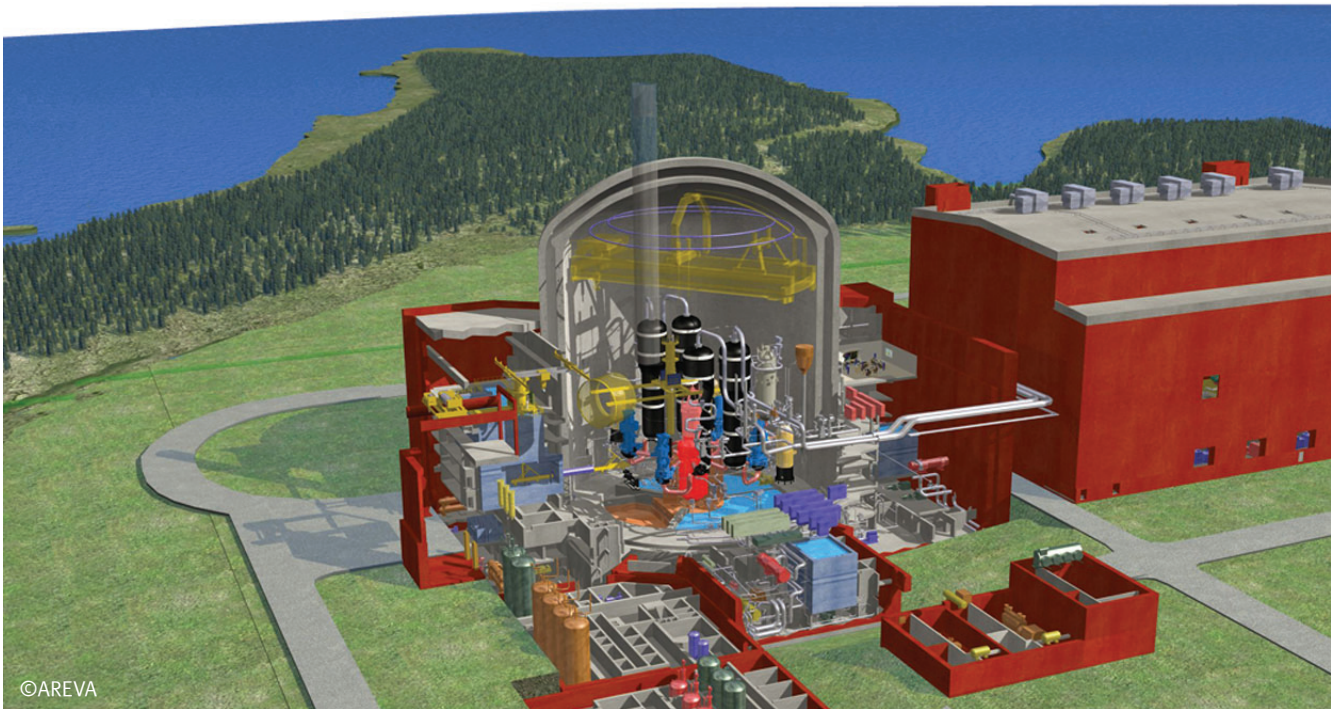
Environment Agency

Generic design assessment of new nuclear power plant designs

Statement of findings following preliminary assessment of the submission by: AREVA NP SAS and Electricité de France SA for their UK EPR design



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Your environment is the air you breathe, the water you drink and the ground you walk on. Working with business, Government and society as a whole, we are making your environment cleaner and healthier.

The Environment Agency. Out there, making your environment a better place.

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GENW0308BNTC-E-P

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Executive Summary

As the leading organisation working to protect the environment, it is the Environment Agency's role to regulate discharges from nuclear power stations in England and Wales and to reduce their impact on our air, water and land.

In response to growing interest in nuclear power and potential applications to build new nuclear power stations in the UK, we have been working on a new approach, Generic Design Assessment (GDA), for assessing the environmental impacts of four reactor designs. GDA means that we assess the acceptability of both the environmental aspects and the overall nuclear reactor design before individual site applications are made. This approach allows us to get involved at the earliest stage where we can have most influence and where lessons can be learned that may apply to other designs. It also gives us enough time to address regulatory and technical issues with designers and potential operators.

The new GDA approach has given us the opportunity to work together with the Health and Safety Executive (HSE), providing a 'one-stop-shop' for nuclear regulation. The process will allow a rigorous and structured examination of detailed environmental, safety and security aspects of the reactor designs, and is likely to take approximately three years to complete. We believe that GDA will greatly improve efficiency both for the regulators and the nuclear industry, and ultimately provide greater protection for both people and the environment.

We are conducting our GDA work in an open and clear way and will communicate with industry, interested groups and the public throughout the process.

GDA is in two stages: preliminary assessment and detailed assessment. In the preliminary assessment, we examine the claims in the submission provided by the requesting party (e.g. the reactor vendor). Our aim is to identify whether we will need to ask for further information, if there are any issues that are obviously unacceptable, or if there needs to be any significant design modifications.

This is the first of our public statements for the UK EPR nuclear power plant design. This summarises our findings to date on environmental aspects following the preliminary stage of generic design assessment.

Electricité de France (EDF) and AREVA NP (the 'requesting party') submitted their UK EPR nuclear power plant design for generic design assessment in August 2007. They published the submission on their website (www.UK EPR-reactor.co.uk) and invited people to comment.

Based on our past experience, authorising the disposal of radioactive waste is the area of regulation that has the highest profile, the greatest perceived uncertainties and the longest lead time for our permitting of new nuclear power stations. For those reasons, our GDA focuses mainly on radioactive waste issues, although we have also looked at aspects of the design that relate to other areas such as abstraction and discharges to water, pollution control issues, as well as management of non-radioactive waste.

We have carried out a preliminary assessment of EDF and AREVA's submission for the UK EPR nuclear power plant design and these are our conclusions:

- We are confident that EDF and AREVA have appropriate management systems in place to control the content and accuracy of the information they provide for GDA. We have confirmed this by inspecting systems at their main offices;
- The annual radiation impact of the UK EPR design on people would be below the UK limit;
- We did not find any matters within the submission that are obviously unacceptable;
- We have not identified any significant design modifications that are likely to be needed before we could issue a permit; and
- The submission does not contain the level of information we need to carry out a detailed assessment.

We have advised EDF and AREVA of the lack of information, they have committed to provide further detailed information and have given a timetable in which they will do this.

It is possible that we may have to reconsider our views about the acceptability of the UK EPR design and the need for any design modifications once EDF and AREVA have provided the additional information.

If we receive this information within the timetable proposed, we believe that we can complete our detailed assessment and consult the public about this in autumn 2009. We will then publish our final conclusions, taking account of all comments received, towards the end of 2010.

Introduction

This report sets out our findings following the preliminary stage of generic design assessment (GDA) for the UK EPR nuclear power plant design. This design was submitted for GDA by Electricité de France SA and AREVA NP SAS (EDF and AREVA) (the 'requesting party').

We established our GDA process when we published guidance in January 2007 (P&I Document[1]). GDA means that we assess the acceptability of the environmental aspects of an overall design before individual site applications are made. The Health and Safety Executive (HSE), which now incorporates the Office for Civil Nuclear Security (OCNS), has introduced a similar process for assessing the safety and security aspects of a design[2,3], and we are working closely with them. GDA allows us to get involved with designers and potential operators at the earliest stage, where we can have most influence and where lessons can be learned that may be apply to other designs. This early involvement also gives us enough time to address regulatory and technical issues with designers and potential operators.

In line with the Government's aim of reducing regulatory burdens on industry, we and the HSE have:

- asked requesting parties to provide information about their designs as a single, integrated submission, addressing the requirements of both regulators;
- set up a Joint Programme Office (JPO) to administer the assessment process on behalf of both of the regulators as a 'one-stop shop'.

We carry out our assessment in two stages:

- **Preliminary assessment** - when we examine the outline details of the requesting party's submission to find out if further information is needed, if there are any issues that are obviously unacceptable, or if there needs to be any significant design modifications.
- **Detailed assessment** - when we examine the submission in detail to decide initially whether we might issue a statement of design acceptability. We will only make our final decision after we have consulted the public and considered the responses we receive.

This document is a statement of our findings from the preliminary assessment stage.

We carry out our GDA work under an agreement made with the requesting party under section 37 of *The Environment Act 1995* (EA95). We began GDA for the UK EPR and three other designs after we signed these agreements in July 2007. Since the Government's consultation about the future of nuclear power in the UK[4] was ongoing at that time, the agreements recognised that the work would stop if the Government decided that new nuclear power stations should not be built. The Government decided in January 2008 that private sector energy companies should be given the option to build such power stations[5].

The Environment Agency regulates nuclear power stations in England and Wales under several regulatory regimes:

- the disposal of radioactive waste requires authorisation under *The Radioactive Substances Act 1993* (RSA 93);
- the abstraction of water (such as for process use or during construction) may require a licence under the *Water Resources Act 1991* (WRA 91);
- the discharge of liquid effluents (such as from cooling or dewatering during construction) requires a consent under WRA 91;

- some “conventional” plant (for example combustion plant used as auxiliary boilers and emergency standby power supplies, and incinerators used to dispose of combustible waste) may require a permit under *The Pollution Prevention and Control Regulations 2000* Statutory Instrument 2000 No. 1973 (PPC 00);
- the disposal of waste by deposit on or into land, including excavation materials from construction, may require a permit under PPC 00.

