

Generic design assessment

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

Final assessment report

**Disposability of ILW and
spent fuel**



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Final assessment report - disposability of ILW and spent fuel

Protective status	This document contains no sensitive nuclear information or commercially confidential information.
Process and Information Document¹	<p>The following sections of Table 1 in our Process and Information document are relevant to this assessment:</p> <p>2.1 – describe how radioactive wastes will be managed and disposed of</p> <p>2.4 – provide and substantiate a view on the disposability of higher activity wastes</p> <p>2.5 – provide and substantiate a view on the disposability of spent fuel (if its direct disposal is proposed)</p>
Radioactive Substances Regulation Environmental Principles²	<p>The following principles are relevant to this assessment:</p> <p>RSMDP1 – Radioactive substances strategy</p> <p>RSMDP11 – Storage</p> <p>RSMDP12 – Storage in a passively safe state</p> <p>RSMDP15 – Requirements and conditions for disposal of wastes</p>
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1. Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Designs, Environment Agency, Jan 2007.

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

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

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

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Summary

- 1 This report presents the findings of our assessment of EDF and AREVA's case concerning the disposability of intermediate level radioactive waste (ILW) and spent fuel from the UK EPR™, based on information submitted by EDF and AREVA.
- 2 We conclude, based on the information provided on EDF and AREVA's management plans, that the UK EPR is not expected to produce ILW or spent fuel for which there is no foreseeable disposal route.
- 3 In due course, we will need to see more definitive assessments to confirm how all of the ILW and spent fuel will be conditioned for disposal, that the selected conditioning methods represent the application of best available techniques (BAT), and that conditioned ILW and spent fuel will be managed to ensure it remains disposable. Our conclusion is, therefore, subject to two assessment findings:

Assessment findings

- a) The future operator shall provide confidence that adequate radioactive waste management cases (RWMCs), supported by appropriate stage Letters of Compliance (LoCs) can be developed for all intermediate level waste (ILW) on the timescales identified in EDF and AREVA's plan for disposability of ILW. (UK EPR-AF10).
- b) The future operator shall, before the commissioning phase, provide confidence that adequate radioactive waste management cases (RWMCs), supported by appropriate stage Letters of Compliance (LoCs) and taking due account of necessary storage periods, can be developed for spent fuel on the timescales identified in EDF and AREVA's plan for disposability of spent fuel. (UK EPR-AF17).

1 Introduction

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

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

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

7 We expect a new nuclear power plant to be designed so that radioactive wastes generated from its operation and decommissioning, if they cannot be reused or recycled, can safely be disposed of by existing or planned disposal routes.

8 We set out in our process and information document (P&ID) (Environment Agency, 2007) the requirements for a requesting party to provide information on:

- a) how radioactive wastes will be managed and disposed of throughout the facility's lifecycle (reference 2.1);
- b) the disposability of any proposed arisings of ILW or high level waste (HLW) (reference 2.4); and
- c) the disposability of spent fuel, if the management options include direct disposal (reference 2.5).

9 We published our Radioactive Substances Regulation Environmental Principles (REPs) (Environment Agency, 2010a) in 2010. Principle RSMDP1 states that:

'A strategy should be produced for the management of all radioactive substances'

and makes clear that the matters that need to be taken into account in such a strategy include:

'The requirement that radioactive wastes are safely disposed of, at appropriate times and in appropriate ways' and 'How creation of waste, incompatible with current disposal techniques or developing techniques likely to be successful, will be prevented'.

10 Principle RSMDP12 states that:

'Where radioactive substances are currently not stored in a passively safe state and there are worthwhile environmental or safety benefits in doing so then the substances should be processed into a passively safe state'

and the considerations to be taken account include:

'The anticipated final disposability of the passively safe waste'.

11 Principle RSMDP11 states that radioactive substances should be stored using BAT, and the considerations to be applied include:

'The need to minimise degradation of the store and the substances stored'. A further consideration in relation to this principle is that: 'Where radioactive wastes are being packaged, operators first need to demonstrate that the wastes being packaged will meet anticipated disposal requirements'.

