Office for Nuclear Regulation

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ASSESSMENT REPORT

Civil Nuclear Reactors Programme

NNB GenCo: Hinkley Point C Pre-Construction Safety Report 2012 Assessment Report for Work Streams B18 (Radioactive Discharges & Waste) and B23 (Decommissioning)

Assessment Report: ONR-CNRP-AR-13-094
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EXECUTIVE SUMMARY

In December 2012 NNB Generating Company Limited (NNB GenCo, the licensee) submitted to the Office for Nuclear Regulation (ONR) the Hinkley Point C Pre-Construction Safety Report 2012 (HPC PCSR2012, Ref. 1) plus supporting documentation. ONR has assessed this material, and my assessment report (AR) reviews the elements of HPC PCSR2012 that fall within the scope of Work Streams B18 (Radioactive Discharges & Waste) and B23 (Decommissioning). Most of the material I assessed is contained within HPC PCSR2012 Chapters 11 and 20 (comprising in total nine completely new sub-chapters, two partially new sub-chapters and one sub-chapter containing consolidated data from an earlier stage within the Generic Design Assessment (GDA) process). I also reviewed and assessed where appropriate material contained within the HPC PCSR2012 Head Document (Ref. 5), Forward Work Activities document (Ref. 6) and relevant supporting documents from the licensee's submission.

My assessment work was conducted to inform my judgments as to the adequacy of the licensee's arrangements for the production of safety cases (i.e. compliance with Licence Condition 14 (*Safety documentation*), and its progress in constructing an adequate safety case for the topics of radioactive discharges and waste and decommissioning (i.e. compliance with Licence Conditions 23 (*Operating rules*), 32 (*Accumulation of radioactive waste*), 34 (*Leakage and escape of radioactive material and radioactive waste*) and 35 (*Decommissioning*)).

Previously, the GDA PCSR produced in November 2012 by the designer of the UK EPR™ had formed the basis for the issue by ONR in December 2012 of a Design Acceptance Confirmation (DAC) for that design. GDA PCSR addressed only the key elements of the design of a single UK EPR™ unit (the generic features on the 'nuclear island') and excluded ancillary installations that a potential purchaser of the design could choose after taking the site location into account. Certain matters were also deemed to be outside the scope of GDA PCSR (including detailed designs for waste management facilities).

In contrast HPC PCSR2012 addresses the whole Hinkley Point C licensed site comprising the proposed twin EPR™ units and all ancillary installations. Some matters that were outside the scope of GDA PCSR are now addressed in HPC PCSR2012. As the generic features were addressed in the GDA process, my focus in this assessment was on site-specific documentation not formally assessed by ONR previously. It is important to note that some generic information brought forward into HPC PCSR2012 from early GDA stages is now superseded by that appearing in the final version of the GDA PCSR which continued to be developed separately. HPC PCSR2012 alone is therefore not sufficient to inform a future ONR decision on whether to permission construction of HPC. Before seeking consent for nuclear island construction, ONR understands that NNB GenCo intends to submit a future major revision to HPC PCSR2012 which will need to fully integrate information contained within GDA PCSR and to be supported by other documentation. NNB GenCo has requested ONR's early assessment of and advice on HPC PCSR2012 and supporting documentation in the context of supporting work on the future major revision to HPC PCSR2012.

My assessment report (AR) has been written to support a Summary Assessment Report that addresses whether HPC PCSR2012 demonstrates suitable progress towards meeting ONR's requirement for an adequate Pre-Construction Safety Report. To this end this AR provides guidance on matters that need to be addressed in the next revision of HPC PCSR. I have assessed new information provided in HPC PCSR2012 relating to more detailed design of waste management facilities, conceptual designs of the proposed Interim Storage Facility (ISF) for intermediate level radioactive waste (ILW) and the proposed Interim Spent Fuel Store (ISFS), choice of waste conditioning options and the conceptual Letter of Compliance (LoC) issued. As part of my assessment process I engaged closely with the licensee and with the Environment Agency.

I reviewed NNB GenCo's progress against GDA assessment findings (AFs) relevant to the timescale of my assessment, and was generally content with NNB GenCo's progress.

The presentation of NNB GenCo's HPC PCSR2012 and supporting documents is largely logical and clear.

