce; and
- the increase in local business activity.

Overall, these changes have potential impacts with respect to the following:

- accommodation and reception infrastructure;
- modes of transportation and transportation routes; and
- local and regional economic activity.

The analysis of these potential impacts is based on assumptions drawn from EDF experience acquired from other construction sites in France. Therefore, the figures provided should be considered as a rough guide.

The approach taken to consider the potential effect of the construction site on demographics and on accommodation capacity and infrastructure is based on assumptions that focus on the greatest possible use of the local workforce.

Such assumptions may be influenced by the prevailing national or local economic climate. The potential impacts outlined in this document are therefore considered to be indicative, but would be applicable assuming that:

- Companies engaged in the construction take advantage of the incentives to employ a maximum number of local people; and
- The region's accommodation capacity stimulates the creation of various establishments, even temporary ones.

1.2.1. Impact of building site on socio-economic activities

Two points must be highlighted on an economic level:

- The financial consequences of the demographic inflow; and
- The participation of local and regional companies.

1.2.1.1. Financial consequences of the demographic inflow

For the construction phase, on the basis of the French experiences (latest units built and the current construction of the EPR unit at Flamanville 3), it can be estimated that the construction site would employ up to 2400 people depending on the various construction phases.

The construction site's workforce is difficult to accurately predict because it depends on the construction site's particularities, the organisation adopted by the companies and its adaptation to the schedule's constraints. These provisions will be consolidated when companies are selected by integrating their organisational propositions.

The workforce peak for the EPR construction site is planned during a period where the civil engineering workforce is added to the electromechanical workforce.

A construction project, which lasts approximately six years and employs more than 2000 workers, at its peak period, thus leading to a significant temporary increase in the population, can gradually transform the economy of the region and that of the surrounding area. It is worth noting that the workforce will increase progressively in the first years. The anticipated workforce for the construction is approximately:

- First concrete to be laid (T0): 200 people;
- At T0 + 12 months: 500 people;
- At T0 + 24 months: 1100 people; and
- At T0 + 30 months: 2000 people.

The indicative breakdown of the workforce at its peak period is of 800 persons for civil work, 1200 persons for electromechanical sector and the rest for services and staff in charge of monitoring the construction and commissioning.

The various economic benefits cannot be accurately predicted, but, some partial indicators can be used to allow the prediction of the likely effects.

A significant part of worker and household earnings directly benefits the region around the construction site. It is estimated that 70% of the salary of a worker is spent locally. Such spending therefore represents the injection of several million pounds to the local economy over the construction period.

For the employees of companies involved in building the power plant, the financial benefits from the salaries paid by these companies represent tens of millions of pounds to the local economy given the variations in local spending coefficients (according to local, displaced or foreign employees).

The business sectors which meet the needs of households and the hotel and catering sector are, by far, those sectors which benefit most from the economic consequences of the construction work.

1.2.1.2. Participation of regionally and locally established companies

The production and assembly of a large part of the materials needed to equip the plant are generally beyond the technical capacity of local companies. In most cases, the material's highly specific and technical nature means that production can only be entrusted to national companies that have been able to take on special means adapted to the work required.

Nevertheless, the possibilities for regionally and locally established companies to participate in the project will be examined either through contracts signed directly with the owner, in association or not with national firms, or as subcontract service providers.

The main areas of interest to local companies could be:

- The construction of accommodation and various forms of infrastructure;
- Site development (annex buildings, roadways and various networks);
- Civil engineering: transportation of building materials, other building works and light works;
- Electromechanical engineering: various boiler work equipment, site lighting, site and building electricity; and
- Businesses and services: collective transportation, car repair, site guarding and cleaning.

Under direct contracts with the owner or under a subcontracting agreement with national companies, regionally and locally established companies can therefore take advantage of orders linked directly or indirectly to the construction site.

1.2.2. Impact of the construction on agriculture

The impact on agriculture will be assessed within the site specific phase.

1.2.3. Impact of the construction on personnel accommodation

To calculate the amount of required accommodation, the potential increase in the number of inhabitants has to be estimated. In the context of a French construction site, and on the basis of observations made on several other Nuclear Power Plant (NPP) building sites in France and experience feedbacks gathered by EDF, the following reference figures are given as a rough guide. Indeed, in the UK it could be envisaged that most of the workers engaged in the construction won't relocate with their families. In addition, some of these figures will vary significantly between sites.

- Civil engineering personnel;

  70% of displaced workers live alone and 30% live with their families. Distribution by type of accommodation is approximately the following:

  - hostels: 30%;
  - mobile homes: 20%;
  - apartments – houses - family dwellings: 30%; and
  - hotel bedrooms and furnished bedrooms and/or studio apartments: 0%.

- Electromechanical engineering personnel;

  30% of these workers live alone and 70% live with their families. Distribution by type of accommodation is approximately the following:

  - hostels: 30%;
  - mobile homes: 20%;
  - apartments – houses: 30%; and
  - hotel bedrooms and furnished bedrooms and/or studio apartments : 20%.

- EDF workers;

  Around 10% live alone and 90% with their family.

- Families;

  The average number of children per family is put at 1.3 for civil engineering personnel and 1.4 for EDF and electromechanical engineering personnel. Statistically, the children of building site personnel are younger than the national average corresponding to the same population group.

- Accommodation needs;

  The above figures applied to the provisional building site workforce numbers allow us to evaluate the total demographic inflow.