We also have a role in relation to flood risk management and agreements will be required for changes to flood management structures or to transfer our responsibilities in this area.

The Environment Agency and the Health & Safety Executive together form the competent authority for the *Control of Major Accident Hazards Regulations 1999* Statutory Instrument 1999 No. 743 (COMAH 99). On-site storage of certain substances in large quantities may fall under these regulations.

Based on our past experience, authorising the disposal of radioactive waste is the area of regulation that has the highest profile, the greatest perceived uncertainties and the longest lead time for our permitting of new nuclear power stations. For those reasons, our GDA focuses mainly on radioactive waste issues, although we have also looked at aspects of the design that relate to the other regulatory regimes. In carrying out a generic assessment, we will take into account all relevant statutory, policy and regulatory matters and constraints, including those set out in our Considerations Document[6], except where they can only be addressed on a site basis. We will also have regard to our *Radioactive Substances Regulation Environmental Principles*[7] (REPs).

Our process

The P&I Document[1] sets out in detail the process that we will follow during generic design assessment. It has six main elements:

- **Initiation** - we make an agreement with the requesting party under section 37 of EA95 and receive a submission.
- **Preliminary assessment** - we examine the outline details of the submission to find out if:
  - we need further information;
  - there are any issues that are obviously unacceptable;
  - any significant design modifications are likely to be needed.
- **Detailed assessment** - we examine the submission in detail to decide initially if we might issue a statement of design acceptability.
- **Consultation** - we consult widely on our initial view. We will produce a consultation document explaining our view and, if we consider that we might issue a statement of design acceptability, we may set out a draft template authorisation appropriate to the design.
- **Post consultation review** - we will carefully consider all relevant responses to the consultation.
- **Decision and statement** - we will decide whether we should issue a statement of design acceptability. We will publish a document that provides the background to and basis for our findings.

Before and during the preliminary phase of GDA, we had various discussions with requesting parties to raise awareness and understanding of the UK regulatory requirements. These requirements are different to regulatory requirements in other countries and additional information has been required.

Process for the UK EPR GDA

This section details the steps we have taken during the first two of those elements for the submission for the UK EPR design.

We set up an agreement with EDF and AREVA, under section 37 of EA95, to carry out and recover our costs for GDA of the UK EPR design. This came into effect on 16 July 2007. Then, together with HSE, we set out a timetable for the initial stage of the work (our preliminary assessment and HSE's 'step 2') starting with a submission of information by EDF and AREVA. Between 16 July and 15 August 2007, we provided advice on the contents of the submission and agreed detailed working arrangements, covering matters such as document identification and tracking, and the public involvement process. EDF and AREVA provided their submission on 14 August 2007. The initial stages end with the publication of this and HSE's document (Easter 2008).

The Joint Programme Office (JPO) received the submission on 15 August 2007. The submission did not contain any sensitive nuclear information or any commercially confidential information. The individual documents that make up the submission are listed in Annexe 1.

The 'public involvement process' was launched on 10 September 2007, so that the public could view and comment on this and three other submissions.

As part of this process:

- the JPO has set up a website (http://www.hse.gov.uk/newreactors/index.htm) with information about GDA and the public involvement process, and links to the requesting parties' websites.
- EDF and AREVA published the submission on its website (http://www.UK EPR-reactor.co.uk) and provided an interactive form for making comments.
- the JPO has distributed CD copies of the publicly available information, paper copies of a summary of that information, and paper copies of the comments form, to members of the public, on request.
- EDF and AREVA placed a notice in several national newspapers to inform the public about the process (see Annexe 3 for details).
- the JPO has provided copies of a leaflet about the process to all public libraries in Great Britain; informed interested organisations about the process; and set up an e-bulletin to keep subscribers informed of progress with GDA.
- comments relating to the UK EPR design received by 4 January 2008 have been forwarded to EDF and AREVA for response. The comments and their responses have been considered by the appropriate regulator (HSE or Environment Agency) during their assessments. Comments received after 4 January 2008 will be considered during the next stage of assessment.

We have carried out our preliminary assessment of the design. This is discussed in detail in a following section and our conclusions are given at the end of this document.

A number of comments made by the public were general in nature and these comments and responses are set out in the HSE report on the JPO website.

In line with our protocol, we raised a Regulatory Issue on EDF and AREVA on 1 February 2008 setting out areas where further information is needed. Our requirements for further information are summarised in Annexe 2.

Next steps

As identified in the Government's consultation document[4] and White Paper on nuclear power[5] an 'energy gap' is likely to occur in the UK between 2016 and 2022. For nuclear power to play a role in addressing this gap, generic design assessments need to be completed by 2010 – 2011 (to allow time for subsequent site-specific permitting and construction). We will work together with HSE to achieve this. The Government has established a prioritisation process[5] so that they can recommend to the regulators which of the designs that have been through the preliminary stage of GDA should continue to the detailed assessment stage. This process is expected to be completed by May 2008.

If the UK EPR design is successful in the prioritisation process, we will begin our detailed assessment to come to an initial view as to whether we might issue a statement of design acceptability. To do this, we will need the further information detailed in Annexe 2. The JPO will make this further information, along with the information HSE need for their 'step 3' assessment, publicly available (apart from any sensitive nuclear information or agreed commercially confidential information) in the same way as the initial submission, and invite comments on it.

Once we have completed our detailed assessment, we will consult widely on our initial view. We expect to begin this public consultation in autumn 2009. We will carefully consider all responses to the consultation before deciding whether we should issue a statement of design acceptability. We expect to report our decision towards the end of 2010.

The UK EPR design

This section provides a brief outline of the design and how it is proposed that waste will be created, processed and disposed of.

Outline of design

The UK EPR design is for a single, pressurised water reactor (PWR) capable of generating in total 1735 megawatts (MW) of electricity and providing 1630 MW of this to the national grid. In the reactor core, the uranium oxide fuel (enriched up to five per cent of uranium-235) is cooled by water in a pressurised circuit, the primary circuit. This water also acts as the neutron moderator necessary for a sustained nuclear fission reaction. The primary circuit includes four steam generators where heat is transferred from the primary circuit to an isolated secondary circuit, producing steam. This steam then drives a turbine-generator to produce electricity, is condensed, and the condensate returned to the steam generators.

The main ancillary facilities include a spent-fuel storage pond, water treatment systems for maintaining the chemistry of the primary and secondary water circuits, standby diesel generators for providing power in the event of loss of grid supplies, and waste treatment and storage facilities. Turbine condenser cooling water will be provided by a once-through system using seawater.

The UK EPR design has evolved from combining experience from earlier separate PWR designs operating in France and Germany (77 operational plants). The most recent French design was the N4, brought into commercial operation in 1996 (Chooz B1). The most recent German design was the KONVOI, brought into commercial operation in 1988 (Isar 2). The EPR has undergone design assessment by the nuclear regulators in Finland and France and has obtained construction licences. A combined Construction and Operating Licence application is being assessed in the USA. Two EPRs are in the early stages of construction, at Olkiluoto in Finland and Flamanville in France.

Sources, processing and disposal of radioactive waste

Radioactive waste would be produced by activities associated either directly or indirectly with operating and maintaining the reactor, and ultimately, from decommissioning the plant. In particular, operating a PWR generates radioactive waste in the water of the primary coolant circuit.

Liquid radioactive discharges are produced mainly from effluents associated with systems for collecting and treating the primary circuit water. Other sources of effluent include the fuel pool purification system and washings from plant decontamination. Effluent treatment facilities include accumulation, hold up and monitoring tanks; filters; evaporation; degassing and demineraliser ion exchange resin beds. Facilities to sample and monitor effluents before they are released are provided. Final discharge is to the sea combined with the cooling water.

The main source of gaseous radioactive emissions is from degassing the water in the primary circuit. This is directed to the gaseous effluent treatment system where waste gas is dried then passed through a line of three activated carbon delay beds (to allow noble gases to decay). After primary filtration, the waste gas is further filtered through high efficiency particulate air (HEPA) filters before being discharged after sampling and monitoring.

Gaseous activity will also be present in the main process buildings, which are serviced by the heating, ventilation and air-conditioning (HVAC) systems. The effluents from ventilation are passed through HEPA filtration systems and, if necessary, iodine traps before being discharged. There is also the possibility of tritium in the secondary circuit from minor leaks

from the primary circuit. This is collected in the condenser vacuum system and directed to the HVAC system for HEPA filtration. All gaseous effluents are collected for discharge through a common stack. Stack height is based on site specific factors to give good dispersion, as a minimum it will be at the height of the reactor building. An initial estimate is 60 metres. There is provision for sampling and monitoring gaseous effluents at various points in the treatment systems as well as at the final combined discharge stack.

Radioactive waste which is not discharged directly to the environment includes spent ion exchange resins; spent filter media; worn-out plant components and parts; contaminated protective clothing and tools; rags and tissues and waste oil. These are collected in the solid effluent treatment plant where basic conditioning is carried out so they can be disposed of off-site.

EDF and AREVA do not expect that the UK EPR will generate any novel solid waste streams. Most solid low level radioactive waste (LLW) from its operation will be suitable for disposal at the UK National LLW Repository near Drigg in Cumbria.

All radioactive plant components are likely to become waste when the plant is decommissioned. The strategy for disposing of decommissioning waste will be provided in further information, as noted elsewhere in this statement.