I conclude that for the current stage of its development, NNB GenCo has generally produced adequate proposals for:

- Producing and implementing radioactive waste and decommissioning strategies
- Waste minimisation, characterisation, segregation, processing and passively safe storage
- Design and operation of facilities to promote their safe decommissioning
- Record keeping and knowledge management for radioactive waste management

However, there are four main areas where I do not consider that NNB GenCo's optioneering studies presented in HPC PCSR2012 adequately substantiate NNB GenCo's proposals:

- Specific choice of concrete casks for radioactive waste storage and disposal
- Transfer or encapsulation of Unit 2 ILW ion-exchange resins
- Transfer or encapsulation of Unit 2 solid radioactive wastes
- Campaign processing of ILW and decay storage of certain non-mobile ILW

NNB GenCo needs to carry out more rigorous and systematic optioneering studies in these areas including clear, objective comparisons of the advantages and disadvantages of appropriate options. These are needed to demonstrate whether NNB GenCo's proposals can be substantiated to meet the legal requirements of sections 2 and 3 of the Health and Safety at Work etc. Act 1974 (to ensure, so far as is reasonably practicable, the health and safety of employees and others) and ONR's expectations as set out in regulatory guidance. I have raised four Level 4 Issues for these main areas where more rigorous optioneering is required.

There is an apparent omission from the decommissioning inventory in that no information is provided on irradiated control rods; NNB GenCo needs to provide information on irradiated control rods, their composition, how they will be stored and disposed of. I have raised a Level 4 Issue relating to this.

Within my assessment I have raised ten other Level 4 Issues relating to design, waste strategy, inventory, disposability, storage, dose assessment and safety management. I have also made observations and identified apparent inconsistencies in NNB GenCo's HPC PCSR2012 and supporting documentation. Although I expect NNB GenCo to consider and address these appropriately, I do not consider formal progress tracking to be necessary at the current time. Should the need arise, these issues, observations and apparent inconsistencies can be elevated to the status of requiring progress tracking as part of NNB GenCo's routine engagement process with ONR during the future development of the PCSR and subsequent safety cases.

My assessment rating reflects NNB GenCo's current stage of development of HPC PCSR2012, and that there remains sufficient time for the Level 4 Issues raised in my assessment to be resolved ahead of the expected submission of the finalised PCSR in 2016. On that basis, my overall assessment rating for NNB GenCo's radioactive discharges, waste and decommissioning proposals within HPC PCSR2012 is 3 (adequate, green).

LIST OF ABBREVIATIONS

AF	Assessment Finding
ALARP	‘As low as reasonably practicable’
AR	Assessment Report
BAT	Best Available Techniques
BMS	How2 Business Management System (ONR)
BPEO	Best Practicable Environmental Option
CSJ	Construction Safety Justification
CSTS	Coolant Storage and Treatment System
DAC	Design Acceptance Confirmation
(D)DWMP	Detailed Decommissioning and Waste Management Plan
DWMF	Decommissioning Waste Management Facility
DWMP	Decommissioning and Waste Management Plan
EDF	Électricité de France
EIADR99	Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999
EPR™	Originally EPR was an acronym for European Pressurised Reactor, but now the name of the design is simply EPR™.
ETB	Effluent Treatment Building
FDP	Funded Decommissioning Programme
GDA	Generic Design Assessment
GWPS	Gaseous Waste Processing System
HPC	Hinkley Point C
HSE	Health and Safety Executive
IAEA	International Atomic Energy Agency
ILW	Intermediate Level Radioactive Waste
ISF	Interim Storage Facility
ISFS	Interim Spent Fuel Store
LC	Licence Condition
LLW	Low Level Radioactive Waste
LoC	Letter of Compliance
LWPS	Liquid Waste Processing System
NAB	Nuclear Auxiliary Building
NNB GenCo	NNB Generating Company Limited (the licensee)
NSDAPs	Nuclear Safety Design Assessment Principles

LIST OF ABBREVIATIONS

NVDS	Nuclear Vent and Drain System
ONR	Office for Nuclear Regulation (an agency of HSE)
OSC	Operational Service Centre
PAR	Project Assessment Report (ONR)
PCSR	Pre-Construction Safety Report
RWMC	Radioactive Waste Management Case
SAPs	Safety Assessment Principles (HSE)
SEPA	Scottish Environment Protection Agency
SNI	Sensitive Nuclear Information
SSC	System, Structure and Component
SWTS	Solid Waste Treatment System
TAGs	Technical Assessment Guides (ONR)
VLLW	Very Low Level Radioactive Waste
WENRA	Western European Nuclear Regulators Association

TABLE OF CONTENTS

Tables

1 INTRODUCTION

1.1 Background

1 This report presents the findings of the assessment of that portion of the Hinkley Point C Pre-Construction Safety Report 2012 (HPC PCSR2012, Ref. 1) that falls within the scope of Work Streams B18 (Radioactive Discharges & Waste) and B23 (Decommissioning).