  On the basis of these assumptions being accurate (building site duration, local employment level, workers' behaviour, etc.), all of these needs could be met through existing vacant accommodation or the provision of new dwellings.

The possibility of using vacant accommodation must be carefully assessed with two specific factors in mind:

- The level of comfort, which must be adapted to permanent use (heating, insulation etc); and
- The need to avoid potential impacts on accommodation for tourism.

- School infrastructure needs;

  The proportion of school age children expected is put at 82%. The provisional breakdown is:

  - 40% in nursery schools;
  - 45% in primary education; and
  - 15% in secondary education.

  On the basis of the potential new population group to be schooled, the new plant may result in the generation of additional classes within local schools in the site vicinity. The ongoing additional needs related to the plant's operating lifetime and the region's economic activity will dictate whether these classes will remain in place after the building site phase has come to an end.

- Other infrastructure needs;

  The demographic inflow and its distribution in the vicinity of the nuclear plant's building site generate new needs:

  - Regarding services, the following kind of services need to be extended:
    - waste water drainage network;
    - waste water purification;
    - electricity network; and
    - telephone network.
  - In the area of commercial equipment and services, the new needs presented by the building site and then the power plant lead to a boost in local business and the creation of new firms and services; and
  - In the area of leisure, it is a fact that the arrival of a new population group, which is mostly young, requires the building of additional sport, cultural and leisure facilities.

1.2.4. Impact of the construction site on transport

During the construction phase, there are likely to be increases in traffic volumes in the site vicinity. This includes the transportation of raw materials required for concrete production and several thousand tonnes of various other kinds of material to the site by lorry. The average volume of road traffic is estimated at 80 lorries per day which is reasonable given the size of the construction site. The average volume of road traffic will be compared with current traffic levels at the site specific phase.

In addition to this traffic, the daily shuttling of personnel, whose number will be close to 2400 during a peak year must be taken into account. The experience of such large construction sites shows that the collective shuttle vehicles between the site and the main neighbouring towns are organised.

1.3. ADDITIONAL LOCAL MEASURES FOR THE PROJECT

1.3.1. Additional measures relating to the demographic contribution during construction

The demographic contribution at the regional level also depends on the geographical origin of the construction site staff and the nature of the jobs created. The total demographic contribution depends on the number of people relocated and the presence or otherwise of family members.

The infrastructure must aim to provide typical living conditions in the site vicinity. The main factors influencing this are the availability of housing, educational, sports and cultural facilities as well as suitable road systems and networks.

In consultation with local officials and local authorities, the need for special provisions will be considered following the selection of the site in order to meet the specific needs of the workforce and to ensure any tourist amenities are not adversely affected.

1.3.2. Additional measures taken to develop local employment during the construction phase

The local economic impact of the construction site is important.

On the basis of French experience, the subdivision should result in approximately 150 contracts in total.

Based on this potential market, the measures that will be taken will aim to:

- Encourage companies to employ local labour or local subcontractors; and
- Give preference to local companies for contracts.

Out of the 150 potential contracts for the construction and supply of equipment, the use of local and regional companies will be favoured. Companies will be consulted directly regarding tendering or regarding subcontracting to contractors. Subcontracting will occur on associated services (accommodation, local industrialists, transportation, construction site logistics, etc.), or in main construction trades (civil engineering, local manufacturing of equipment, electromechanical work, etc.).

Joint work with the local authorities will be carried out to identify the local companies that may be employed directly or as subcontractors.

1.3.3. Additional financial measures for the Post-construction

This involves preventing the large amount of economic activity generated by the construction phase from suddenly slowing down and making sure that the activity created by the construction site constitutes the starting point and is the driving force for further economic development and employment in the region.

A dialogue with the local authorities will be initiated at an early stage so that the transition between construction phase and operation phase will be as smooth as possible.

2. DURING OPERATIONAL PHASE

The EPR unit's operating period follows the building stage. This unit is designed to operate for 60 years.

2.1. WORKFORCE AND JOBS FORECAST

The allocation of operating personnel to the EPR unit site occurs gradually following opening. The operating workforce should increase by approximately 300 jobs which are created shortly after commissioning.

The teams would be mainly formed by workers with high qualification requirements needed to operate a nuclear unit. These workers will be recruited in the UK and will follow training periods. Some employees will be local.

The number of subcontracting jobs, which reach several thousand during the construction stage, drops after commissioning the EPR development could generate a few dozen near-permanent subcontracting jobs. This concerns the personnel of the plant's operating department's living and maintenance quarters.

For unit shutdowns, which occur every 12 to 24 months, the EPR unit requires an extra 500 individuals and even 1000 individuals at peak times. These individuals would come from all over the country including from local companies.

2.2. REPERCUSSION ON SOCIO-ECONOMIC ACTIVITIES

On the basis of French experience, it has been noted that personnel working at the NPP integrate into the local population well.

These employees spend a large part of their earnings locally. This benefits businesses and services connected to daily life (food, domestic appliances, transport, leisure, education, etc.).

2.3. WASTE HEAT RECOVERY

This section deals with the requirement 3.1 of the Environment Agency Process and Information Document [Ref-1].

The use of renewable heat (produced by renewable energy) or heat from Combined Heat and Power (CHP) plants is a present subject of interest in the UK. Indeed, this kind of energy represents an opportunity to reduce the UK's carbon emission.

The EPR NPP can supply heat on two levels:

- by extracting high temperature steam; and
- by using the heat of warm water from the cooling system.