Spent fuel will be stored under water in the fuel pool for about 10 years. The strategy for longer term management will be provided in further information, as noted elsewhere in this statement.

Non-radioactive waste

Non-radioactive waste is produced from the operation and maintenance of the 'conventional' side of the plant. It includes:

- combustion gases discharged to air from the diesel generators;
- water containing water-treatment chemicals from the turbine-condenser cooling system; other non-active cooling systems and the secondary circuit purge, which is discharged to the sea;
- waste lubricating oils;
- screenings from sea inlet filters;
- worn-out plant and components and general trash.

Further information on the management of non-radioactive waste will be provided in a future submission.

Non-radioactive substances will also be present in the radioactive waste and may affect how that waste is managed or the impact it has on the environment. For example, liquid radioactive discharges will contain boron compounds. Boron (a neutron absorber) is added to the primary coolant circuit to help control reactivity in the core.

Preliminary assessment

As indicated in the P&I Document[1], our preliminary assessment has involved a more detailed examination of three aspects of the submission:

- the requesting party's management system for producing the submission;
- the generic site description;
- the assessment of the impact of proposed radioactive discharges.

The management system is discussed below. The generic site characteristics that are of interest to us are, mainly, those that are relevant to estimating the impact of discharges of radionuclides and non-active species, and of cooling water abstraction and discharge. For this reason, there is considerable overlap between the generic site description and the assessment of the impact of proposed discharges, and these two aspects are considered together below.

EDF and AREVA management system

We have examined this aspect in some detail so we can be confident about the quality of the submission. This supports our risk-based 'sampling' approach for the detailed assessment stage and confirms that we are using our resources appropriately. We want to know that:

- the design has been developed and the submission produced by suitably qualified and experienced people (whether in-house staff or contractors);
- there has been an appropriate level of verification, review and approval of design and submission documents (including those produced by contractors) and the submission accurately reflects the design;
- the design has been developed taking environmental requirements (for all plant lifecycle stages) into account;
- design changes are (and will be) controlled, evaluated for their impact on environmental matters, recorded and reflected in the submission.

The EDF and AREVA submission describes the relevant management systems in Volume 1, the Head Document, Chapter B. The organisation for the UK EPR project is described as well as the quality management system (QMS) for the project. As well as examining this information, we and HSE visited both the EDF and AREVA main offices in Paris to see how the management system worked in practice. To assist us we were joined by an inspector from the French nuclear regulatory body, Autorité de Sûreté Nucléaire (ASN). Our objectives were:

- to check that both EDF and AREVA have quality management systems that adequately support production of the submissions;
- to establish that both EDF and AREVA have implemented and continue to review arrangements that adequately control their GDA-related activities;
- to inform our and HSE's assessment of the EDF and AREVA submission.

Over five days, we examined samples of the management system procedures and other documentation, and held discussions with relevant staff. The full inspection report is available on http://www.hse.gov.uk/newreactors.

The conclusion of our joint report is that:

"EDF/AREVA operate appropriate separate and joint QMSs which include and integrate aspects that control the content and accuracy of submissions to the Joint Programme Office. The development of a quality plan specific to the GDA process, the adoption of INSA and DSRC concepts and the involvement of AMEC and Rolls Royce provide significant indicators of the co-applicants' commitment to the GDA process. EDF/AREVA have experienced, knowledgeable and dedicated staff and the commitment to recruit to ensure continued adequate and continuing levels of technical resources is evident. On that basis, the UK Nuclear Regulators have confidence that the production and update of the submission is adequately controlled for this stage of the GDA process and that any comments or queries raised will be properly dealt with."

(AMEC is a UK engineering consultant)

There were, however, some matters that in our opinion could be improved, and we raised the following issues with EDF and AREVA:

Recommendation 1:

"The EDF/AREVA Project Team should consider, as part of its restatement of the role of the GDA Steering Committee, the role the latter plays in providing Governance to the process."

Recommendation 2:

"The EDF/AREVA Project Team should consider the formal tracking of Regulatory Issues possibly by using the existing action tracking database."

EDF and AREVA responded positively to the recommendations and have advised us of appropriate changes to systems.

We had not received any public comments on EDF and AREVA's management systems by 4 January 2008.

Apart from the above issues, we do not require further information on this topic. Our conclusion is that EDF and AREVA have appropriate management systems in place to control the content and accuracy of information they provide for GDA.

Generic site description and assessment of the impact of proposed radioactive discharges

The purpose of examining these aspects in detail at this stage is to ensure that the relevant constraints of potential sites are appropriately reflected, and to provide early assurance that dose constraints will be complied with.

The generic site characteristics that are of interest to us include:

- weather and other parameters affecting gaseous dispersion and deposition;
- hydrographic and other parameters affecting aqueous dispersion;
- location of nearest food production, human habitation, sensitive habitats and species;
- food consumption rates and other human habits data;
- availability of water for abstraction.

The submission discusses the generic site in Volume 3 Chapter C. It provides an overview of the site requirements for the UK EPR and defines extremes for matters such as flooding,

rainfall and high winds. Some information on food intake and human habits are provided in Chapter D.7.3.1 but are referenced to the Flamanville site. EDF and AREVA say that a similar approach would be developed for specific UK sites. The submission did not provide us with a set of site characteristics, as defined in the P&I Document, for us to assess:

- whether they were appropriate for sites in England and Wales;
- the environmental impact of the UK EPR design.

We raised a technical query on this issue, see below.

Our P&I Document[1] asks the requesting party to provide dose assessments addressing annual doses from gaseous and liquid radioactive discharges and direct radiation, potential short-term doses from the maximum anticipated short-term discharges for normal operation, and collective dose. The submission provides dose assessments extracted from the EPR proposal for Flamanville, France in Volume 3 Chapter D.7.3.1, the conclusions are reproduced below:

- *"The total annual effective dose owing to liquid and gaseous radioactive discharges from the Flamanville site is estimated at around 11 µSv/year for the maximum discharges and less than 2 µSv/year for the "realistic" discharges;*

- *For adults in the "fisherman" group, the total annual effective dose owing to liquid and gaseous radioactive discharges from the Flamanville site is estimated at less than 16 µSv/year* [for the maximum discharges] *and less than 3 µSv/year for the "realistic" discharges;*

- *For infants, the total annual effective dose owing to liquid and gaseous radioactive discharges from the Flamanville site is estimated at less than 15 µSv/year* [for the maximum discharges] *and around 3 µSv/year for the "realistic" discharges."*

The Flamanville site has two nuclear power units already in operation and the above includes the contribution of these. The difference between maximum and "realistic" discharges is discussed below (see below under "disposal limits"). The results compare favourably to:

- the annual dose constraint to the critical group of 300 µSv from any single new source (see Considerations Document[6]);
- the UK discharge strategy aim that the dose from liquid discharges to the marine environment will not exceed 20 µSv (see Considerations Document[6]).

However, the results are not for a generic site. We felt it essential, for our preliminary assessment, to at least have an assessment of the annual doses from the gaseous and liquid discharges for an appropriate generic site. We asked for this to be provided by issuing a Technical Query 29 November 2007. We provided an extract from our initial radiological assessment methodology[8,9] to help the requesting parties do this. This methodology uses default parameters which are appropriate to the UK and which will produce a cautious, but not unrealistic, dose assessment.

EDF and AREVA provided information in its response on 31 January 2008. This provided dose assessments based on the above methodology. The assessment used the emission figures stated in the submission, Volume 3 Chapter D.7.1 (see below under "disposal limits"). The assessment for gaseous discharges used an effective stack height of 20 metres (down from 60 m nominal height to allow for entrainment in the wake of the reactor building) and gave an estimated dose for "maximum discharges" as less than 12 µSv/year. The assessment for liquid discharges used a discharge to sea only with a volumetric exchange rate of 130 cubic metres per second (a pessimistic value for estuaries or bays) and gave an estimated dose to a "fishing family" (one eating lots of local seafood) for "maximum

discharges" as about 46 μSv/year. The annual dose from direct radiation from the UK EPR to the critical group living at 100 m from the reactor building is stated as less than 6 μSv/year.

The total annual dose (sum of the above) is then estimated to be 63 μSv/year.

The total assessed annual dose of 63 μSv/year is a pessimistic typical figure but is still well within the source constraint of 300 μSv/year from any single new source (see Considerations Document[6]).

We also applied our initial radiological assessment methodology[8,9] and input the EDF and AREVA "maximum discharge" figures. We have assumed an average exchange rate for coastal liquid discharges of 100 m^3/s which is our normal practice when making screening calculations for radioactive discharges to the marine environment. The exchange rate represents the rate of dispersion of the liquid effluent – the lower the exchange rate the slower the dispersion. An exchange rate of 100 m^3/s is slightly lower than that found at the locations of existing nuclear facilities in England and Wales and will result in a cautious but not unrealistic approach.

In our assessment of the annual dose from discharges to air we have used a release height of 20 meters in the absence of information on the effective release height from the plant stack. Effective release height is dependent on site specific characteristics such as topography and geography. At the next stage of the GDA process we will carry out a more detailed dose assessment which will take into account the effects that nearby buildings may have on the dispersion of the radioactive gaseous effluent.