2 Assessment was undertaken in accordance with the requirements of the Office for Nuclear Regulation (ONR) How2 Business Management System (BMS) procedure AST/003 (Ref. 2). The ONR Safety Assessment Principles (SAP), Ref. 3, together with supporting Technical Assessment Guides (TAGs), Ref. 4, have been used as the basis for this assessment.

3 This assessment report (AR) has been written to support a Summary Assessment Report that addresses whether HPC PCSR2012 demonstrates suitable progress towards meeting ONR’s requirement for an adequate Pre-Construction Safety Report. To this end this AR provides guidance on matters that need to be addressed in the next revision of HPC PCSR

4 A Generic Design Assessment (GDA) was conducted by the Office for Nuclear Regulation (ONR) on the generic features of the EPRPP™ design and a final GDA Pre-Construction Safety Report (GDA PCSR), produced in November 2012, formed the basis of ONR issuing a design acceptance confirmation (DAC) for the design. However, the safety submissions assessed during GDA were carried out for the key elements of the design of a single EPR™ unit (i.e. the generic features of the ‘nuclear island’) and took no account of site specific features and ancillary buildings (including those related to waste management facilities).

5 The licensee, NNB Generating Company Ltd (NNB GenCo), has since further developed the EPR™ design for the UK context and has also further developed the extant safety case to address issues specific to construction of twin EPRs™ at Hinkley Point C (HPC), including all required associated ancillary buildings to be constructed on the site. This revised safety case was presented in the Hinkley Point C Pre-Construction Safety Report 2012 (HPC PCSR2012, Ref. 1), which now considers many of the matters deemed to be outside the scope of the GDA exercise (including waste management facilities). HPC PCSR2012 is therefore a mixture of new information and information derived from the GDA process.

6 Some generic information in HPC PCSR2012 has now been superseded by that appearing in GDA PCSR. It is therefore important to note that HPC PCSR2012 alone is not sufficient to inform a future ONR decision on whether to permission construction of Hinkley Point C. Before seeking consent for nuclear island construction, I understand that NNB GenCo intends to submit a major revision to HPC PCSR2012 which will need to fully integrate information contained within GDA PCSR and to be supported by other documentation, including any necessary design changes from the new Électricité de France (EDF) reactor under construction at Flamanville in France (Flamanville 3), the design of which is the reference design for HPC.

7 This AR was written as one of a set of technical ARs to support a Summary Assessment Report which in turn is to support a Project Assessment Report (PAR) to address whether HPC PCSR2012 demonstrates suitable progress against the requirements of Licence Conditions LC14 and LC23. This work is intended to support ONR's requirement for an adequate PCSR (to be known as PCSR3) to permit ONR to release the first construction hold-point i.e. for the pouring of first nuclear island concrete. In addition this AR summarises the licensee's progress towards closure of a number of GDA findings, which are either of direct relevance to radioactive discharges and waste and decommissioning, or which will need specific design information to allow closure of the findings, or which impact generically upon the design of waste management facilities. To this end this AR provides guidance and other observations on matters that need to be addressed in the next revision of the HPC PCSR.

1.2 Scope

8 The scope of this report covers the findings of my assessment of the elements of HPC PCSR2012 that fall within the scope of Work Streams B18 (Radioactive Discharges & Waste) and B23 (Decommissioning). Most of this material is contained within HPC PCSR2012 Chapters 11 and 20 (comprising in total nine completely new sub-chapters, two partially new sub-chapters and one sub-chapter containing a consolidation of earlier GDA data). Section 0.3 of the HPC PCSR2012 'Head Document' (Ref. 5) tabulates the HPC PCSR2012 elements relevant to my assessment that:

- are completely new (sub-chapters 11.3 and 11.5 and chapter 20);
- are partially new and include GDA data (sub-chapters 11.2 and 11.4);
- present information from earlier versions of GDA PCSR (sub-chapter 11.0); and
- are not used (sub-chapter 11.1).

9 I also reviewed and assessed where appropriate material contained within the HPC PCSR2012 Head Document, Forward Work Activities document (Ref. 6) and relevant supporting documents from the licensee's submission. In general, my assessment covers NNB GenCo-specific and HPC site-specific proposals.

10 I noted that the approach to safety function categorisation and safety system classification agreed during GDA is not fully reflected in HPC PCSR2012 which largely uses the approach employed on Flamanville 3. I understand that the integration of the methodology agreed during GDA will be demonstrated by NNB GenCo in its next revision of HPC PCSR.