The French experience on various nuclear sites demonstrates that different sectors can benefit from the warm water the NPPs produce. The warm water could be made available to:

- The agricultural sector within horticultural and market gardening (greenhouses heating) and aquaculture;
- The residential dwellings and public buildings such as swimming pools, hospitals; and;
- The industrial sector such as wood heating.

Thus, the recovery of waste heat from NPP can create an attractive centre for the socio-economic development and increase sustainability.

However, the completion of such a project has to take into account the local context. Socio economic issues, the technical feasibility and the economic constraints would need to be explored and adequately addressed as part of a feasibility study into waste heat recovery options.

SUB-CHAPTER 12.4 – REFERENCES

External references are identified within this sub-chapter by the text [Ref-1], [Ref-2], etc at the appropriate point within the sub-chapter. These references are listed here under the heading of the section or sub-section in which they are quoted.

2. DURING OPERATIONAL PHASE

2.3. WASTE HEAT RECOVERY

[Ref-1] Process and Information Document for Generic Assessment of Candidate Nuclear Power Designs. The Environment Agency. January 2007. (E)

SUB-CHAPTER 12.5 – UNCERTAINTIES OF THE METHODS

1. IMPACTS ON TERRESTRIAL ECOSYSTEM

Gaseous non radioactive species impact

Procedures described in the Environment Agency (EA) Integrated Pollution Prevention and Control (IPPC) H1 Guidance Note [Ref-1] will be followed, with regards to impacts from gaseous non radioactive species. The initial step of this H1 assessment prescribes a high level calculation to determine the likely long-term and short-term ground level concentrations that might arise from an installation. It is based on release rate of the emission species to be assessed and a dispersion factor derived from the release height. This methodology assumes a 'worst case' scenario and tends to result in an overestimation of the potential effects. Indeed, the dispersion factors proposed in the H1 methodology have been determined using worst case scenario dispersion conditions, with no allowance for thermal or momentum plume rise. Long-term dispersion factors are presented as maximum annual averages and short-term dispersion factors as maximum hourly averages, but they do not take into account all the parameters that may influence dispersion of substances to air, such as the flue gas velocity and temperature for example. Distance from the release point should also be taken into account. The H1 methodology is a screening methodology which is intended to screen out insignificant emissions and determine significant ones that require more detailed dispersion modelling.

In addition, the Environmental Assessment Levels (EAL) which are used to compare the process contributions for substances released to air have been derived from a variety of published UK and international sources. The H1 guidance states that these EAL may be revised over time due to new legislation or scientific information.

Noise and vibration impact

The characteristics of the EPR Unit are defined by identifying equipment and facilities that might be heard at sensitive noise receptors. Until the equipment specifications in the EPR Unit are finalised for individual sites, potential noise sources are based on similar sources found in other operational nuclear power plants.

It is not possible to define zones which indicate where noise-sensitive receptors will be impacted upon by the EPR at this stage. The propagation of noise from the EPR will depend upon; frequencies of noise being emitted, directionality of noise emitted, ground surface or cover and topography between source and receptor, background noise levels and dominant meteorological conditions (wind speed and/or direction).

2. IMPACTS ON AQUATIC ECOSYSTEM

Thermal impact

A detailed assessment of the impact of thermal discharges will be carried out using a 3D model at the site specific phase. The uncertainties of the methodology used will be presented within this study.

Liquid non radioactive species impact

With regards to the impact from liquid non radioactive species, procedures described in the EA IPPC H1 Guidance Note [Ref-1] [Ref-2] will be followed. Process Contribution (PC) and Predicted Environmental Concentration (PEC) are calculated and compared against Environmental Quality Standards (EQS) or EAL available in the H1 guidance.

The PC calculation is based on dispersion rate and flow rate. The generic methodology assumes a near field dilution factor of 0.2 after discharge.

The PEC is calculated by summing the background concentration and the process contribution. For coastal and estuarine waters, guidance on appropriate background data may be obtained from the regulator's local and/or regional office. Information may be obtained from various sources including Scottish Environment Protection Agency and EA area. For the Generic Design Assessment, in the absence of background concentration measurements, background concentration data can be taken from some seawater general composition grids [Ref-3].

At this stage, the PC calculated are less than 1% EQS, so it is not necessary to calculate the PEC and therefore the background concentrations can be used instead.

SUB-CHAPTER 12.5 – REFERENCES

External references are identified within this sub-chapter by the text [Ref-1], [Ref-2], etc at the appropriate point within the sub-chapter. These references are listed here under the heading of the section or sub-section in which they are quoted.

1. IMPACTS ON TERRESTRIAL ECOSYSTEM

[Ref-1] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. July 2003. (E)

2. IMPACTS ON AQUATIC ECOSYSTEM

[Ref-1] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. July 2003. (E)

[Ref-2] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. March 2008.

[Ref-3] Seawater general composition grids used: OSIL seawater standards, YH (1991). Li, 1991. Distribution patterns of the elements in the ocean: a synthesis. *Geochim. Cosmochim. Acta* 55: 3223–3240.

SUB-CHAPTER 12.6 – ENVIRONMENTAL MONITORING

1. OBJECTIVES OF THE MONITORING PLAN

A site specific environmental protection and monitoring programme will be established to monitor the environment around the UK EPR site. The objectives of the monitoring programme will be to:

1. Collect data in order to assess the state of the environment surrounding the UK EPR, relevant to baseline studies.

2. Determine to what extent, the UK EPR is responsible for any pollution or impact detected.

The monitoring programme will be agreed with the Regulator, in accordance with the 'Guidance on the Protection of Land under the PPC Regime: Application Site Report and Site Protection & Monitoring Programme' and may cover:

- extent of monitoring requirements;
- type of monitoring - continuous or intermittent, and in the case of intermittent, the frequency for each element;
- location and scope of testing for each element;
- reporting format; and
- data storage and management systems for future interrogation if required.