For our screening dose calculations we have treated some radionuclides individually and grouped some radionuclides as follows:

- Tritium (hydrogen-3) was assessed individually as tritiated water
- Carbon-14 was assessed individually
- Argon-41 was assessed individually
- All krypton radionuclides were taken together and assessed as krypton-85
- All iodine radionuclides were taken together and assessed as iodine-131
- All xenon radionuclides were taken together and assessed as xenon-133
- All other beta or gamma emitters were taken together and assessed as caesium-137

Our results were:

- dose from discharges to sea = 45 μSv/year;
- dose from discharges to air = 11 μSv/year.

We used an estimate of 10 μSv/year for the direct radiation at the perimeter fence of Sizewell B during our authorisation review of 2006. Adding this figure as a pessimistic value to the above dose gives the Environment Agency assessment:

- Total annual dose = 66 μSv.

Our assessment is similar to that of EDF and AREVA and confirms their calculations. The assessments are pessimistic, for example using the dispersion factor for the Suffolk coast of 350 would reduce the dose from sea discharges to 13 μSv/year. A more detailed assessment using dispersion models may reduce the values.

Also EDF and AREVA have provided an estimate for carbon-14 in the liquid discharge based on the practice in France, whereas some RPs have not. Past practice has been to assume that all carbon-14 is discharged to air whereas some evidence suggests a proportion

remains in the liquid phase. Carbon-14 contributes very significantly to the dose from sea discharge, without it our dose estimate would reduce to 1.6 µSv/year (from 45 above). We will be consider limiting carbon-14 in discharges to water during our detailed assessment.

We had not received any public comments relating to the generic site or dose assessment for this design by 4 January 2008.

Our conclusion is that, for a coastal site:

- the annual dose constraints and limits will be met by this design;
- to ensure that the UK discharge strategy aim that the dose from liquid discharges to the marine environment will not exceed 20 µSv/year (see Considerations Document[6]) is met for this design we will need to consider the site specific discharge location and its dispersion characteristics.

For our detailed assessment, we will need further information, as set out under reference 2.7 of Annexe 2.

Matters considered at principle level

For matters other than management and the assessment of impact we have carried out our assessment at a "principle" level. That is that we have accepted EDF and AREVA's claims with only very limited scrutiny of the supporting arguments and evidence. These matters are discussed below.

Waste and spent fuel strategy

Our P&I Document[1] asks the requesting party to provide a waste and spent fuel strategy. We expect the requesting party to have considered this strategy when they developed the design of the plant, particularly for the waste management and spent fuel facilities. In respect of radioactive waste and spent fuel, our REPs[7] set out (Developed Principle 1) the issues this type of strategy should take into account. The Government's consultation document[4] and White Paper[5] also indicate that the disposal of intermediate level radioactive waste (ILW) to a future geological repository, from any new nuclear power stations, is unlikely to occur until late this century. It states that "*The Government has concluded that any nuclear power stations that might be built in the UK should proceed on the basis that spent fuel will not be reprocessed*…." This effectively means that the strategy (and the design) need to include provision for on-site storage of both ILW and spent fuel for the lifetime of the plant, or an appropriate alternative. For conventional waste, we expect the strategy to meet the relevant objectives of the Waste Framework Directive[10].

EDF and AREVA's submission refers to radioactive solid waste and spent fuel in Volume 3 Chapter B 8.3 and Chapter D.7.1 section 6. While this gives an overview of waste produced and objectives to minimise its impact, we do not consider that a formal strategy has been presented.

We received two public comments, one relating to length of on-site storage and the other saying that there was little information on waste and spent fuel management. EDF and AREVA responded with overview information as noted above. We also believe more information is needed for detailed assessment, as noted below.

Insufficient information has been provided for us to draw any conclusions on this topic at this stage. For our detailed assessment, we will need further information as set out under reference 1.4 of Annexe 2.

Best available techniques

Our P&I Document[1] asks the requesting party to provide an analysis, including an evaluation of options considered, that demonstrates that the best available techniques (BAT) will be used to minimise the production and discharge or disposal of waste. It specifies a number of issues that the analysis should address. We are required by law to exercise our pollution control powers to prevent, minimise, remedy or mitigate the effects of polluting the environment (see Considerations Document[6]). Requiring the requesting party to use BAT is one of the main ways in which we achieve this.

EDF and AREVA's submission provides information on techniques used to minimise waste produced in Volume 3 Chapter D.7.1. At the principle level we did not find any matters that are obviously unacceptable nor any significant design modifications that are likely to be needed before we could issue a permit. However there is no apparent BAT assessment. EDF and AREVA have identified in Volume 1 Chapter I that "*Demonstration that UK EPR environmental protection measures employ Best Available Techniques*" is outstanding information.

We had not received any public comments on EDF and AREVA's analysis of BAT by 4 January 2008.

Insufficient information has been provided for us to draw any conclusions on this topic at this stage. For our detailed assessment, we will need further information as set out under reference 1.5 of Annexe 2.

Quantification of liquid and gaseous waste

Our P&I Document[1] asks the requesting party to:

- describe how liquid and gaseous radioactive waste will be produced, managed and disposed of, identifying any discharge points for gaseous waste and discharge routes for liquid waste;
- provide estimates for the expected monthly discharges of gaseous and liquid radioactive waste, specifying the extent of, and reasons for, any changes.

This information is needed to support the assessment of the impact of the discharges and the BAT analysis, and to provide a basis for limit setting. As stated in the Government's consultation document[4] and reiterated in the White Paper[5], it is expected that the application of BAT would ensure that discharges from new nuclear power stations constructed in the UK would not exceed the levels of comparable power stations across the world.

EDF and AREVA's submission addresses this topic in Volume 3 Chapter D.7.1.

Liquid waste is mainly produced from the primary coolant and consists of:

- activated corrosion products – for example, radionuclides activated from components of steel (such as iron, nickel and cobalt) used in the structural items of the coolant circuit;
- activated products from chemicals in the coolant – for example, from the activation of boric acid and lithium hydroxide;
- volatile fission products such as caesium-134, caesium-137 and iodine-131 that may escape from minute leaks in fuel pins.

Depending on the type of waste, various treatment options are available. These include delay storage; demineralisation by ion exchange resin; degassing; evaporation; and, filtration. Discharge will be to the sea together with the cooling water.

Gaseous waste is mainly produced from degassing the water in the primary circuit. This will comprise:

- noble gases formed by fission such as xenon-133 and xenon-135 with a lower proportion of krypton-85;
- carbon-14 from activation of the coolant water;
- tritium from fission within the fuel and activation of boron in the cooling water;
- iodines, mainly iodine-131 and iodine-133, also from fission.

This waste stream is directed to the gaseous-effluent treatment system, where waste gas is dried then passed through a line of three activated carbon delay beds (to allow noble gases to decay). After primary filtration, the waste gas is further filtered through high efficiency particulate air (HEPA) filters before being discharged.

Gaseous activity will also be present in the main process buildings, which are serviced by the heating, ventilation and air-conditioning (HVAC) systems. The HVAC air may contain some argon-41 formed in the reactor building air and trace amounts of aerosols of cobalt-58/60 and caesium-134/137. The HVAC air is passed through HEPA filtration systems and, if necessary, iodine traps before being discharged.

There is also the possibility of tritium in the secondary circuit from minor leaks from the primary circuit. This is collected in the condenser vacuum system and directed to the HVAC system.

All gaseous waste is collected for discharge through a common stack with a nominal height of 60 metres.

The proposed treatment techniques are similar to those used in comparable reactors worldwide.

Monthly discharge information has not yet been provided but estimates of annual discharges are given in Volume 3 Chapter D.7.1, see "realistic discharges" below in "disposal limits". We have compared these discharges to some currently operating reactors[13] using mean values for 1995 to 1999 and normalised to 1000 MW electric gross to even out the effect of reactor size (the UK EPR values were normalised by a factor 1000/1735):

Table 1: Annual operational discharges to water, GBq normalised to 1000 MWe

Reactor	Type	Tritium	Other beta or gamma
Sizewell B	PWR	33100	21
Olkiluoto 1 & 2	BWR	893	6.4
Tihange 1,2 & 3	PWR	15700	9.4
Emsland	PWR	10700	0.13
Gundremmingen	BWR	3290	0.33
Bruce B	CANDU	118000	1.6
Darlington	CANDU	27700	2.9
UK EPR "realistic"	PWR	29971	0.35*

*Note: UK EPR "Other beta or gamma" does not include iodines or carbon -14
(Type: PWR is Pressurised Water Reactor, BWR is Boiling Water Reactor, and CANDU is CANada Deuterium Uranium*)*

Table 2: Annual operational discharges to air, GBq normalised to 1000 MWe

Reactor	Type	Tritium	Noble Gases	Iodine-131	Carbon-14	Other beta or gamma
Sizewell B	PWR	566	6330	0.09	66	0.008
Olkiluoto 1 & 2	BWR	189	9960	0.01	410	0.02
Tihange 1, 2 & 3	PWR	1970	2780	0.006	not reported	0.01
Emsland	PWR	1530	572	0.0004	290	0.0001
Gundremmingen	BWR	533	26	0.0004	450	0.00004
Bruce B	CANDU	101000	19400*	0.015	967	0.03
Darlington	CANDU	59600	48600*	0.018	813	0.02
UK EPR "realistic"	PWR	288	461	0.03	202	0.0023

* Units are GBq-MeV

The UK EPR discharges are similar to or less than those of comparable reactors. We will be comparing on a worldwide basis during our detailed assessment.

We had not received any public comments on EDF and AREVA's quantification of liquid and gaseous radioactive waste arisings by 4 January 2008.