11 During the GDA process, twelve AFs were recorded against the proposals relating to radioactive waste and decommissioning. My assessment considered NNB GenCo's progress in constructing resolution plans to provide ONR with sufficient information to permit closure of these AFs within appropriate timescales.

1.2.1 Changes from GDA design

12 The main changes in HPC PCSR2012 from the GDA design that are relevant to my assessment are:

- Twin EPRs™ rather than a single unit
- More detailed design of waste management facilities in the Unit 1 Effluent Treatment Building (ETB) and the Nuclear Auxiliary Buildings (NABs)
- Conceptual designs of the Interim Storage Facility (ISF) for ILW and the Interim Spent Fuel Store (ISFS)
- Choice of waste conditioning options
- Conceptual Letter of Compliance (LoC) issued for C1 and C4 concrete casks

1.3 Methodology

13 My assessment was undertaken in accordance with the requirements of the Office for Nuclear Regulation (ONR) How2 Business Management System (BMS) procedure AST/003 (Ref. 2). I used HSE's Safety Assessment Principles (SAPs, Ref. 3), together with ONR's supporting Technical Assessment Guides (TAGs) for the management of radioactive materials and radioactive waste on nuclear licensed sites (Ref. 7) and decommissioning (Ref. 8) as the technical basis for my assessment.

14 The methodology for my assessment followed the requirements of the ONR BMS 'produce assessments' step in the nuclear safety permissioning process, in particular in relation to the *Guidance on Mechanics of Assessment* (Ref. 9). I drew up initial tentative structures for possible safety justifications weighted in those areas most directly related to safety, based around the key principles set out in guidance. I then carried out my assessment of the relevant parts of HPC PCSR2012 and supporting documents against that structure.

15 In my assessment I looked for the expected safety case hierarchy of safety requirements (or claims), supported by arguments and evidence. I used the recommended approach of sampling to limit the areas scrutinised, to limit the total effort to be applied, and to improve the overall efficiency of the assessment process.

16 For radioactive discharges and waste I drew up a core structure to base my assessment against:

- Production and implementation of the strategy for the management of radioactive waste on the site
- Minimisation in terms of quantity and activity of the radioactive waste generated and accumulated
- Characterisation and segregation to facilitate subsequent safe and effective management
- Processing into a passively safe state
- Storage in accordance with good engineering practice
- Recording and preservation of information that might be required in the future for the safe management of radioactive waste

17 For decommissioning I drew up a core structure to base my assessment against:

- Design and operation of facilities
- Preparation and maintenance of the decommissioning strategy
- Production and implementation of the strategy for the management of radioactive waste from decommissioning
- Preparation and maintenance of the decommissioning plan and programme
- Identification, preparation, updating and retention of documents and records required for decommissioning
- Establishment and maintenance of organisational arrangements
- Review and modification of the safety management system

18 Where necessary, I extended the core structures of my assessments of these two areas to cover and focus on:

- GDA AFs
- Design changes and changes from GDA
- HPC site-specific aspects
- NNB GenCo-specific aspects

19 I recognised that HPC PCSR2012 is intended by NNB GenCo to be a development stage towards a future finalised version of its PCSR. In line with this I noted that some of NNB GenCo's proposals within HPC PCSR2012 remain conceptual with some areas of detail yet to be completed. I also recognised that for some of NNB GenCo's proposals, particularly those for decommissioning, the physical activities are intended to be carried out many years or decades into the future. Within my assessment I took the approach of focusing on the regulatory requirements that I would expect to be met at the PCSR stage of a future nuclear reactor, in order to ensure the safety of future waste management and decommissioning activities for that installation. The approach taken in my assessment was therefore necessarily different to that which would have been appropriate for the assessment of radioactive waste management and decommissioning proposals at an existing nuclear installation currently in its operational or decommissioning phase.

20 I liaised to the extent necessary with ONR staff responsible for the assessments of the HPC PCSR2012 chapters relating to spent fuel and storage (Ref. 10) and reactor chemistry (Ref. 11), and with those involved in producing ONR's Step 4 GDA AR for the EDF and AREVA UK EPR™ Reactor (Ref. 41) and ONR's assessment of radioactive waste management and decommissioning work streams in support of the licensing of the HPC site to NNB GenCo (Ref. 42).