The exact extent of the monitoring programme will be dependent on the particular characteristics of the area in and around the selected EPR site. However, it is possible to identify the range of generic monitoring that is likely to be required for this type of development.

This sub-chapter outlines a proposed 'menu' for an environmental protection and monitoring programme, which can then be developed into a formal programme once the site is confirmed and the full details are known. The programme is based on the PPC template for a Site Protection & Monitoring Programme and is based on the requirements of various non-radiological environmental permits including PPC, discharge consents and the outcome of the site specific environmental impact assessments. All the different categories of environmental monitoring set out in this section are provisional and the actual need and extent of each category will be confirmed on a site specific basis.

The monitoring programmes will be submitted to the relevant regulatory authorities and key stakeholders and agreement will be obtained prior to the programme implementation.

The generic objectives of an individual monitoring programme will be to:

- Ensure (as far as possible) that pollution prevention measures are sufficient to prevent the emission of pollutant to land;
- Demonstrate and maintain the effectiveness of the pollution prevention measures at the site throughout the life of the installation;

- Ensure adequate maintenance, inspection and testing of infrastructure to demonstrate its effectiveness throughout the life of the UK EPR; and

- Monitor land and/or groundwater to ensure pollution prevention measures are effective and to provide warning of the failure of pollution prevention measures.

Following implementation of a site specific environmental protection and monitoring programme, the monitoring results will be reported regularly as required by the regulators.

2. MARINE BIOLOGICAL AND ECOLOGICAL MONITORING

The following marine biological and ecological monitoring programme is a typical example of a proposed monitoring programme, which will be based on the site specific environmental impact assessments and on the specific characteristics of the designed site. Such a monitoring programme will be agreed with the relevant conservation authority, such as Natural England, Countryside Council for Wales, Sea Fisheries Committees and/or local stakeholder groups.

2.1. ECOLOGICAL MONITORING OF ESTUARINE WATERS

Estuarine systems are highly dynamic in their ecology due to the complex interactions of tides, river flows and salinity variation. Therefore, the monitoring of estuarine ecological systems would be undertaken via benthic and sessile macroinvertebrate sampling. Ideally, sampling should be undertaken within quadrats along transect lines across the inter-tidal zone. Monitoring locations should be established at rock outcrops or concrete sea defences for sessile plant and animal organisms. Samples will be processed to examine species diversity and abundance. Typically, sampling would be on a quarterly basis.

2.2. ECOLOGICAL MONITORING OF COASTAL WATERS

The ecological monitoring of coastal waters would typically include benthic invertebrate species and fish populations. Studies of plankton and zooplankton composition and abundance is likely to require large numbers of samples with frequent sampling to provide any meaningful information, due to the highly dynamic nature of these populations. Sampling of marine invertebrates would need to be undertaken through a combination of grab sampling from nominated areas or through fine mesh beam trawl. Fish populations may need to be sampled through a number of techniques such that the range of species is captured. This may include techniques such as trawling, purse seine netting or gill netting (if permitted in that area). Typically, sampling would be on a quarterly basis.

2.3. ECOLOGICAL MONITORING OF SPECIES OF COMMERCIAL INTEREST

If monitoring of species of commercial interest is required, this may include migratory salmonid species that are captured within an estuary area or by recreational anglers upstream or inshore marine fisheries including shellfish. Monitoring may involve census of local inshore fisherman and their catch sizes and composition. Monthly census of commercial catches may be undertaken along with any local aquaculture facilities. Samples of fish may be collected from fishermen on a routine basis for testing for a range of organic, inorganic and radio-isotope pollutants.

Water quality testing results would need to be compared with the EC Shellfish Waters Directive (79/923/EEC) and for microbial contamination under the EC Shellfish Hygiene Directive (91/942/EEC).

2.4. ECOLOGICAL MONITORING OF BENTHIC SPECIES

Typical benthic invertebrate species would be sampled in freshwater reaches either by benthic grab sample or five minute kick sampling using a standard FBA invertebrate hand-net, for shallower reaches.

Typically, samples would be collected on a bi-annual basis in the spring and autumn. Invertebrates would be identified to species level and estimates of abundance made. Invertebrate results would be calculated for BMWP and ASPT scoring. For estuarine areas sampling would be undertaken using Surber sampling of inter-tidal area for benthic invertebrate present within the local substrates. This will be undertaken along a series of transects, for example in a radial pattern from a discharge point. This sampling would need to be undertaken on a quarterly basis and collected samples examined for species composition and estimates of abundance. Offshore benthic invertebrate monitoring would also be carried out along a series of transects radiating from the development area using benthic grab sampling from a boat.

3. MONITORING OF TERRESTRIAL ECOLOGY

3.1. ECOLOGICAL MONITORING OF LOCAL AREA

A programme of appropriate monitoring of terrestrial ecology may be needed according to the local conditions and the results of the impact assessment. This possible program should be suited to the different kinds of impact and will be based on an assessment of:

- Conservation condition of habitats;

  As part of the baseline assessments, each identified habitat within the local area would be assessed for its biodiversity, integrity, fragmentation, etc with individual vegetation communities within each community assessed according to their closeness to NVC (National Vegetation Classification) communities and their vegetative structure. Ongoing monitoring and assessment, if required, would be carried out on a regular basis and compared to baseline conditions and “ideal” conservation status, e.g. NVC communities.