- 12 Principle RSMDP15 states that:
- ‘Requirements and conditions that properly protect people and the environment should be set out and imposed for disposal of radioactive waste. Disposal of radioactive waste should comply with imposed requirements and conditions’*
- and makes clear that such requirements and conditions include waste receivers’ conditions for acceptance.
- 13 In this report we assess the arguments and evidence provided by EDF and AREVA to show that the ILW and spent fuel from the operation and decommissioning of the UK EPR can all be processed into disposable forms using current techniques or developing techniques likely to be successful.
- 14 EDF and AREVA obtained and provided to us a view from the Radioactive Waste Management Directorate (RWMD) of the Nuclear Decommissioning Authority (NDA) (as the UK’s authoritative source) on the disposability of their proposed arisings of ILW and spent fuel (NDA, 2009). EDF and AREVA provided the Regulators with the RWMD GDA disposability assessment reports for the UK EPR in October 2009 (summary report), and January 2010 (part 1: main report and part 2: data sheets and inventory tables). EDF and AREVA provided an opinion of the RWMD assessment reports in October 2009 (EDF and AREVA, 2009a) which they placed on their public website for GDA.
- 15 We raised a Regulatory Observation (RO) (HSE (now Office for Nuclear Regulation¹ (ONR)) and Environment Agency, 2009a) on EDF and AREVA during our assessment, with Regulatory Observation Actions (ROAs) (ONR and Environment Agency, 2009b and 2010) requiring EDF and AREVA to provide further information on their case for disposability of spent fuel and ILW and plans for the future development of the case.
- 16 EDF and AREVA responded to the RO (EDF and AREVA, 2010 and 2011a), and we have taken account of their responses in this assessment.
- 17 Our findings on the wider environmental impacts and waste management arrangements for the UK EPR may be found in our decision document (Environment Agency, 2011a).

2 Assessment

2.1 Basis for assessment

2.1.1 Environment Agency scrutiny of the GDF programme

- 18 The Environment Agency is responsible in England and Wales for regulating disposals of radioactive waste. RWMD is currently charged with developing a GDF to dispose of higher activity solid radioactive waste. The programme to implement the GDF will take many years. Our involvement falls into two categories: early engagement and advice; and formal regulatory permitting.
- 19 Prior to any formal application, our role is to provide advice. We have entered into an agreement with NDA to provide, and charge for, advice during the early stages of the development of a GDF. Our scrutiny of the work by RWMD during these early stages enables us to:
- a) advise on the requirements for, and preparation of, future submissions to the Regulators;

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

- b) improve our understanding of the safety and environmental performance of proposals for the GDF and provide our views on improving safety and environmental protection;
 - c) provide guidance on regulatory issues that may arise;
 - d) inform stakeholders of our requirements;
 - e) inform RWMD of the work it will be required to carry out to meet our regulatory requirements during future stages; and
 - f) reduce the risk of unnecessary expenditure or delays during the formal regulatory stages.
- 20 We will ensure that our advice to RWMD, or information provided in dialogue with stakeholders, during the early stages of developing a GDF will not compromise our independence. Any such advice does not alter our ability to make regulatory decisions in the future.
- 21 Any GDF in England or Wales will have to be designed and located so as to satisfy the Environment Agency that the environmental safety requirements specified in our guidance (Environment Agency and Northern Ireland Environment Agency, 2009) will be met. This will be the case for any GDF, whether or not its intended inventory includes ILW and/or spent fuel from new build nuclear power stations, but where they are intended to be part of the disposal inventory then this will need to be taken into account in demonstrating that the requirements will be met. Part of this assessment of EDF and AREVA's disposability case is to consider, to the extent possible with the information currently available, whether the ILW and spent fuel from a fleet of UK EPRs would necessitate any significant changes to the design of a GDF, and if so whether those changes are likely to be feasible without compromising the environmental safety of the facility. However, the environmental safety of any GDF, with whatever inventory it is to contain, will ultimately be determined through the due processes of regulatory scrutiny and decision making based on actual information about the site, facility and wastes to be accepted.