21 As part of my assessment process I held meetings with representatives of NNB GenCo, EDF and the Environment Agency and a teleconference with representatives of NNB GenCo:

- On 25 October 2013 an initial meeting was held at EDF Energy's office in Barnwood, Gloucester which provided me with a useful overview and update of NNB GenCo's radioactive discharges and waste and decommissioning proposals (ONR intervention report Ref. 12).
- On 27 November 2013 a further meeting was held at EDF Energy's office in London to discuss NNB GenCo's operational radioactive waste strategy and segregation, proposals for radioactive waste process and storage buildings at Hinkley Point C, and NNB GenCo's progress with the Letter of Compliance (LoC) assessment process and its approach to optioneering (ONR intervention report Ref. 13).
- On 17 December 2013 a teleconference was held to update NNB GenCo on my progress with the assessment (ONR contact report Ref. 14).

22 I reviewed the notes of relevant meetings held previously:

- On 7 September 2011 ONR, NNB GenCo, EDF and the Environment Agency met (Ref. 15) to discuss NNB GenCo's proposed strategy for the management of operational ILW. ONR noted that better alignment of the strategy with the Decommissioning and Waste Management Plan (DWMP) was required, and suggested revision to provide more detail on the methods used and planned to optimise and reduce the volume of waste produced.
- On 23 May 2012 ONR and NNB GenCo met (Ref. 16) to discuss NNB GenCo's LC32 compliance matrix and the planning condition associated with radioactive contaminated land.
- On 25 June 2012 ONR, NNB GenCo, EDF and the Environment Agency met (Ref. 17) for a presentation on the structure of the radioactive waste chapter within NNB GenCo's developing HPC PCSR2012, and constructive discussions on the closure of GDA AFs were held.

2 STRATEGY

23 My assessment strategy is set out in this section which identifies the standards and criteria against which I have assessed the relevant chapters of HPC PCSR2012.

2.1 Standards and Criteria

24 The relevant national standards and criteria I used within this assessment are principally HSE's Safety Assessment Principles (SAPs, Ref. 3), ONR's Technical Assessment Guides (TAGs) and the 'Joint Guidance' from HSE, the Environment Agency and the Scottish Environment Protection Agency (SEPA) on the management of higher activity radioactive waste on nuclear licensed sites detailed within this section. I also considered international standards and I have cited relevant good practice, where applicable, within the body of the assessment.

2.2 Safety Assessment Principles

25 The key SAPs I applied within the assessment are included within Table 1 of this report.

2.2.1 Technical Assessment Guides and 'Joint Guidance'

26 I referred to the following TAGs and elements of the 'Joint Guidance' as part of my assessment:

- *Management of radioactive materials and radioactive waste on nuclear licensed sites* (Ref. 7)
- *Decommissioning* (Ref. 8)
- *Civil engineering* (Ref. 18)
- *Fundamentals of the management of radioactive waste* (Ref. 19)
- *The management of higher activity radioactive waste on nuclear licensed sites*:
    - *Overview and glossary* (Ref. 20)
    - *Part 1: The regulatory process* (Ref. 21)
    - *Part 2: Radioactive waste management cases* (Ref. 22)
    - *Part 3a: Waste minimisation, characterisation and segregation* (Ref. 23)
    - *Part 3b: Conditioning and disposability* (Ref. 24)
    - *Part 3c: Storage of Radioactive Waste* (Ref. 25)
    - *Part 3d: Managing information and records relating to radioactive waste in the United Kingdom* (Ref. 26)

2.2.2 International Standards and Guidance

27 I referred to the following International Atomic Energy Agency (IAEA) Safety Standards as part of my assessment:

Safety Fundamentals

- *Fundamental Safety Principles* (Ref. 27)

Safety Requirements

- *Predisposal Management of Radioactive Waste* (Ref. 28)
- *Decommissioning of Facilities Using Radioactive Material* (Ref. 29)

Safety Guides

- *The Management System for the Processing, Handling and Storage of Radioactive Waste* (Ref. 30)
- *The Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste* (Ref. 31)
- *Predisposal Management of Low and Intermediate Level Radioactive Waste* (Ref. 32)
- *Safety Assessment for the Decommissioning of Facilities Using Radioactive Material* (Ref. 33)
- *Storage of Radioactive Waste* (Ref. 34)
- *Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants* (Ref. 35)
- *Decommissioning of Nuclear Power Plants and Research Reactors* (Ref. 36)

28 I also considered the Western European Nuclear Regulators Association (WENRA) Safety Reference Levels Reports for Waste and Spent Fuel Storage (Ref. 37) and Decommissioning (Ref. 38).

29 I discussed these international standards and guidance documents with the ONR principal inspector responsible for drafting the latest versions of ONR's TAGs covering radioactive waste management and decommissioning published in May 2013. He confirmed to me that a systematic exercise was undertaken as part of the drafting to ensure that the TAGs fully incorporated all the relevant requirements of the IAEA and WENRA documents. I was advised that the findings of an assessment carried out against HSE's SAPs, ONR's TAGs and the 'Joint Guidance' would therefore be very similar if not identical to the findings of an assessment against the international standards and guidance.