- Presence or absence and population data for protected species;

  The baseline ecological survey will have identified which protected species are present within the near vicinity of the development, such as breeding birds, bats, badger, water vole, otter, great crested newt, common reptiles, etc. If regular monitoring of these species is required, this would be undertaken in accordance with the good practice guidelines for assessment of those particular species which include prescriptions for surveying.

- Monitoring of damaged, restored or created habitats as a result of developments; and

- Designated sites.

If the EPR lies within or adjacent to a designated site, there will be a requirement to monitor all environmental and ecological conditions which could have a damaging effect on the habitats or species for which the site has been designated.

In all cases where a designated site is involved, all monitoring schemes would be agreed in advance with the appropriate SNCO (Statutory Nature Conservation Organisation), either Natural England, the Countryside Council for Wales or Scottish Natural Heritage. The SNCO is also likely to require particular monitoring methodologies to be used, depending on the sites reason for designation.

4. SURFACE WATER MONITORING

Site specific impact and risk assessments will determine the extent of surface water monitoring requirements. A surface water monitoring programme will be proposed to monitor the impacts upon surface waters, of:

- fall out from gaseous emissions;
- sub surface migration of contaminants; or
- contaminated runoff.

4.1. FRESHWATER OR ESTUARINE WATER QUALITY MONITORING

If fresh surface water is present in the vicinity of the UK EPR, a suite of suitable water quality parameters will be proposed for monitoring at appropriate locations up stream and down stream of the site.

Composite samples would be taken preferably from areas which are deep enough to minimise direct sediment influence on water quality samples.

Estuarine waters will need to comply with all appropriate EC Directives including the EC Bathing Waters Directive (76/160/EEC), EC Nitrates Directive (91/676/EEC), EC Shellfish Waters Directive (76/923/EEC) and the EC Dangerous Substances Directive (76/464/EEC). Most rivers are rated for their chemical quality and will have specific improvement targets, therefore the monitoring parameters will be highly site specific.

4.2. COASTAL CHEMICAL WATER QUALITY MONITORING

Chemical water quality monitoring of coastal waters will be carried out in the same manner as for freshwater or estuarine monitoring above. However, as environmental quality standards for saline waters differ significantly to freshwater equality standards, the suite of parameters and limits of detection will be different.

Monitoring points will be chosen on a site specific basis. It is anticipated that a monitoring location above the discharge water outlet will be chosen, together with several monitoring locations at various distances from this outlet will also be sampled in order to provide some comparison.

5. GROUNDWATER MONITORING

Site specific impact and risk assessments will determine the extent of groundwater monitoring requirements, in order to monitor the impact upon groundwater of:

- fall out from gaseous emissions;
- sub-surface migration of contaminants; or
- contaminated runoff.

5.1. CHEMICAL GROUNDWATER QUALITY MONITORING

Groundwater quality will be monitored at a network of boreholes located around the perimeter of the UK EPR site. Given that no direct discharge to groundwater is anticipated and the likely size of the UK EPR site, at least ten boreholes could be sufficient to monitor potential groundwater contamination.

The layout of the boreholes will be developed taking account of key factors, including groundwater flow direction, position of potential pollution sources, position of receptors and preferential pathways.

The borehole locations will be also chosen to provide hydraulic gradient data and will be installed prior to commencement of construction, and during construction phase and operational phase if necessary.

Sampling protocol

The following precautions will be taken to ensure no cross contamination of samples occurs and validity of the samples:

- Boreholes will be purged prior and allowed to recharge prior to retrieving a sample, according to hydrogeological conditions;
- Samples will be retrieved using clean bailer, pumps and hoses;
- Bailers, pumps and hoses will be cleaned with drinking water between sampling locations;
- Sample containers will be clean, unused containers, compatible with the intended analyses (in accordance with the laboratory specifications) and appropriately labelled;
- Sample containers will be filled and appropriately sealed as per the analysing laboratory's instructions; and
- A record will be maintained of the following information: date, name of sampler, location, depth, basic characteristics (colour and odour etc.), physico-chemical parameters (pH, conductivity, Eh), water table level before, during and after pumping and weather conditions.

5.2. GROUNDWATER LEVEL MONITORING

As the construction of the UK EPR is likely to involve deep excavations and sub-surface structures, monitoring of groundwater level will be required. If dewatering or significant groundwater abstraction is required, level monitoring may be required as part of an environmental permit.

Groundwater level will be monitored on a monthly basis using piezometers.

Piezometers will be laid out according to the direction of groundwater flow, position of potential pollution sources, position of receptors, preferential pathways, etc.

Groundwater level will be monitored in 'm AOD' to an accuracy of + or - 10 cm.

Open standpipes piezometers are generally used to measures water table levels.

Measurements shall be recorded either manually (e.g. with an electric contact gauge) or automatically (e.g. by a pressure transducer).

The network of piezometers will be used to monitor both groundwater level and groundwater quality.

6. AIR QUALITY MONITORING

Site specific impact and risk assessments will determine the requirement and extent of air quality monitoring. An air quality monitoring programme may be required to monitor for the impact of:

- fall out from gaseous emissions; and
- direct gaseous emissions to air.