2.1.2 RWMD's Letter of Compliance (LoC) process

- 22 The overall objective of the LoC assessment process (NDA, 2008) is to give confidence to all stakeholders that the future management and disposal of waste packages has been taken into account as an integral part of their development and manufacture. This is achieved by the site operator working to NDA packaging standards and seeking input from RWMD to explicitly demonstrate that the waste packages produced by a proposed packaging process will be compliant with the generic waste package specification and compatible with plans for transportation to and emplacement in the planned future GDF.
- 23 This is achieved through production by RWMD of a comprehensive disposability assessment. This is produced following assessment of the proposed waste package against published safety assessment methodologies for transport, repository operations and repository post-closure.
- 24 In cases where the assessment has concluded that the waste package is compliant with the reference repository concept and underpinning assessments, RWMD is prepared to confirm this by the issue of an LoC.
- 25 The Environment Agency scrutinises the operation of the LoC process as part of its wider scrutiny of the GDF programme (see above).
- 26 Disposability assessments and LoCs are generally issued at three stages during development of waste retrieval and packaging plant: at the conceptual stage when the waste producer is looking to define a preferred conditioning and packaging option; at an interim stage typically prior to placing 'design and build' contracts for

conditioning plant; and at a final stage prior to active operations. The provision of disposability assessments and LoCs at these stages is designed to support important commissioning stages in the waste conditioning project.

- 27 Plans for management of the ILW and spent fuel from future nuclear power stations have not yet reached even the conceptual stage, but obtaining a preliminary view of their likely disposability has been identified as an element of the generic design assessment (GDA) process. The RWMD disposability assessment for EDF and AREVA has therefore not been prepared as part of the LoC process, but has followed the same basic approach as is used for the LoC process.

2.1.3 Joint Guidance on the Management of Higher Activity Wastes

- 28 The relevant Regulators issued joint guidance (HSE, Environment Agency and SEPA, 2010) on how nuclear licensees should manage higher activity wastes so as to satisfy regulatory requirements. This guidance recommends that licensees develop and maintain radioactive waste management cases (RWMCs) for all higher activity wastes, addressing the longer-term safety and environmental issues associated with the waste.
- 29 An important component of the RWMC relates to the conditioning of the radioactive waste. This is addressed through:
- a) options assessment to show how the conditioning option was selected and how it fits within an integrated waste strategy (IWS);
 - b) a description of what conditioning will be carried out on the waste, or the justification for storing the waste without conditioning; and
 - c) considering disposability². A reasoned judgement must be provided on whether the conditioned waste meets the anticipated requirements for acceptance from a potential disposal site operator. Where a proposal is for storage of waste in an unconditioned form, a suitable outline of a proposed conditioning strategy for the waste should be included (this forms the basis for a suitable 'exit strategy' for producing a disposable package).
- 30 Other aspects that should be covered in RWMCs are:
- a) possible deterioration of the waste or its packaging during storage;
 - b) key constraints on how the waste will be managed in the future, such as storage conditions and monitoring requirements;
 - c) arrangements for preserving information that might be needed to ensure safety and environmental protection during the future management of the waste stream and to make sure the wastes can be accepted in a future long-term storage or disposal facility; and
 - d) management, including disposal, of secondary radioactive waste arisings, especially those from the waste conditioning stage.
- 31 Disposability assessments and LoCs from RWMD will therefore typically be important sources of evidence for RWMCs. However the RWMC needs to present *the licensee's* whole case to demonstrate that they are applying good practice in managing their higher activity wastes. Regulatory acceptance or otherwise that a licensee is satisfying regulatory requirements will be based on the Regulators' assessment of the RWMC in its entirety. Regulatory scrutiny of the LoC process allows the Regulators to satisfy themselves of the reliability of disposability assessments and LoCs as evidence.

² For simplicity, in this report we refer to the application of the Joint Guidance in England and Wales. Its application in Scotland would be consistent with the Scottish Government's policy of near-site, near-surface storage of higher activity wastes rather than disposal.

32 We did not expect EDF and AREVA to present fully developed RWMCs supported by LoCs as an output of the GDA process. We did expect them to identify at least one complete credible route by which the higher activity wastes from a fleet of UK EPRs could be safely disposed of and to provide grounds for reasonable confidence that the route(s) could be followed successfully. We also expected that interactions through the course of the GDA process would comprehensively identify issues that will need to be addressed in the future programme. We anticipated provision of a developed plan demonstrating how these issues will be addressed and providing confidence in a successful outcome (for example, likely to result in future LoC endorsement).

2.2 Assessment of EDF and AREVA's disposability case

33 EDF and AREVA have provided comments on RWMD's disposability assessment. We have considered the assessment report (NDA, 2009) and these comments (EDF and AREVA, 2009a) collectively as EDF and AREVA's disposability case. We informed EDF and AREVA that we expected them to take ownership of the disposability case so that it unambiguously presents *their* arguments and evidence for the disposability of ILW and spent fuel from a fleet of UK EPRs, with a plan showing how identified issues will be addressed. This may draw upon RWMD's assessment and conclusions as evidence but should present EDF and AREVA's case.