30 In line with my discussion with ONR's principal inspector responsible for drafting the relevant ONR guidance, I decided to base my assessment against the UK national guidance.

2.3 Use of Technical Support Contractors

31 I did not use any technical support contractors to support my assessment.

2.4 Integration with other Assessment Topics

32 My assessment topics have interfaces with those covering spent fuel and storage and reactor chemistry. To avoid duplication of effort and to ensure full assessment coverage, I liaised to the extent necessary with the ONR inspectors and principal inspectors responsible for drafting:

- the AR for the HPC PCSR2012 chapter relating to spent fuel and storage (Ref. 10);
- the AR for the HPC PCSR2012 chapter relating to reactor chemistry (Ref. 11);
- ONR's GDA Step 4 AR for radioactive waste and decommissioning relating to the EDF and AREVA UK EPR™ Reactor (Ref. 41); and
- ONR's assessment of radioactive waste management and decommissioning work streams in support of the licensing of the HPC site to NNB GenCo (Ref. 42).

2.4.1 Spent fuel

33 The ONR HPC assessor for spent fuel assessed NNB GenCo's proposals for the ISFS, other than the proposals relating to radioactive waste from, and decommissioning of, the ISFS (which I assessed). NNB GenCo's design and assessments of the ISFS remain at the conceptual stage; when the design is more mature the ISFS interdependencies with the radioactive waste and decommissioning work streams will become more significant.

2.4.2 Reactor chemistry

34 The ONR HPC assessor for reactor chemistry assessed the chapters of NNB GenCo's HPC PCSR2012 relating to minimisation and control of the generation of radioactive waste through chemical control in the gaseous and liquid effluent systems. I assessed NNB GenCo's proposals for the generation and management of solid waste, including that arising from the gaseous and liquid effluent systems.

2.4.3 GDA Step 4 Assessment Report

35 The ONR inspector responsible for producing the GDA Step 4 AR for radioactive waste and decommissioning had already assessed the elements included within the GDA submission, and we agreed that ONR's proposal to assess in detail only elements not covered by the DAC, was a sound approach.

2.4.4 ONR assessment of NNB GenCo's radioactive waste management and decommissioning plans in support of licensing of the HPC site

36 As part of the assessment carried out in support of licensing of the HPC site, ONR had previously assessed NNB GenCo's radioactive waste management and decommissioning plans, including its Detailed Decommissioning and Waste Management Plan ((D)DWMP, Ref. 39):

- ONR's accepted NNB GenCo's revised ILW management strategy to reflect the use of decay storage; the proposal to use decay storage for short-lived immobile ILW was deemed to be in accordance with ONR's expectations. ONR considered it relevant good practice, in a UK context, to use decay storage where practicable (and safe to do so) to allow short-lived ILW to decay to LLW in preference to packaging short-lived ILW promptly.
- NNB GenCo demonstrated to ONR that its proposal to transfer ion-exchange resins between Unit 2 and the waste treatment building via an underground pipe was consistent with how resins are transferred in most of EDF's French power stations, and also at Sizewell B. ONR accepted this as relevant good practice.
- NNB GenCo's decommissioning strategy of early site clearance was judged in line with international practice for decommissioning similar reactors. ONR accepted this as relevant good practice.

37 I agreed with the inspector responsible for that assessment that although the assessment and engagement process with NNB GenCo had served to identify potential issues early, a more formal assessment in greater depth against ONR's SAPs and other regulatory standards would be necessary for the assessment of HPC PCSR2012.

2.5 Out-of-Scope Items

38 The following items are outside the scope of the assessment:

- Spent fuel management and storage, including the Nuclear Decommissioning Authority's Radioactive Waste Management Directorate's revised disposability assessment and feasibility study reports with updated information following a correction to a thermal model used to estimate the cooling time required for spent fuel (Ref. 40)
- Waste generation occurring as a direct consequence of reactor chemistry
- Matters considered and assessed within ONR's Step 4 GDA AR for the EDF and AREVA UK EPR™ Reactor (Ref. 41). I did not assess elements already covered by the DAC, and revisited generic documentation only where more recent developments or changes from the GDA design have materially affected the case being made.
- Matters considered and assessed within ONR's assessment of radioactive waste management and decommissioning work streams in support of the licensing of the HPC site to NNB GenCo (Ref. 42)
- Proposed activities that would be regulated by the Environment Agency under an environmental permit, including disposals of radioactive waste such as discharges to air and water, and transfers of wastes for incineration or transfers of waste off-site for incineration or final disposal at suitably permitted premises