There are two distinct categories of monitoring for the assessment of air quality impact assessment and management:

- Monitoring of the concentrations and emission rates of the key pollutants at the point of release; and
- Monitoring of the ambient concentrations of key pollutants at selected short range locations around the source (the range is determined by the distance to the maximum ground level concentrations arising from the source).

6.1. MONITORING OF EMISSIONS TO AIR

The air quality assessment set out in Sub-chapter 12.1 will identify significant emissions to air from the installation. The PPC permit will specify the continuous emission monitoring and extractive test monitoring that is required, in accordance with Environment Agency (EA) guidance, including:

- Technical Guidance Note M1 [Ref-1] – Sampling requirements for monitoring stack emissions to air from industrial installations, Version 4, Environment Agency 2006;

- Technical Guidance Note M2 [Ref-2] – Monitoring of stack emissions to air, Version 4.2, Environment Agency, 2007.

The type of monitoring required (which can range from occasional extractive sampling to continuous emission monitoring) will be determined in accordance with this guidance and the quantities and frequency of pollutant releases.

6.2. LOCAL AIR QUALITY MONITORING

There are existing national and local authority networks of ambient air quality monitors. The need for additional ambient air quality monitoring will depend on the significance of the installation impacts on air quality and the existing background air quality. The monitoring required (if any) will be determined taking account of air quality impact assessment carried out for the installation in accordance with H1, the conclusions of the local air quality strategy, the existence and location of any local air quality management areas, any sensitive local receptors, the Department for Environment, Food and Rural Affairs national guidance on air quality monitoring and management and the relevant EA guidance, including:

- Technical Guidance Note M8 [Ref-1] – Environmental Monitoring Strategy – Ambient Air; and

- Technical Guidance Note M9 [Ref-2] – Monitoring Methods for Ambient Air.

Particular reference will be made to *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*. Department for the Environment, Food and Rural Affairs in partnership with the Scottish Executive, The National Assembly for Wales and the Department of the Environment for Northern Ireland, July 2007 [Ref-3].

6.3. ODOUR MONITORING

The UK EPR is unlikely to be the source of any significant odours during the operational phase, therefore a quantitative monitoring programme is unlikely to be required.

However, if complaints of odour do arise, a monitoring programme would be prepared and implemented as part of an investigation, and agreed with the relevant regulatory authority.

7. NOISE MONITORING

As part of the site specific environmental impact assessment, a comprehensive baseline survey of existing noise levels will be undertaken. Based on the results of this assessment, a programme of ongoing noise monitoring may be implemented to ensure that any noise emissions from the site do not become a nuisance to local noise sensitive features. The requirement for ongoing noise monitoring is likely to be included within relevant planning permissions for the UK EPR.

The monitoring programme should aim to monitor changes in noise levels during operational phase, to allow for actions to be taken if noise levels are deemed to be excessive.

Monitoring will be undertaken in conjunction with BS4142 and all measurements and reporting will be carried out in accordance with that standard. Specifically, monitoring should only take place during certain appropriate weather conditions. Monitoring will not be undertaken in the rain, during wind speed above 5 m s^{-1} or with temperatures below –3°C. In addition, the microphone will be positioned between 1.2-1.5 m above the ground level and for free field measurements will be at least 3.5 m away from any reflective surface other than the ground.

Off-site noise monitoring locations will be based on the location of sensitivity of receptors, such as residential houses, schools and commercial buildings.

Based on Flamanville 3, vibration is not anticipated during the operational phase.

8. OTHER ENVIRONMENTAL MONITORING

8.1. SEAWATER TEMPERATURES

Monitoring of seawater temperatures will be undertaken prior to construction of the UK EPR as part of an assessment into the design and location of the cooling water outfall.

Ongoing monitoring of seawater temperatures during the operational life of the UK EPR will be required to ensure that optimal dispersion and mixing of the effluent occurs, and that the increase in temperature is maintained as a minimum.

Seawater temperature profiles (throughout the water column) will be taken at regular intervals; the frequency of monitoring will be greatest over the initial months of heated water discharge, when dispersion is first modelled. The frequency of monitoring may then be decreased as site specific information and knowledge increases.

Temperature profiles will be taken at points set over a grid overlaying the discharge point (in order to facilitate modelling work). A control profile may be taken at a suitable distance from the discharge point.

8.2. GEOLOGY AND SEDIMENTOLOGY

As part of an environmental protection and monitoring programme, local soils and sediments from surface water features will be subjected to a routine programme of sampling and analysis. The objective will be to determine if the quality of the land surrounding the UK EPR site is affected by fall out or contaminant migration from the site.

The programme will build upon the initial site investigations undertaken prior to the construction of the UK EPR as to provide a record of the quality of the local soil throughout the operational span of life of the UK EPR.

The locations for sampling will depend upon site specific characteristics in relation to the final layout of the UK EPR site. It is anticipated that precise locations will be based upon:

- Local and regional hydrogeological conditions; and
- Previous site occupation and history of pollution cases.

Therefore, the locations of on going soil quality monitoring are likely to be relative to the locations of these features.

The following precautions will be taken to ensure no cross contamination of samples occurs and validity of the samples:

- Samples will be retrieved using clean tools. Tools will be cleaned with drinking water between sampling locations;
- Sample containers will be clean, unused containers compatible with the intended analyses (in accordance with the laboratory specifications) and appropriately labelled;
- Sample containers will be filled and appropriately sealed as per the analysing laboratory's instructions; and
- A record will be maintained of the following information: date, name of sampler, location, depth and basic characteristics (colour and form).