Our conclusion, at the principle level, is that the design meets the expectation that discharges should not exceed the levels of comparable power stations across the world. However, more detailed information is required on this topic to support the assessment of the impact of the discharges, the BAT analysis, and the setting of indicative limits.

For our detailed assessment, we will need further information as set out under references 2.2 and 2.3 of Annexe 2.

Disposal limits for radioactive liquid and gaseous discharges

Our P&I Document[1] asks the requesting party to propose annual limits for radioactive liquid and gaseous discharges based on the information provided on arisings and our published report on setting limits[11].

The EDF and AREVA submission provides discharge information in Volume 3 Chapter D.7.1. Information is given for:

- "realistic discharges" – expected discharges for normal operation with no significant margin for normal operational contingencies/events;
- "maximum discharges" – maximum estimated discharges that include margins for a range of contingencies such as shutdowns, start-ups and minute fuel assembly leaks (but excluding faults and design basis accidents).

Summarising the information:

Table 3: Annual estimated discharges to water for the UK EPR, GBq

Radionuclide	"realistic discharge"	"maximum discharge"
Tritium	52,000	75,000
Carbon-14	23	95
Iodines	0.007	0.05
Other beta or gamma	0.6	10

Table 4: Annual estimated discharges to air for the UK EPR, GBq

Radionuclide	"realistic discharge"	"maximum discharge"
Tritium	500	3000
Carbon-14	350	900
Iodines	0.05	0.4
Noble gases	800	22500
Other beta or gamma	0.004	0.34

We have taken the "maximum discharge" figures as an initial proposal for annual limits. We will be investigating in depth the base data and methodology used for producing the above information during our detailed assessment. We will then consider what limits we could set in an authorisation.

We have made an initial comparison with the current limits for Sizewell B. Figures are normalised to 1000 MW gross electricity capacity to help this, as the UK EPR is a larger capacity unit than Sizewell B. In our detailed assessment we will consider against units worldwide.

Table 5: Comparison of UK EPR annual discharges to water with Sizewell B limits, GBq normalised to 1000 MWe

Radionuclide	Sizewell B limits	UK EPR "maximum discharge"
Tritium	67,230	43,228
Other beta or gamma	109	6

Table 6: Comparison of UK EPR annual discharges to air with Sizewell B limits, GBq normalised to 1000 MWe

Radionuclide	Sizewell B limits	UK EPR "maximum discharge"
Tritium	2520	1730
Carbon-14	420	520
Iodines	0.42	0.23
Noble gases	25200	12970
Other beta or gamma	0.08	0.2

The UK EPR "maximum discharge" figures compare favourably with Sizewell B limits apart from carbon-14 and other beta or gamma for discharges to air. However, the significance of the higher values does not prevent us moving to a detailed assessment, where we will consider the arguments and evidence supporting EDF and AREVA's claims.

We had not received any public comments on EDF and AREVA's proposed discharge limits by 4 January 2008.

Our conclusion, at the principle level, is that the maximum discharge levels are appropriate for us to use as a basis for determining emission limit values for the UK EPR in our detailed assessment. However, for our detailed assessment we will need further information as set out under reference 2.3 of Annexe 2.

Quantification of solid waste and spent fuel

Our P&I Document[1] asks the requesting party to:

- describe how solid radioactive waste will be produced, managed and disposed of;
- provide estimates for the annual arisings (during operations and decommissioning) of high level (HLW), intermediate level (ILW) and low level (LLW) radioactive waste;
- describe how spent fuel will be managed and estimate the quantity that will be produced during the lifetime of the facility;
- provide a view from the Nuclear Decommissioning Authority (NDA) on how disposable any proposed ILW or HLW waste or spent fuel is.

This information is needed to:

- support the waste and spent fuel strategy and BAT analysis;
- support the assessment of the impact of any proposed direct disposal of waste (for example by on-site incineration);
- provide a basis for indicative limit setting, where appropriate;
- provide confidence that waste will not be generated for which there is no foreseeable disposal route.

EDF and AREVA's submission provides an overview of this topic in Volume 3 Chapter D.7.1. Solid waste will be collected and treated in a "solid effluent treatment plant". The type of waste expected is:

- "process waste" – from treating effluents such as ion-exchange resins, sludges from tanks, used filters and evaporator concentrates;
- "technological waste" – mainly from maintenance work such as used gloves, papers, insulation, cleaning materials etc;
- "sundry waste" – generally from incidents such as contaminated oils or from one-off operations such as replacing control rods.

The total annual volume of raw radioactive waste from the UK EPR is not expected to exceed 80 cubic metres and should not contain any new or novel waste streams. Most low level waste (LLW) should be suitable for disposal at the UK national LLW disposal facility near Drigg. Decommissioning waste is not adequately described.

Some information on spent fuel management is provided in Volume 3 Chapter D.7.2 section 5. There are UK EPR design features that allow increased fuel burn-up to 60 gigawatt days per tonne, which reduces the total amount of spent fuel quantities over its operating life. Quantities are not defined. Spent fuel will initially be stored for up to 10 years in the fuel pool

within the UK EPR. The submission does not provide a firm proposal for long term management.

Our conclusion, at the principle level, is that the amount of solid radioactive waste produced is consistent with those of comparable reactors around the world and the design should not lead to waste being produced that cannot be disposed of.

Insufficient information has been provided for us to draw any conclusions on the management of spent fuel at this stage. For our detailed assessment, we will need further information as set out under references 2.4 and 2.5 of Annexe 2.

Methods for determining discharges

Our P&I Document[1] asks the requesting party to describe the sampling arrangements, techniques and systems proposed for measuring and assessing discharges and disposals of radioactive waste.

EDF and AREVA's submission gives an overview of monitoring arrangements in Volume 3 Chapter 7.5.

Liquid effluent is discharged from tanks and its volume and activity will be measured before it is discharged. Tanks can only discharge into adequate dilution provided by the cooling water flow. There is some indication that activity monitors installed on discharge pipes will be used to stop discharge if pre-set thresholds are exceeded. The sampling and measurement of the final discharge is not described. Measurements of activity are only described for groups such as “global alpha” rather than for specific radionuclides, apart from tritium and carbon-14.

Gaseous effluent is collected in a single discharge stack. The submission states the stack will be continuously monitored with alarms to the control room if pre-set thresholds are exceeded. There is no detail provided on the systems to be used. There is some information that waste streams feeding into the stack will be individually monitored and alarmed, but again no detail is given. Radionuclide categories for measurements are stated: tritium, radioactive iodides, inert radioactive gases, carbon-14, other beta and gamma emitters and alpha emitters.

The submission states that an environmental monitoring programme would be agreed for specific sites and gives, as an example, an outline of the programme proposed for Flamanville.

The monitoring of solid waste is mentioned briefly in Volume 3 Chapter D.7.1 section 6.2, but detail is lacking. In our view the submission fails to address whether the arrangements:

- are adequate to determine discharges at the levels of detection recommended by the EU[12];
- represent the best available techniques for measuring and assessing discharges and disposals.

We had not received any public comments on EDF and AREVA's proposed methods for measurement and assessment of discharges and disposals by 4 January 2008.

Insufficient information has been provided for us to draw any conclusions on whether the proposed methods for determination of discharges are acceptable. For our detailed assessment, we will need further information as set out under reference 2.6 of Annexe 2.

Assessment of the impact of radioactive discharges on non-human species

Our P&I Document[1] asks the requesting party to provide an assessment of the likely impact of the radioactive discharges on non-human species and gives a methodology for doing this. This is required to demonstrate acceptability with regard to relevant conservation legislation (see Considerations Document[6]).

EDF and AREVA's submission provides some overview information in Volume 3 Chapter D.7.3.2/3. This is a summary of assessments for the Flamanville site and does not address our requirements to evaluate impact at a generic UK site.

We had not received any public comments on EDF and AREVA's assessment of non-human impacts by 4 January 2008.

Insufficient information has been provided for us to draw any conclusions on the acceptability of the impact of radioactive discharges on non-human species at this stage. For our detailed assessment, we will need further information as set out under reference 2.10 of Annexe 2.

Impact of water abstraction and discharge

Our P&I Document[1] asks the requesting party to provide an analysis of the environmental impact of a range of cooling options relevant to the generic site characteristics, considering the impact of any proposed water abstraction and any discharges to water as a consequence. This is needed to demonstrate acceptability with regard to WRA 91 requirements.

EDF and AREVA's submission describes sea water cooling in Volume 3 Chapter B. The requirement for sea water will be 67 cubic metres per second with a return temperature no higher than 14°C above the intake temperature. Environmental impact is not addressed in sufficient detail for our detailed assessment. Other cooling options are not addressed.

We had not received any public comments on EDF and AREVA's assessment of the environmental impact of cooling options by 4 January 2008.

Insufficient information has been provided for us to draw any conclusions on the acceptability of the impact of water abstraction and discharge associated with cooling options at this stage. For our detailed assessment, we will need further information as set out under reference 3.1 of Annexe 2.

Non-radioactive species in liquid discharges

Our P&I Document[1] asks the requesting party to provide an analysis of how non-radioactive liquid waste streams will arise, be managed and disposed of during the lifetime of the facility, including identifying options and the associated environmental impact for disposal of each individual effluent stream. This is needed to demonstrate acceptability with regard to the requirements of WRA 91 and *The Groundwater Regulations 1998,* Statutory Instrument 1998 No. 2746.