- Potential environmental impacts of projects to decommission nuclear power stations and nuclear reactors requiring consent under the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (EIADR99, Ref. 43)
- The licensee’s arrangements for covering the costs of decommissioning the site and managing operational and decommissioning wastes within its Funded Decommissioning Programme (FDP) approved under section 46(1) of the Energy Act 2008 (Ref. 44)
- Activities in relation to the planning or preparation of future submissions to the European Commission under Article 37 of the Euratom Treaty
- The licensee’s proposed licence condition compliance arrangements
- Aspects relating specifically to Hinkley Point A and B nuclear licensed sites, including any existing land and groundwater contamination

3 LICENSEE'S SAFETY CASE

39 NNB GenCo prepared HPC PCSR2012 to provide the baseline safety justification for the construction and operation of twin EPR™ units at HPC. HPC PCSR2012 is the highest level of the safety case for the pre-construction phase, and comprises a Head Document (Ref. 5), a Forward Work Activities document (Ref. 6), a set of 21 topic-specific chapters divided into sub-chapters, and supporting reference documents. The majority of topic-specific material relating to Work Streams B18 (Radioactive Discharges & Waste) and B23 (Decommissioning) is located within Chapters 11 (Discharges and waste / spent fuel) and 20 (Decommissioning) of HPC PCSR2012.

40 In the remainder of section 3 I have provided an outline description of the HPC PCSR2012 material and supporting documents that I considered within my assessment.

3.1 Safety report overview

41 The *Hinkley Point C Pre-Construction Safety Report 2012 Head Document* (Ref. 5) is the top-level summary of HPC PCSR2012, presenting a high-level collated overview of the safety report:

- NNB GenCo summarises the safety functional roles, discharges and disposals and gives an overview of facilities and systems related to radioactive waste and interim storage of solid waste and spent fuel.
- NNB GenCo outlines decommissioning activities and their compliance with safety objectives and provides a brief description of the decommissioning plan together with NNB GenCo's claimed demonstration that it would be safe and feasible to decommission HPC (including the interim storage facilities for spent fuel and ILW) using current technology, and that consideration of decommissioning issues has been made in the design.

3.1.1 Site Data and Bounding Character of GDA Site Envelope

42 The site description and data are presented (Ref. 5) together with a comparison of the site-specific conditions against the generic site envelope presented in GDA PCSR. NNB GenCo also summarises its claimed assessment of how risks are reduced to ALARP through optimisation of the site layout and design.

3.1.2 General Design and Safety Aspects

43 HPC PCSR2012's general safety principles, classification scheme, design procedures, equipment qualification, and design codes and standards are described (Ref. 5).

3.2 Forward Work Activities

44 The *Hinkley Point C Pre-Construction Safety Report, Version 2, Forward Work Activities* document (Ref. 6) presents a summary of the main Forward Work Activities, completion of which is required to develop the safety case as the HPC design matures.

45 The Forward Work Activities document is structured according to the chapters of HPC PCSR2012. I assessed the relevant parts of Chapters 11 (discharges and waste / spent fuel) and 20 (decommissioning) of the Forward Work Activities document:

- There are no specific GDA issues in the area of Discharges and Waste / Spent Fuel.
- There are four GDA Step 4 AFs that require resolution prior to the ONR milestone of nuclear island safety-related concrete:
  - AF-UKEPR-RW-01 to produce a site-specific Radioactive Waste Management Case (RWMC)
  - AF-UKEPR-RW-03 to implement a records management procedure for waste and decommissioning
  - AF-UKEPR-RW-06 to produce a safety report for the processing and long-term storage of ILW
  - AF-UKEPR-RW-07 to plan the provision of the evidence necessary to underpin the spent fuel storage, transport and disposal strategy (not within the scope of this assessment)
- NNB GenCo has plans to develop further the design and safety case for the interim storage facilities for ILW and spent fuel, along with the process for the treatment of evaporator concentrates and wet sludges.
- There are no specific GDA issues in the area of Decommissioning.
- There are two GDA Step 4 AFs that require resolution prior to the ONR milestone of nuclear island safety-related concrete:
  - AF-UKEPR-RW-02 to review construction activities to identify actions beneficial to decommissioning
  - AF-UKEPR-RW-03 to implement a records management procedure for waste and decommissioning
- One GDA AF was raised by the Environment Agency (EA AF-UKEPR-02) to provide an updated decommissioning strategy and decommissioning plan at the detailed design stage.
- Hazard analyses and workforce and public dose assessments from decommissioning activities have not yet been carried out.