34 In particular, this case should:

- a) be based on assumptions that EDF and AREVA consider to be appropriate;
- b) indicate how and when EDF and AREVA intend to address outstanding issues, including those identified by RWMD (or, where appropriate, how and when they foresee a future licensee addressing them); and
- c) show how EDF and AREVA expect to arrive at a credible application for LoCs for ILW and spent fuel from a fleet of UK EPRs, and give some assurance that RWMD will be adequately prepared to assess such an application.

35 [EDF and AREVA have subsequently demonstrated ownership of the disposability case and provided a plan for addressing disposability issues and seeking LoC endorsements, as discussed below \(see paras 54 et seq\).](#)

2.2.1 Storage of spent fuel

36 The disposability assessment is based on the assumption that all fuel elements will have a burn-up of 65 GWd/tU and will be stored for 90 years between discharge from the reactor and emplacement in the GDF³. ONR indicated its requirements for a demonstration that safety can be assured during storage, possibly for significant timescales (for example, 90 years). Since the disposability assessment assumes that this storage takes place, our view on disposability must be subject to such a demonstration being provided to ONR's satisfaction. We note the following:

- a) RWMD has assumed in its assessment that fuel elements are manufactured with fresh uranium, and state explicitly that further assessment would be needed if recycled uranium were used.
- b) The determining factor for the duration of storage might be availability of the GDF for emplacement rather than heat generation, that is the GDF might not be available to accept spent fuel from the UK EPR fleet as soon as the heat

³ Based on a reference case design involving spent fuel sealed in a durable container surrounded by bentonite. The constraints associated with such concepts (for example, permissible package heat outputs) are yet to be fully evaluated.

generation reaches an acceptable level. Therefore the necessary storage period could be longer than anticipated in the disposability assessment, and could be independent of assumptions about burn-up.

- c) In effect the disposability assessment addresses whether the spent fuel discharged from the reactor would be disposable if the radioactive inventory and heat generation were reduced to the levels expected after 90 years. It will need to be demonstrated that the other physical and chemical characteristics of the fuel as it ultimately goes to the GDF will not differ sufficiently from those of the fuel discharged from the reactor as to invalidate the disposability assessment. Therefore, in addition to providing assurance to ONR that storage will be safe for the necessary duration, it will be necessary to demonstrate to us that the storage conditions and fuel characteristics are such that disposability of the fuel will not degrade to an unacceptable degree during that period of storage.
 - d) For example, the instant release fractions (IRFs) assumed are clearly not derived from study of fuel that has been stored for 90 years after discharge from the reactor. We recognise that the IRFs assumed for fuel with a burn-up of 65 GWd/tU are potentially pessimistic for fuel with an average burn-up of less than 50 GWd/tU. To date, we have seen no evidence concerning whether IRFs could change in fuel over extended timescales. We are aware, for example, of arguments that IRFs may increase over time in closed systems due to diffusive processes (for example, within packages in the disposal environment prior to groundwater ingress).
- 37 Various potential arguments have been put forward to reduce the necessary duration of storage, including modifications to the GDF design, changes to fuel packaging assumptions, or simply applying a more realistic value for the average burn-up of fuel. [Such possibilities have also been identified and explored briefly by RWMD in an initial feasibility study of options for various aspects of spent fuel management and disposal commissioned by the Nuclear Industry Association \(NIA\) \(NDA, 2010\).](#) Clearly, if the required storage period can genuinely be reduced, the importance of the concerns set out above would decrease to some extent, and the points might need to be reconsidered on their merits (bearing in mind that some of the suggested solutions might change other aspects of the assessment, for example, by increasing the GDF footprint). In particular, using a realistic average burn-up as the basis for the assessment could reduce the expected storage period by about 20 years. This could make it marginally easier to make the necessary cases concerning storage, but we would not expect a step change as the storage period would still be relatively long.
- 38 Furthermore, if the storage period is determined by availability of the repository for disposal, then none of the arguments about heat generation are relevant and storage for the longer period would need to be assessed.
- 39 [In the light of ONR's assessment of the options for long-term storage of spent fuel \(ONR, 2011\), we conclude that EDF and AREVA have provided sufficient assurance for GDA that there are unlikely to be reasons why spent fuel from the UK EPR should not be disposable. However, we will expect EDF and AREVA and potential UK EPR operators to continue to make progress in consultation with RWMD towards confirming the disposability of the spent fuel from planned reactors taking account of necessary periods of storage.](#)