EDF and AREVA's submission provides some information on this topic in Volume 3 Chapter D.1. In particular, section 3.2.6 gives estimates of annual discharges and daily maximum concentrations for a range of substances. The highest emission is of boric acid. Nitrogen compounds, phosphates, morpholine and ethanolamine (from water treatments) are also significant. A more detailed assessment is required relating to Environmental Quality Standards for a UK discharge. There is information on design considerations to minimise the potential for any fugitive emissions to groundwater. These include measures for

subsurface structures, sumps, surfaces, storage tanks and areas. We believe there is sufficient information for us to proceed to detailed assessment on this issue.

We had not received any public comments on non-radioactive liquid waste streams by 4 January 2008.

Insufficient information has been provided for us to draw any conclusions on the acceptability of the impact of non-radioactive species in liquid discharges at this stage. However, at the principle level, the UK EPR should be able to meet requirements for preventing fugitive releases to groundwater or other controlled waters. For our detailed assessment, we will need further information as set out under reference 3.2 of Annexe 2.

Standby generation and incineration

Our P&I Document[1] asks the requesting party to identify whether any plant included in the design, such as standby diesel generators, would need to be considered under PPC 00 and, if so, to provide specified information.

EDF and AREVA's submission refers to the inclusion of standby diesel generators, but does not identify whether they would be subject to PPC 00. We believe from the information provided that the aggregate thermal input of diesel generators will exceed 50 MW and that a PPC permit will be needed.

We had not received any public comments on plant subject to PPC 00 by 4 January 2008. For our detailed assessment, we will need further information as set out under reference 3.3 of Annexe 2.

COMAH

Our P&I Document[1] asks the requesting party to identify any need for the on-site storage of substances above the qualifying thresholds in COMAH 99.

EDF and AREVA's submission states in Volume 1 Chapter I that this information will be supplied at the detailed assessment stage.

We had not received any public comments on substances subject to COMAH 99 by 4 January 2008.

Insufficient information has been provided for us to draw any conclusions on this topic at this stage. For our detailed assessment, we will need further information as set out under reference 3.4 of Annexe 2.

Overall conclusions of our preliminary assessment

In our preliminary assessment we examined the management systems used for producing the submission and the impact of the proposed radioactive discharges. We formed a view as to whether the submission contained any matters that are obviously unacceptable or whether we could identify any significant design modifications that are likely to be required. We also assessed whether there was sufficient information for us to undertake the detailed assessment stage. Our conclusions are presented below:

• EDF and AREVA have appropriate management systems in place to control the content and accuracy of the information they provide for GDA.
• The annual radiation impact of the UK EPR design on people would be below the UK constraint for any single new source.
• We did not find any matters within the submission that are obviously unacceptable.
• We have not identified any significant design modifications that are likely to be needed before we could issue a permit.
• The submission does not contain the level of information we need to carry out a detailed assessment.

Our conclusions above are provisional and dependent upon our assessment of further information.

Further information

Our information requirements are set out in our P&I Document[1]. The submission fails to adequately address a number of these requirements. As such, we cannot progress to the detailed assessment stage of GDA with the current submission. Only if we receive the level of information we need promptly, will we be able to maintain our overall target of three years for completing the GDA (as outlined in our P&I Document[1]).

We wrote to EDF and AREVA on 1 February 2008 asking for its commitment to provide the further information listed in Annexe 2, and its timetable for doing so. EDF and AREVA responded on 28 February 2008, committing to provide each item of information by the relevant date specified. We believe that the proposed timetable will allow us to begin our detailed assessment once the results of the prioritisation process are known (if EDF and AREVA is successful in that process). Subject to the quality of the information provided, we should be able to proceed to public consultation in the autumn of 2009. This is consistent with achieving the three year timeframe for completing the GDA.

References

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4. *The Future of Nuclear Power. The Role of Nuclear Power in a Low Carbon UK Economy: Consultation Document*, DTI, May 2007.
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5. *Meeting the Energy challenge. A White Paper on Nuclear Power*, BERR, January 2008.
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7. *Radioactive Substances Environmental Principles (Interim)*, Environment Agency, Nov 2005.

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10. *Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste.* Off. J. Eur. Union, L114, 27.4.2006.
11. *Development of Guidance on Setting Limits on Radioactive Discharges to the Environment from Nuclear Sites* (Science Report: SC010034/SR, Environment Agency, December 05)
12. *Commission Recommendation of 18 December 2003 on standardised information on radioactive airborne and liquid discharges into the environment from nuclear power reactors and reprocessing plants in normal operation* (2004/2/Euratom). Off. J. Eur. Union, L 2, 6.1.2004.
13. Information collated from:
    Radiation Protection 127 Radioactive effluents from nuclear power stations and nuclear fuel reprocessing plants in the European Union, 1995 -1999 (European Commission, 2001)
    Radiation Protection 143 Radioactive effluents from nuclear power stations and nuclear fuel reprocessing sites in the European Union, 1999 - 2003 (European Commission, 2005)
    Nuclear Power Reactors in the World, Reference Data Series No 2, IAEA, April 2006
    Nuclear Engineering International, Vol 51, No 625, August 2006
    Radioactive Release Data from Canadian Nuclear Generating Stations 1994 to 2002, INFO-0210 (Revision 12), CNSC, Jan 2005

Annexe 1

Documents included in EDF and AREVA's submission

General Introduction
Volume 1 Head Document
Volume 2 Design and Safety
Volume 3 Environmental Impact

Annexe 2

Further information required for detailed assessment stage

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
1.3 The Generic Site Characteristics that the requesting party wishes us to take into account when assessing the environmental impact of the reactor design. If we issue any statement of acceptability after our assessment, it would be on the basis of these characteristics. A range of generic sites might be addressed with coastal, estuarine and inland characteristics.	There is a lack of information. Advice: 1. The characteristics of the environs of the site/sites that are used to assess the environmental impact of the design. A critical group/groups should be defined with its habits. A sensitive habitat should be defined for non-human species. The Environment Agency report *"Initial Radiological Assessment Method SC030162"* should be referenced. Examples of recent assessments are given in *"Decision on the future regulation of disposals of radioactive waste from British Energy Generation Limited's Nuclear Power Stations in England"* published March 2007.	November 2008

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
1.4 A proposed waste and spent fuel strategy based on the expected waste generation and management practices throughout the facility lifecycle. This strategy should have regard to - the *UK Government's Sustainable Development Strategy (March 2005) Cm 6467;* - the objectives of the *UK strategy for radioactive discharges 2001-2020, Defra;* - the *Review of Radioactive Waste Management Policy, Final Conclusions, Cm2919 July 1995;* - *The Decommissioning of the UK Nuclear Industry's Facilities* (decommissioning policy); and - our *Radioactive Substances Regulation Environmental Principles* (REPs). Further background on UK radioactive waste management policies can be found at RWPG	The information provided is an overview, more details are needed. Advice: 1. A definitive strategy shall be proposed for both radioactive and non-radioactive waste. 2. Information provided to support the strategy will need to include design information for the ancillary facilities required, such as waste treatment or storage. 3. A review of the strategy shall be provided to demonstrate that the strategy has considered relevant UK requirements, as listed in the P & I D. 4. The strategy for non-radioactive waste will need to demonstrate that the Waste Framework Directive, Waste Management Licensing Regulations 1994, Pollution Prevention and Control Regulations and Duty of Care requirements have been considered and will be satisfied.	Part April 2008 Complete in November 2008

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
1.5 An analysis should be provided that includes an evaluation of options considered and shows that the Best Available Techniques will be used to minimise the production and discharge or disposal of waste. This should include - a description of the means used by each significant waste generating and management process to minimise waste arising and discharged or disposed of, and a demonstration that these are the best practicable; - a review of design features, including those of fuel usage, such as burn-up and rating, that facilitate minimisation of arisings and disposal of waste during operation of the reactor; - a review of design features that facilitate decommissioning and minimise the arisings of decommissioning waste. - Reference should be made to: - all periods of "operation", for example, at power, shutdown, maintenance and refuelling (including related tasks such as fuel and flask handling); - transitory periods (e.g. returning to power following shutdown); - issues relating to minimising radioactivity source terms (for example materials of construction and coolant chemistry); - abatement issues (for example optimising resin types and usage in treatment systems); - process control and monitoring arrangements including fault detection; continued....	Some information on the proposed techniques was provided but no BAT assessment. Advice: 1. A formal BAT assessment is required for each significant waste stream: an options appraisal for preventing or reducing to the minimum emission. The appraisal should then be used to justify the chosen technique. The Environment Agency PPC guidance note H1 "Environmental Appraisal and Assessment of BAT" provides an indication of the approach we would prefer. 2. Design features that help decommissioning and minimise arisings of decommissioning waste are an important consideration for us and need to be considered in detail. 3. The P&ID indicates a number of issues "that reference should be made to". It is not clear these that issues have been addressed. You should ensure that further information addresses these issues and is clearly signposted to help assessment against each issue.	June 2008 April 2008 June 2008