8.3. HYDROLOGY AND HYDRODYNAMICS

Given the likelihood that site development may take place within a floodplain (fluvial or tidal), consideration will be given to the effects of and mitigation with regards to flooding. Liaison with the EA's Flood Warning area teams may allow specific levels and flood warning risk areas to be characterised. Rising flood levels may be monitored using EA gauging data if available; early warning detection of threshold flood levels may be sufficient to allow preparations to be made.

Where gauging stations are too far inland or not located in the local area, it may be necessary to install monitoring and logging equipment for flood warning purposes.

Monitoring of hydrodynamic effects upon the underwater discharge tunnel and cooling water outlet point is important given the considerable forces which will be exerted upon this from the sea. A checklist of stress points may be drawn up by the construction engineers and these may be monitored during other routine diving work (such as cleaning of intake structures, outlet diffusers, etc).

8.4. COASTAL TOPOGRAPHY AND BATHYMETRY

Impacts upon coastal topography are anticipated to be minimal given that the currents, waves and tides, which naturally shape each unique length of coastline, can be large in force and highly variable in nature. Separating natural processes and anthropomorphic impacts is a very difficult task.

If particular concern is identified, due to the specific nature of local bathymetry in relation to an abstraction point for example, then more thorough monitoring may be recommended at the site-specific baseline identification stage.

A LIDAR (Light Detection And Ranging) data survey may be carried out annually for the first six years of operation to confirm no significant impact upon beach geomorphology. The survey would be carried out at the same time of year.

It may be deemed necessary to carry out sand or sediment analysis in parallel with LIDAR surveys. The composition, in particular the grain sizes of sand or sediment may be investigated along set transects of the shoreline. These investigations should aim to take place at the same time of year and approximate same tide conditions, e.g. corresponding to a specific size of low tide. A change to sand or sediment particle size in a particular location may be indicative of impacts due to the seawater abstraction. Any such association is inherently hard to categorise.

It may be appropriate to monitor coastal, sub-marine bathymetry by radar or echo ranging boat surveys. Local bathymetry, sediment and sub-marine geology and the risk of impact will be more easily characterised when site specific engineering surveys are produced for a discharge tunnel and outlet point.

8.5. METEOROLOGICAL MONITORING

A condition of the environmental permits will be to monitor meteorological conditions on a regular basis. Local meteorological stations may be used however an on-site weather station may be used to provide more localised information

If an on-site meteorological monitoring station is used, it will be positioned to satisfy Meteorological Office recommendations; i.e. siting of the stations should take account of factors such as surrounding topography and buildings (possible shielding effect), height above ground level, position with relation to identified sensitive receptors.

Meteorological data will be viewed in conjunction with other data and may be used to support the use or interpretation of other data, e.g. noise level monitoring.

SUB-CHAPTER 12.6 – REFERENCES

External references are identified within this sub-chapter by the text [Ref-1], [Ref-2], etc at the appropriate point within the sub-chapter. These references are listed here under the heading of the section or sub-section in which they are quoted.

6. AIR QUALITY MONITORING

6.1. MONITORING OF EMISSIONS TO AIR

[Ref-1] Sampling requirements for monitoring stack emissions to air from industrial installations. Technical Guidance Note (Monitoring) M1. Version 4. Environment Agency. 2006. (E)

[Ref-2] Monitoring of stack emissions to air. Technical Guidance Note (Monitoring) M2. Version 4.2. Environment Agency. 2007. (E)

6.2. LOCAL AIR QUALITY MONITORING

[Ref-1] Environmental Monitoring Strategy - Ambient Air. Technical Guidance Note (Monitoring) M8. Environment Agency. 2000. (E)

[Ref-2] Monitoring Methods for Ambient Air. Technical Guidance Note (Monitoring) M9. Environment Agency. 2000. (E)

[Ref-3] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. DEFRA. 2007. (E)

SUB-CHAPTER 12.7 – CONCLUSIONS

1. IMPACTS ON TERRESTRIAL ECOSYSTEM

Impact on air quality and climate

With regards to the impact on air quality from the release of gaseous non radioactive species, a distinction is made between the installation's building phase and the normal operating phase.

During the building phase, potential sources of gaseous non-radioactive emissions are chemical discharges (formaldehyde and carbon monoxide), dust emissions and exhaust emissions from vehicles movements. A two staged approach is adopted to determine the potential significance of processes related to these emissions in the UK. This approach is in accordance with the procedures described in the Environment Agency (EA) Integrated Pollution Prevention and Control (IPPC) H1 Guidance Note [Ref-1]. It enables to determine that formaldehyde and carbon monoxide emissions produced during construction phase are unlikely to cause a significant impact on air quality. The impact of dust and exhaust emissions from vehicles movements will be assessed once the specific site will be selected.

During the installation's normal operating phase, the potential sources of gaseous non-radioactive emissions are chemical discharges and exhaust emissions from vehicles movements. The impact of exhaust emissions will be assessed at the specific stage. Regarding chemical discharges, the following three main groups are identified:

- Sulphur and nitrogen dioxides in the exhaust gases from engines in the back-up electricity generators;
- Formaldehyde and carbon monoxide emitted by the insulation into the ventilation system which is discharged via the stack; and
- Ammonia discharged as the temperature rises in the steam generators during start-up.

According to the H1 methodology and using its conservative assumptions:

- The formaldehyde, carbon monoxide and ammonia emissions are unlikely to cause a significant impact on air. No further modelling is required; and
- The emissions of sulphur and nitrogen dioxides are above the thresholds of significance and require consequently a further assessment. The detailed assessment will be provided at the specific stage. In order to give confidence that a PPC application will be successful at the site specific phase, information has been provided in PCER Chapter 3.