2.2.2 Conditioning options

- 40 For the GDA process, we expected to see evidence that, for each of the higher activity waste streams, there is at least one identified conditioning route that could be relied upon with reasonable confidence to provide disposable waste packages. In the future, we will expect to see evidence that different conditioning options have been evaluated and proposals to apply the option(s) identified as optimal.

41 In presenting a reference case and two variants for the conditioning of ILW, EDF and AREVA have gone beyond what we would have expected at this stage. They have demonstrated a credible conditioning route and also described variant options that could provide flexibility for future operators, but in doing both may have slightly obscured the central aim at this stage (of demonstrating that there is at least one credible conditioning route). In particular the assessment report states, referring to both the reference case and variant case 2, that ‘it should be feasible to develop design concepts’ for transport and disposal of the resulting waste packages. These are rather weaker conclusions than we would wish to see at this stage. The conclusions on variant case 1 provide a more positive assessment of disposability, and therefore at this stage we regard this as the primary demonstration that a credible conditioning route exists (indeed, given the similarity between ILW waste streams from the UK EPR and those from existing UK reactors, we might have expected this option to be identified with greater confidence as ‘viable’ rather than only ‘potentially viable’)

2.2.3 Critical assumptions the validity of which will need to be confirmed

42 The assumption of a fleet of reactors sufficient to generate about 10 GW(e) is not necessarily bounding but seems a reasonable working assumption. Parts of the disposability assessment depend fairly strongly on this assumption. Clearly it may not be possible to confirm absolutely how many reactors might be built, and the current assumption is sufficient for the GDA process, but we note that RWMD will need to decide in due course the types and amounts of wastes and spent fuel that will be accepted by the GDF⁴ as currently foreseen.

43 The additional risks posed by the ILW from a fleet of UK EPRs are judged by RWMD to be small in the context of the total ILW inventory destined for the GDF. Furthermore, since RWMD’s generic assessment (based on a generic geology⁵) indicates risks well within regulatory criteria, particularly the post-closure risk guidance level of 10^{-6} per year, it is concluded that the risks will remain within regulatory criteria with the additional ILW from the UK EPRs. However, RWMD’s generic assessment rests on many assumptions, by no means all of which have been demonstrated to be bounding. Indeed some assumptions are essentially specifications (albeit specifications judged by RWMD to be achievable) of what will need to be achieved for the GDF to meet regulatory criteria. These assumptions – or replacement assumptions that achieve the same outcome – will need to be confirmed in due course. More particularly, the arguments that the relatively large carbon-14 (C-14) inventory assumed for the decommissioning ILW need not be a significant concern are rather speculative at this stage and will need to be underpinned more convincingly. We recognise that RWMD is unlikely to have markedly more confidence in their estimates of the risks associated with C-14 from repository-generated gases before a site for the GDF has been selected, by which time responsibility for the disposability case is likely to have transferred from EDF and AREVA as a Requesting Party to licensees. We will expect EDF and AREVA – and, subsequently, licensees – to keep themselves abreast of any developments in this regard as well as refining their projected C-14 inventories, so as to provide assurance as soon as possible that decommissioning ILW will be disposable.

44 Similarly, the assessed peak risk from disposal of spent fuel from the fleet of UK EPRs is quoted as $5.3 \times 10^{-7} \text{ y}^{-1}$. This projected risk from just one waste stream does not leave a large margin to the regulatory risk guidance level of 10^{-6} y^{-1} . We

⁴ Or GDFs, if it is decided to develop separate facilities for different wastes, for example, one for ILW and another for HLW/spent fuel.

⁵ Noting that the modelling parameters used to represent the generic geosphere are essentially calibrated against the risk guidance level, although it has been argued (by Nirex) that they are not unreasonable for a UK geosphere.