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
- the selection of materials and physical features to minimise activation and contamination, facilitate decontamination, removal of components etc; and - practices at other existing and proposed facilities.		
2.1 A description of how radioactive wastes will arise, be managed and disposed of throughout the facility's lifecycle**.** This should include: - sources of radioactivity and matters which affect wastes arising; - gaseous, liquid and solid wastes; - discharge points for gaseous wastes and discharge routes for liquid wastes; - disposal routes for solid wastes (including any proposals for incineration of combustible waste).	Some information is provided but additional details are required. Advice: 1. An assessment of waste produced during decommissioning phase to be included. 2. A single gaseous discharge stack is proposed, information on this stack, such as height, diameter, flows etc is lacking. 3. Detail on the management, handling and disposal of solid waste is required – this supports the strategy provided in 1.4 above and should answer 1.4.2 above.	April 2008
2.2 Design basis estimates for monthly discharges of gaseous and liquid radioactive waste (for each radionuclide identified in *EU Commission Recommendation* 2004/2/Euratom). Such estimates should be fully supported with the reasons for, and extent of, any variability being identified. The consideration of variability should take into account the results of a fault analysis and include events such as start-up, shutdown, maintenance, steam generator leaks and leaking fuel, for example. The design basis estimates should be compared with the performance of other comparable facilities.	The submission contained no information. Advice: 1. The monthly profile of emissions over longer periods including operating cycles is important for our assessment. It enables us to assess short term impacts for any peak emissions. It enables us to compare the design with current operating power stations across the world.	November 2008

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
2.3 Proposed annual limits with derivation for radioactive gaseous and liquid discharges consistent with the information of 2.2 above and taking account of *Development of Guidance on Setting Limits on Radioactive Discharges to the Environment from Nuclear Sites,* (Science Report: SC010034/SR, Environment Agency, December 05) (see Publications Catalogue). Where the requesting party feels it relevant, they may additionally propose limits to reflect an operating cycle i.e. campaign limits.	Some information was provided but more details are required. Advice: 1. You have provided maximum emissions and we have taken these, at this stage, as proposed annual limits. You will need to justify these against your "realistic" emissions using the Environment Agency report referenced in the P&ID. 2. The derivation of emissions with supporting data will need to be audited by us, this could be met in part by inspection at offices/stations.	November 2008
2.4 Design basis estimates and substantiation of annual arisings of solid radioactive waste during operation and decommissioning. Wastes should be identified in terms of category (HLW, ILW, LLW), physico-chemical characteristics and proposed disposal route (if any). Quantification should be in terms of activity of key individual radionuclides and overall groupings of radionuclides (e.g. total alpha), mass and volumes. The requesting party should obtain, and provide, a view from the Nuclear Decommissioning Authority (NDA) (as the UK authoritative source in providing such advice) on the disposability of any proposed arisings of ILW or HLW.	Some information was provided but more details are required. Advice: 1. Waste produced needs to be assessed during decommissioning as well as during operation. 2. The physico-chemical characteristics of waste are important to us so that we can assess the suitability of your proposed treatment, storage and disposal proposals. 3. Quantification of radionuclides within wastes are again important to us for the same reasons as 2. above. 4. You are strongly recommended to approach the Nuclear Decommissioning Authority regarding your disposal proposals and provide us with their views.	Covered in response to reference 1.4

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
2.5 A description of how spent fuel will be managed and the quantities that will arise throughout the facility's lifecycle. This should include: - new fuel composition and characteristics; - expected fuel burn up and ratings; - short and long term management proposals including any for off site management or disposal. If the management options include direct disposal, the requesting party should obtain, and provide, a view from the Nuclear Decommissioning Authority (NDA) (as the UK authoritative source in providing such advice) on the disposability of the spent fuel.	An overview was provided, plans supported by detail information are required. Advice: 1. Quantities of spent fuel over the station lifetime and estimates of short term storage quantities in the cooling ponds are required. 2. Longer term spent fuel management plans need to be detailed and supported with design of any storage facility. 3. Your plans for final disposal are required. As with 2.4 above you are recommended to approach the Nuclear Decommissioning Authority regarding your disposal proposals and provide us with their views.	Covered in response to reference 1.4
2.6 A description of and supporting reasoning for the sampling arrangements, techniques and systems proposed for measurement and assessment of discharges and disposals of radioactive waste. This should : - include consideration of whether these are sufficient and adequate to determine all discharges and disposals from the facility at the levels of detection specified in EU Commission Recommendation 2004/2/Euratom; - include details of in-process as well as final discharge arrangements; - identify how a decision on the adequacy of the arrangements has been reached; and - show that they rUK EPResent the best practicable means for such analyses. The requesting party is directed towards our Guidance on Monitoring: M11 (monitoring releases to atmosphere) and M12 (monitoring releases to water).	General information was provided, more details are required. Advice: 1. General arrangements for monitoring have been described but lack consideration of the issues raised by the P&ID: 1.1 adequacy against EU Commission Recommendation 2004/2/Euratom; 1.2 how a decision on adequacy of arrangements has been reached; 1.3 justification that the monitoring rUK EPResents the best available techniques. 2. Design details of monitoring points and the specific radionuclides to be measured at each should be included. 3. Accurate flow monitoring is considered to be good practice. Refer to the Environment Agency standard for measuring flow (MCERTs): M18. 4. Compare your proposals to our guidance on monitoring: M11 and M12.	April 2008 April 2008 June 2008 April 2008 April 2008 April 2008

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
2.7 Prospective dose assessment for the generic site at the proposed limits for levels of discharge. This should include: - annual dose to most exposed members of the public for liquid discharges; - annual dose to most exposed members of the public for gaseous discharges (identifying separately the dose associated with on site incineration where applicable); - annual dose to the most exposed members of the public for all discharges from the facility; - annual dose from direct radiation to the most exposed member of the public; - annual dose to the critical group for the facility; - potential short-term doses, including via the food chain, based on the maximum anticipated short-term discharges from the facility in normal operation; - a comparison of the calculated doses with the relevant dose constraints; and - an assessment of whether the build-up of radionuclides in the local environment of the facility, based on the anticipated lifetime discharges, might have the potential to prejudice legitimate users or uses of the land or sea. All assumptions made should be set out and reasons for their validity given. Continued...	An initial screening assessment was provided for some dose parameters. A detailed assessment is required. Advice: 1. Information using our screening methodology was requested by our TQ UK EPR000008. This will need to be developed by a detailed assessment to answer issues in the P&ID, in particular: 1.1 annual dose from direct radiation; 1.2 short term doses – will need to relate to 2.2 above; 1.3 build-up of radionuclides in the environment including at sensitive non-human habitats. 2. The methodology used for detailed assessment needs to be defined and proposals given for how this methodology will be expanded for specific site assessments in the future. Computer models used will need full definition so that we may assess whether they are appropriate to use in England and Wales.	Initial response by April 2008 with completion by November 2008

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
See: *Authorisation of Discharges of Radioactive Waste to the Environment, Principles for the Assessment of Prospective Public Doses, Interim Guidance* (Environment Agency et al, Dec 2002) (see Publications Catalogue). The appropriate use of the exposed groups, exposure pathways, habit data, and radionuclide dispersion/transfer parameters specified in *Initial radiological assessment methodology – part 1 user report* (Science Report SC030162/SR1, Environment Agency, May 2006) and *Initial radiological assessment methodology – part 2 methods and input data* (Science Report SC030162/SR2, Environment Agency, May 2006) (see Publications Catalogue) is likely to produce a cautious, but not unrealistic, generic dose assessment.		
2.8 Collective dose assessments for discharges from the facility truncated at 500 years to the UK, European and World populations. Assumptions made in carrying out these assessments should be set out.	No information was provided. Advice: 1. Refer to P&ID and complete all requirements.	November 2008

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
2.9 Sufficient assumed data for others to be able to carry out all dose assessments including as relevant : - radionuclide composition of each release; - gaseous release points (including heights, effective heights and volumetric flow rates); - liquid release points; - fractions of releases made via each release point (including incinerators); - release rate; - information used to estimate incinerator releases - (i.e. expected quantities of wastes to be incinerated, expected radionuclide composition and concentrations, and retention factors for any abatement provided; and - hydrographic data (mean volumetric flow for any inland water courses, such as rivers, or volumetric exchange rate for estuaries/coasts that receive discharges). Additionally, detail of assumptions made concerning the following will be helpful to enable others to refine any assessment made: - dose receptor points; - weather data; - chemical form of the activity discharged; - deposition velocities, washout coefficients and surface roughness factors; - dose per unit intake factors; - food consumption rates; - critical group habits data; - nearest food production location; and - nearest habitation(s).	Some data was provided but a number of P&ID issues were not addressed. Advice: 1. Refer to P&ID and tabulate all assumed data to enable independent dose assessments to be made.	Initial response by April 2008 with completion by November 2008

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
2.10 The requesting party should provide an assessment of the likely impact of the radioactive discharges on non-human species. A methodology for carrying out such an assessment is provided in *Impact Assessment of Ionising Radiation on Wildlife* (R&D Publication 128, Environment Agency, June 2001). For a generic radiation dose assessment, it could be assumed that all the reference organisms specified in that report for terrestrial ecosystems are present at the site boundary and that all those for the appropriate aqueous ecosystem are present close to the point of discharge. Further developments in this methodology are expected following the output of the ERICA programme in early 2007 and these should be taken into account.	An example qualitative assessment was provided, a quantitative assessment for the generic site is required. Advice: 1. We will need to assess impact to flora and fauna within any sensitive habitat (Habitats Directive). Detailed quantitative assessment will be needed for us to carry out our own appropriate assessment.	November 2008