With regards to the odour, there are potential sources of odorous emissions during construction and operational phases, but these emissions occur over short time periods. Consequently, it is unlikely that these emissions will lead to significant impact. If a situation where odour is a problem arises, an appropriate assessment shall be carried out.

With regards to the climate, Nuclear Power generation has a relatively small carbon footprint as Nuclear Power Plant do not produce carbon dioxide directly from electricity generation. As a consequence, the EPR activities do not affect the climate.

Noise and vibration impacts

During the construction phase, the adoption of a Construction Environnemental Management Plan and operation in accordance to best practice will minimise noise disturbance to nearby noise-sensitive receptors as far as reasonably practicable. However, it is recognised that due to the nature of construction works, there is still the potential for a temporary adverse impact at nearby noise-sensitive receptors. However, this is considered to be of minor significance at worst.

In the operation phase, following the process control and monitoring stage of the development, the operation of the EPR should have a negligible impact on nearby noise-sensitive receptors. This will be validated via in situ measurements once the EPR unit is commissioned.

As the data required to assess the impact of noise and vibration is site specific, the detailed assessment is postponed to the site specific phase.

Landscape and visual impacts

The construction and operational phases of the EPR can have the potential to impact the coastal landscape and its visibility, the key views and visual amenity. Visual effects result from changes in the landscape or seascape. They are defined as changes in the appearance of the landscape or seascape, and the effects of these changes on people. Different potential effects as traffic impact and impact on cultural designations will be taken into account in the site specific detailed assessment.

Other impacts during the construction phase

As the impact assessment of works during the construction phase is strongly dependent on the site retained, the particular impacts of works (on topography, geology, fauna and flora) will be studied during the site specific phase.

2. IMPACTS ON AQUATIC ECOSYSTEM

Impact on hydrogeology

Structures, plant and machinery will be built to strict building control standards. Pollution Prevention and Control Regulations (PPC), regulatory specifications and Best Available Techniques (BAT) will minimise the potential for unplanned discharges to ground and to groundwater.

Impact of water abstraction

The impact of seawater and freshwater abstraction will be assessed during the site specific phase as the means of sourcing freshwater and the data required to assess these impacts depends on the site retained.

Mitigation measures will be studied to minimise the impacts of seawater abstractions on fish.

Thermal impact

A site specific assessment will be carried out in order to determine the impact of thermal discharges upon the local marine environment using a 3D model.

The assessment will confirm that the maximum temperature rises are reached under neap tide conditions, the effects are localised at or near the surface of the receiving water body and that the thermal plume sweeps a limited surface area.

Liquid non radioactive species impact

The methodology retained to assess the impact of liquid chemical discharges follows the EA IPPC H1 Guidance Note [Ref-1] [Ref-2]. For each substance discharged, the Process Contribution (PC) and Predicted Environmental Concentration (PEC) have to be calculated and compared with the relevant environmental benchmark.

For the substances for which Environmental Quality standards are available, Process Contributions are calculated and are less than 1% of the relevant EQS. The impact on the receiving water can be considered as insignificant.

Others impacts

As they are strongly dependent of the site specific environmental conditions, the particular impacts of works during construction phase, the impact of discharges on sedimentology and hydrogeology, the impact of potential dredging and the flood risk will be assessed at the site specific stage.

3. IMPACT ON DESIGNATED AREAS, SENSITIVE HABITATS AND PROTECTED SPECIES

The impact of UK EPR activities on designated sites (SACs designated under the 'Habitats Directive', SPAs designated under the 'Wild Birds Directive', Ramsar sites designated under the Ramsar Convention and UK designated sites), on UK sensitive habitats and on UK protected species was assessed for an EPR facility located on a representative site.

This ecological impact assessment for the GDA has provided a description of the methodology used and a series of tables describing the outcome of the impact assessment for a representative site during the construction and operational phases of an EPR.

The main results of the impact assessment indicate that there could be potential impacts on habitat integrity and protected species, direct and indirect, temporary (construction phase) and permanent (operational phase), particularly in coastal and near-shore marine environments as a result of construction and operation of a new facility.

A programme of appropriate mitigation measures could be necessary to prevent or minimise significant impacts. Chief amongst them would be the preparation of a Management Plans, designed to manage and control.

A more detailed assessment of impacts on sensitive areas (habitats and species) will be carried out during the site specific phase.

4. IMPACT ON SOCIO-ECONOMICS

The worksite and then the EPR operation represent an opportunity for socio-economic development. A detailed assessment of the socio-economic impacts will be assessed within the site specific application for consent.

SUB-CHAPTER 12.7 – REFERENCES

External references are identified within this sub-chapter by the text [Ref-1], [Ref-2], etc at the appropriate point within the sub-chapter. These references are listed here under the heading of the section or sub-section in which they are quoted.

1. IMPACTS ON TERRESTRIAL ECOSYSTEM

[Ref-1] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. July 2003. (E)

2. IMPACTS ON AQUATIC ECOSYSTEM

[Ref-1] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT. Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. July 2003. (E)

[Ref-2] Integrated Pollution Prevention and Control (IPPC) – Environmental Assessment and Appraisal of BAT, Horizontal Guidance Note IPPC H1. Environment Agency & Environment and Heritage Service & Scottish Environment Protection Agency. March 2008. (E)