- recognise that some assumptions within the post closure risk assessment are potentially bounding (for example, a pessimistically high average burn up) or conservative (for example, relatively short containment timescales associated with steel rather than copper containers, evolution rates of C-14 in mobile gaseous form from activated metal matrices). Other assumptions might not be bounding or conservative (for example, the assumed groundwater return times, assumptions regarding the form in which C-14 might arise in the gas pathway). At the time of disposal it will need to be confirmed by the GDF licensee that the performance of the GDF with its whole inventory will be consistent with our risk guidance level.
- 45 We note that NDA/RWMD has published a generic Disposal System Safety Case (DSSC) for the disposal of higher activity wastes in a range of hypothetical GDF concepts in different geological environments (NDA, 2011). The generic DSSC represents a major update on Nirex's previous generic performance assessments, and among other things for the first time includes consideration of the disposal of HLW and spent fuel in a GDF. We are reviewing the generic DSSC as part of our scrutiny of RWMD's work, but we do not expect such a generic case to provide definitive confirmation of the points highlighted above.
- 46 NDA has also provided a report regarding the impact of the generic DSSC on its previous new build disposability assessments undertaken for RPs to support GDA submissions (RWMD, 2011). The report concludes:
- a) *'The original 2009 GDA Disposability Assessments concluded that ILW and spent fuel from operation and decommissioning of an AP1000 or EPR raised no new disposability issues when compared against legacy wastes and existing spent fuel. These assessments have been reviewed in the light of recent developments to disposal concepts and generic safety assessment methodologies as applied in the generic DSSC.*
- Overall, the changes in concept, assessment methodology and assumptions regarding parameter values have only minor impacts on the findings of the original GDA Disposability Assessments. The review therefore confirms that there are no new issues arising from the generic DSSC that would challenge the fundamental disposability of the wastes and spent fuel expected to arise from operation of the AP1000 and EPR. This conclusion is supported by the similarity of the wastes to those expected to arise from the existing PWR at Sizewell B, which are included in the generic DSSC Baseline Inventory and have been found to be acceptable.'*
- 47 The assumption cited by RWMD that ILW evaporator concentrates can be incinerated leaving no radioactive residue will need clarification in LoC submissions and in the RWMC if a future operator proposes such incineration. Furthermore, it will need to be demonstrated that any wastes assumed to be incinerated meet expected conditions of acceptance for an incinerator (as well as that incineration is BAT for those wastes). We note that EDF and AREVA wrote to us in July 2011 (Letter: EPR00918N) stating that there is no intention to perform such incineration in the UK, and that the waste incinerated in France is LLW, not ILW.
- 48 Clarification will be needed from prospective reactor operators or from the NDA of how and where the spent fuel will be packaged for disposal. The disposability assessment assumes that the consignor will package it before sending it to the GDF, and therefore that it will be transported in its disposal package. However, EDF and AREVA have assumed that it will be packaged at the GDF, in which case the assessment of transportability would need to be based on unpackaged fuel. Options for packaging spent fuel have been discussed by EDF and AREVA in documents submitted during 2010, and ONR has concluded (ONR, 2011) that the information provided by EDF and AREVA is sufficient to show that packaging for disposal should be feasible. We acknowledge that it will not be EDF and AREVA's decision whether a spent fuel packaging plant is built at the GDF. We note, for example, that RWMD's initial feasibility study for NIA (NDA, 2010) identifies and

briefly explores options for spent fuel packaging, but does not propose a definitive position. Nevertheless, to be internally consistent, the disposability case should assume either packaging at the reactor site and transport packaged (in which case the packaging process should be included in the assessment) or packaging at the GDF site and transport unpackaged.

- 49 Assumptions about wastes to be disposed of as LLW will need to be confirmed in order to confirm the inventory requiring disposal as ILW. We discuss the evidence on LLW streams provided by EDF and AREVA to date in our final Assessment Report EPR-06 on solid radioactive waste (Environment Agency, 2011b).