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
3.1 An analysis of the environmental impact of a range of cooling options relevant to the generic site characteristics considered at 1.3 above, including seawater abstraction, river water abstraction, conventional cooling towers and hybrid cooling towers. The analysis should include, where appropriate, relevant consideration of : - abstraction inlet fish deterrent schemes; - options for beneficial use of the waste heat produced; - the environmental impact, including thermal, of any proposed water abstraction and consequential water and aerial discharges. As part of the analyses provided in response to this item and the following item(3.2), consideration should be given to the relevant requirements of the EU's *Directive 2000/60/EC establishing a framework for Community action in the field of water policy* (the Water Framework Directive) and *Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora* (the Habitats Directive) and to relevant water quality standards.	Some basic Information was provided but more detail is required. Advice: 1. You will be using seawater cooling and have provided an estimate of flow required and return temperature. We need further information: 1.1 on inlet fish deterrent schemes; 1.2 options for beneficial use of waste heat; 1.3 example assessment of heat impact for typical UK coastal scenario; 1.4 as noted in 2.10 above the impact on sensitive habitats is an important part of our assessment and we will need quantitative data against typical UK sea species.	Initial response by April 2008 with completion by November 2008

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
3.2 An analysis of how liquid waste streams will arise, be managed and disposed of throughout the facility's lifecycle**.** This should include consideration of: - sources and quantities of contaminants (including disinfectants and biocides), highlighting dangerous substances; - identification and control of the effluent and surface water runoff streams contributing to the overall discharge; - identification of potential options and associated environmental impact for disposal of each individual effluent stream; and - means of control in the event of detection of unplanned radioactive or other contamination of the discharge.	Some basic information was provided but more details are needed to demonstrate compliance with UK regulatory requirements. Advice: 1. Provide information on the presence on site of List 1 and List 2 substances defined in the Groundwater Regulations; and 2. Demonstrate that BAT is used to prevent direct or indirect discharges of these to groundwater. 3. Define ground information to be gathered before construction, the use of a Conceptual Site Model is recommended. 4. Specify in general terms a monitoring programme for the life of the installation including use of boreholes. 5. Provide information on the discharge of listed dangerous substances and their concentrations in the receiving waters, required by the Environment Agency to assess whether Environmental Quality Standards could be exceeded. 6. Present an options appraisal to demonstrate that BAT has been used to prevent or minimise emissions of pollutants from each significant effluent stream. 7. Detail measures to contain unplanned emissions of effluents, spillages, firewater and localised floodwaters.	April 2008 June April 2008 April 2008 November 2008 June 2008 June 2008

P & I document reference	Preliminary assessment finding and our advice to EDF and AREVA to help them comply with the P & I document requirement	Date by which EDF and AREVA has committed to provide information
3.3 Standby generation capacity in excess of 50 MWth in total or in excess of 20 MWth for an individual unit, and on-site incinerators may require to be considered under The Pollution Prevention and Control (England and Wales) Regulations 2000 and relevant EU Directives. The requesting party should define the scope of any PPC installation. The proposed technology should be compared with that in our relevant PPC Sector Guidance Notes and the environmental aspects addressed by comparing them with the Environment Agency's published criteria for low-impact installations. In particular, the impact of emissions of polluting substances should be assessed using the methodology given in our guidance note *IPPC Environmental Assessment and Appraisal of BAT*, IPPC H1 (Environment Agency, July 2003).	A PPC assessment was not provided. Advice: The preliminary submission indicates that a PPC combustion activity permit will be required. 1. Provide relevant application information to enable the Environment Agency to assess whether a permit could be issued for the generic site. See "Applying for a PPC permit" on our web site.	June 2008
3.4 The requesting party should identify the need for the on-site storage of substances above the qualifying thresholds in The Control of Major Accident Hazards Regulations 1999.	A COMAH assessment was not provided. Advice: 1. List all relevant COMAH materials with their maximum installation storage quantities and compare with COMAH qualifying thresholds. 2. State whether COMAH will apply and, if so, how compliance with the COMAH Regulations will be achieved, for example, provide a draft Major Accident Prevention Policy (MAPP). Materials may include: hydrogen, hydrazine, fuel oil etc.	April 2008 if COMAH applies compliance information in June 2008

Annexe 3

Publication of notice

A notice to inform the public about how they could view the design information and make a comment was placed in each of the following newspapers on the specified date:

Newspaper	Date
The London Gazette	10 September 2007
The Daily Telegraph	10 September 2007
The Times	10 September 2007
The Daily Mail	10 September 2007
The Daily Express	10 September 2007
The Sun	10 September 2007
The Daily Mirror	10 September 2007
The Daily Record	10 September 2007
The Herald	10 September 2007
The Western Mail	10 September 2007
The Liverpool Daily Post	10 September 2007

Annexe 4

Definitions

Activation product: a material which has been subject to a neutron flux and has been made radioactive as a result.

Alpha activity: some radionuclides decay by emitting alpha particles which consist of two neutrons and two protons.

Becquerel: the standard international unit of radioactivity equal to one radioactive transformation per second.

- megabecquerel (MBq) – 1 million transformations per second
- gigabecquerel (GBq) – 1 thousand million transformations per second
- terabecquerel (TBq) – 1 million million transformations per second

Best available techniques (BAT): in all matters relating to radioactive substances, the "best available techniques" means the most effective and advanced stage in the development of activities and their methods of operation; and:

a) "available techniques" means those techniques that have been developed on a scale that allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the cost and advantages, whether or not the techniques are used or produced inside the United Kingdom, as long as they are reasonably accessible to the operator;

b) "best" means the most effective in achieving a high general level of protection of the environment as a whole;

c) "techniques" includes everything that has a bearing on the benefits to be derived, for example:

- the selection of a process to be used
- the design of facilities and systems
- the detailed implementation of facilities and systems
- how it is managed, operated and maintained.

Collective dose: the dose received by a defined population from a particular source of public exposure. This is obtained by adding the dose received by each individual in the population, and is expressed in units of man-sieverts (man-Sv). Within limits, collective dose can represent the total radiological consequences of the source on the group, over a certain period of time.

Critical group: a group of members of the public whose radiation exposure is reasonably similar and is typical of people receiving the highest dose from a given source.

Decommissioning: the process whereby a facility, at the end of its life, is taken permanently out of service and its site is made available for other purposes.

Direct radiation: radiation received directly from a source such as a nuclear power station, instead of indirectly as a result of radioactive discharges.

Discharge: the release of aerial or liquid waste to the environment.

Disposal: includes

- placing solid waste in an authorised land disposal facility without plans to retrieve it at a later time

- releases to the environment (emissions and discharges) of aerial waste (gases, mists and dusts) and liquid waste
- transfer of waste, together with responsibility for that waste, to another person

Dose: a general term used as a measure of the radiation received by man and usually measured in sieverts.

Dose constraint: a restriction on annual dose to an individual from a single source, applied at the design and planning stage of any activity. The dose constraint places an upper limit on the outcome of any optimisation study.

Dose limit: the UK legal dose limit for members of the public from all man-made sources of radiation (other than from medical exposure) is 1 mSv/year.

Fission: splitting of atomic nuclei.

Fission products: radionuclides produced as a result of fission.

High level waste (HLW): waste in which the temperature may rise, as a result of its radioactivity, to such an extent that it has to be accounted for in designing storage or disposal facilities.

Intermediate level waste (ILW): waste with radioactivity levels exceeding the upper boundaries for low level waste, but which does not require heat generation to be accounted for in the design of disposal or storage facilities.

Low level waste (LLW): waste containing levels of radioactivity greater than those acceptable for disposal with normal refuse but not exceeding 4 GBq/tonne alpha-emitting radionuclides or 12 GBq/tonne beta-emitting radionuclides.

Man-sievert (manSv): a measure of collective dose.

Radioactive waste: material that contains radioactivity above levels specified in the Radioactive Substances Act 1993 and for which there is no use foreseen by the producer or handler.

Radioactivity: the property of some atomic nuclides to spontaneously disintegrate emitting radiation such as alpha particles, beta particles and gamma rays.

Radiological assessment: an assessment of the radiation dose to members of the public, including that from discharges, which will result from operation or decommissioning of a facility.

Radionuclide: a general term for an unstable atomic nuclide that emits ionising radiation.

Sievert (Sv): a measure of radiation dose received.
- millisievert (mSv) – one thousandth of a sievert
- microsievert (µSv or microSv) – one millionth of a sievert

Annexe 5

Abbreviations

µSv	microsievert
BAT	Best available techniques
BWR	Boiling water reactor
COMAH	Control of Major Accident Hazards
DSRC	Design Safety Review Committee
EA95	Environment Act 1995
EDF	Electricité de France
UK EPR	European pressurised water reactor
GBq	gigabecquerel
GDA	Generic design assessment
HEPA	High efficiency particulate filter
HLW	High level waste
HSE	Health and Safety Executive
HVAC	Heating, ventilation and air conditioning system
ILW	Intermediate level waste
INSA	Independent Nuclear Safety Assessment
JPO	Joint programme office
LLW	Low level waste
MW	megawatts
NDA	Nuclear Decommissioning Authority
OCNS	Office for Civil Nuclear Security
P&I	Process and information
PPC	Pollution Prevention and Control
PWR	Pressurised water reactor
QA	Quality assurance
QMS	Quality management system
REPs	Radioactive substances environmental principles
RSA93	Radioactive Substances Act 1993
WRA91	Water Resources Act 1991

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