2.2.4 Minor observations

- 50 Comparisons of waste volumes and other characteristics from a UK EPR fleet (and their potential effects on a GDF) with the corresponding information on the existing legacy may be legitimate and can provide useful context but are not indicators of the acceptability of waste generation from UK EPRs.
- 51 The technical question concerning the pessimism of assumptions about the chloride content of fuel and cladding is noted, but there seems to be some confusion as to the origin of the assumptions. The disposability assessment indicates that EDF and AREVA have made much more pessimistic assumptions than RWMD has assumed in previous assessments, but EDF and AREVA's critique appears to imply that the assumptions originate from RWMD. Since we regard both the disposability assessment and critique as parts of EDF and AREVA's submission, this distinction is not in itself significant to us, but we would expect to see clarity about where assumptions come from.
- 52 The comparison between ILW streams from the UK EPR and from Sizewell B focuses on decommissioning ILW because this dominates the total activity of ILW. This is reasonable if the purpose of the comparison is only to consider inventory as an indicator of disposability. It is not clear, however, why a comparison of other aspects of the waste streams – such as waste volumes and material composition – might not also provide some insight into disposability questions, in which case some comparison of operational ILW streams between the UK EPR and Sizewell B could be instructive. A superficial comparison with the 2007 UK Radioactive Waste Inventory suggests significant differences between the volumes of what appear from their descriptions to be similar waste streams.
- 53 The intention for disposing of the RCCAs will need to be clarified and explained in LoC submissions and in the RWMC. The disposability assessment reasonably indicates that they will not constitute a major addition to the overall inventory, and that they could be conditioned separately as ILW or disposed of with the rest of the fuel assembly. [We note that EDF and AREVA consider that the RCCAs will be ILW following cooling in a spent fuel pond, as is established practice in PWRs.](#)

2.3 EDF and AREVA's response to ROA-UKEPR-48

- 54 In Regulatory Observation Action ROA-UKEPR-48.A1 (HSE and Environment Agency, 2009b) the Regulators requested EDF and AREVA to make a case for the disposability of spent fuel and ILW, which demonstrates the following:
- a) How the issues identified in their critique of RWMD's disposability assessment will be addressed.
 - b) How the issues in Appendix B of RWMD's disposability assessment will be addressed.
 - c) How they will manage any risks associated with these issues.

- 55 In a subsequent Regulatory Observation Action ROA-UKEPR-48.A2 (HSE and Environment Agency, 2010), the Regulators requested EDF and AREVA to update their previous response to identify the following:
- a) What stage of Letter of Compliance will be achieved prior to operations (this should be justified in the response, for example taking into account the level of characterisation of the waste and the availability of different viable disposal management options that may be used by the reactor operator).
 - b) The work and any associated research they will have to undertake to gain the stated stage Letter of Compliance.
 - c) The work and research that the RWMD will have undertaken to provide the stated stage Letter of Compliance.
- 56 EDF and AREVA's responses to these ROAs are provided in EDF and AREVA's Report R10-017(A), dated 24 February 2010 (EDF and AREVA, 2010), and the Appendix to a subsequent letter dated 14 January 2011 (EDF and AREVA, 2011a), both of which we have reviewed. We note in particular that EDF and AREVA have consulted with RWMD specifically on the stages in the LoC process at which it would expect issues to be addressed. We recognise that, in most cases, these issues will need to be addressed by future operators of UK EPRs, rather than by EDF and AREVA, and we understand that EDF and AREVA have also discussed the timing of resolution of these issues with a potential UK EPR operator.
- 57 In general, we consider the plans proposed by EDF and AREVA, outlining how and when they and future licensees will address the outstanding disposability issues to be adequate at this stage. We will expect these plans to be periodically refined and updated in future to reflect developments. In particular, while we understand EDF and AREVA's caution in not making commitments that might be impossible to meet for reasons outside their control (such as obtaining particular stage LoCs for spent fuel at defined times, when RWMD might not be in a position to grant them), we will expect prospective licensees to make progress on demonstrating disposability at the earliest reasonable opportunities rather than waiting for dates specified in the plan.
- 58 We stress in particular that we will expect before any UK EPRs begin operation to see further information from EDF and AREVA or prospective operators on the properties of high burn-up spent fuel following long-term storage (particularly in relation to IRFs). We recognise that detailed and definitive information may not be available until there is direct operational experience (for example, for the Interim Stage LoC submission, as proposed by EDF and AREVA), but we will expect much earlier than that to see evidence of sufficient progress to provide reasonable confidence that any issues are likely to be manageable.
- 59 We note that EDF and AREVA have produced a 'mapping document' (EDF and AREVA, 2009b), intended to indicate where the information that will be needed for future RWMCs will come from, and when. An updated version of this document (EDF and AREVA, 2011b) responds to comments from the Regulators and takes account of developments during the period of GDA. The updated document gives us sufficient assurance for this stage of the GDA process that RWMCs can be compiled at relevant future stages in the development of a UK EPR fleet. In March 2011, EDF and AREVA provided us with a further update of this report (EDF and AREVA, 2011c).

3 Public comments

- 60 One comment on ILW was received from the public involvement process relating to the UK EPR design during our detailed assessment stage. The comment asked whether the UK EPR design adequately caters for the encapsulation, storage and disposal of ILW. EDF and AREVA responded with information that is available in

their submission, that is that ILW is encapsulated in concrete containers and that final ILW packages will be placed in an interim storage facility before their disposal in the proposed GDF.

- 61 Public comments on spent fuel were received during our detailed assessment stage. One comment requested information about the type of spent fuel cask that would be used to transport spent fuel for processing or disposal. The response from EDF and AREVA confirmed that TN type transport casks would be used to transport spent fuel in the UK, and provided information about the casks. The TN cask is a dual purpose cask that can be used to store and to transport spent fuel.
- 62 A public comment was received in regard to storage of spent fuel following the closure of reactor operations, and the need for ongoing secure power supplies to service the spent fuel storage ponds, water treatment systems, waste treatment systems and storage facilities. The comment also queried whether the design of the dry storage casks would take into account the varying enrichment levels of the fuel elements. The response from EDF and AREVA confirmed that the technology for longer-term spent fuel management is not chosen although several options are available such as dry cask or dry vault storage, or long-term pool storage. The response also confirmed the design of the storage facilities will take into account the enrichment and residual heat of the spent fuel elements, whatever technology is chosen. With regard to the ongoing availability of electrical power for services following reactor closure, it was confirmed that it is the aim of the UK national energy policy to ensure security of supply, together with the integrity of back up power supplies to provide power in the event of loss of grid supplies. The latter is considered specifically in GDA.

4 Consultation comments

- 63 [A number of consultation comments referred or alluded to disposability issues. Our responses to these comments can be found in our final assessment reports on management of solid radioactive waste \(Environment Agency, 2011b\) and spent fuel \(Environment Agency, 2011c\) and are not repeated here. Comments classified as outside the scope of the consultation can be found in Annex 8 of our decision document \(Environment Agency, 2011a\).](#)

5 Conclusions

64 On the basis of the information provided for GDA, we see no reason at this stage to believe that any of the ILW or spent fuel from a fleet of six UK EPRs will not be disposable in a suitably designed and located GDF. We conclude that the UK EPR is not expected to produce ILW or spent fuel for which there is no foreseeable disposal route.

65 In due course, we will need to see more definitive assessments to confirm how all of the ILW and spent fuel will be conditioned for disposal, that the selected conditioning methods represent the application of BAT, and that in their conditioned forms the ILW and spent fuel will continue to be disposable. Our conclusion is, therefore, subject to two assessment findings:

Assessment findings

- a) The future operator shall provide confidence that adequate radioactive waste management cases (RWMCs), supported by appropriate stage Letters of Compliance (LoCs) can be developed for all intermediate level waste (ILW) on the timescales identified in EDF and AREVA's plan for disposability of ILW. (UK EPR-AF10).
- b) The future operator shall, before the commissioning phase, provide confidence that adequate radioactive waste management cases (RWMCs), supported by appropriate stage Letters of Compliance (LoCs) and taking due account of necessary storage periods, can be developed for spent fuel on the timescales identified in EDF and AREVA's plan for disposability of spent fuel. (UK EPR-AF17).

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

Abbreviations

BAT	Best available techniques
BPEO	Best practicable environmental option
DSSC	Disposal system safety case
GDA	Generic design assessment
GDF	Geological disposal facility
HLW	High level waste
HSE	The Health and Safety Executive
ILW	Intermediate level waste
IRF	Instant release fraction
IWS	Integrated waste strategy
LLW	Low level waste
LoC	Letter of Compliance
NDA	Nuclear Decommissioning Authority
NIA	Nuclear Industry Association
P&ID	Process and information document
REPs	Radioactive substances environmental principles
RO	Regulatory observation
ROA	Regulatory observation action
RWMC	Radioactive waste management cases
RWMD	Radioactive Waste Management Directorate (of NDA)
SEPA	Scottish Environment Protection Agency
SNF	Spent nuclear fuel. That is fuel that has been irradiated in and permanently removed from a reactor core (IAEA)

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