3.3 Discharges and Waste / Spent Fuel

3.3.1 Safety Requirements

46 NNB GenCo provides (Ref. 45) a very high-level overview of the safety requirements including safety functions, functional requirements and design requirements applying to the radioactive waste management aspects of the Gaseous Waste Processing System (GWPS), the Nuclear Vent and Drain System (NVDS) and the Coolant Storage and Treatment System (CSTS).

3.3.1.1 Radioactive liquid discharges

47 NNB GenCo provides a description of how operational effluent is proposed to be collected, treated and discharged, depending on its characteristics, and also gives an overview of the operational solid radioactive waste and spent fuel strategy (Ref. 46). A summary of the proposed discharges and disposals of radioactive and non-radioactive effluents and waste from HPC is also provided (Ref. 47).

48 NNB GenCo's overall strategy for the management of liquid radioactive wastes is minimisation at source based on the design of the plant and operational practices; partitioning of radionuclides where appropriate; segregation and treatment; abatement with demineralisation, evaporation and filtration; storage with delay and decay where appropriate; assessment; and discharge in an optimised manner.

49 The anticipated sources of radioactive liquid effluent discharges are described (activated corrosion products, activated products from chemicals in the primary coolant and volatile fission products dissolved in the primary cooling water) together with the nature of the radioactive liquid effluents proposed to be produced:

- Recyclable primary circuit liquid effluent
- Non-recyclable spent liquid effluent
- Steam generator blowdown
- Liquid effluent from the secondary circuit
- Water drained from the turbine hall
- Site-specific liquid effluents including those from the 'hot' workshop and decontamination facilities, 'hot' laundry and interim spent fuel store (ISFS)

50 The proposed arrangements for processing and storing liquid effluent are described:

- Primary liquid effluent is proposed to be treated by demineralisation, filtration, evaporation and degassing in the Coolant Storage and Treatment System (CSTS) before recycling to the primary reactor circuit if appropriate.
- Non-recyclable liquid effluent is proposed to be segregated at source as process drain effluent, chemical drain effluent or floor drain effluent, before treatment including demineralisation, evaporation and filtration in the Liquid Waste Processing System (LWPS) in the Effluent Treatment Building (ETB). They are then sent to the on-site storage tanks for monitoring and recorded discharge (or, if needed, transfer back to LWPS for further treatment). Effluents from the hot workshop and decontamination facilities are proposed to be treated in the same way.
- Drainage water from the turbine hall is proposed to be sent to on-site storage tanks for monitoring, recording and discharge.
- Steam generator blowdown is proposed to be processed by filtration, demineralisation and recycling to the main turbine condenser circuit, or if unsuitable to storage tanks for monitoring, hydrazine destruction if needed and recorded discharge.
- Effluents from the turbine hall originating from the secondary circuit are proposed to undergo hydrocarbon removal prior to discharge.
- Laundry effluent is proposed to be filtered (and treated via LWPS if necessary) and discharged.

- Detailed design of the water treatment facilities for the proposed ISFS has not been finalised, and NNB GenCo states it is likely to contain filtration and demineralisation before discharge of non-recyclable effluent.

3.3.1.2 Liquid effluent treatment systems

51 NNB GenCo describes (Ref. 48) how the treatment of liquid effluent is proposed to be divided into:

- unit systems;
- Effluent Treatment Building (ETB) and Operational Service Centre (OSC) systems; and
- site systems.

3.3.1.2.1 Unit systems

52 The liquid effluent treatment systems of the unit are proposed to be:

- the Coolant Storage and Treatment System (CSTS) which would be the primary effluent treatment system; and
- the Chemical and Volume Control System (CVCS);
- the Fuel Pool Purification System (FPPS); and
- the Nuclear Vent and Drain System (NVDS) which would collect liquid and gaseous effluent and transfer it to various systems for recycling and treatment.

3.3.1.2.2 ETB and OSC systems

53 The ETB and OSC systems are proposed to be:

- the NVDS which would be located partly in the ETB and partly in the OSC, and would collect liquid effluent and transfer it to:-
- the Liquid Waste Processing System (LWPS) which would treat effluents from process drains, chemical drains and floor drains before transfer to site systems.

3.3.1.2.3 Site systems

54 Site systems are proposed to include:

- three separate monitoring and discharge systems for different liquid effluents;
- laundry and decontamination facilities; and
- other systems such as the site buildings NVDS and the ISFS liquid effluent collection and treatment systems (yet to be designed).

3.3.1.3 Liquid chemical effluent discharges

55 Liquid chemical effluent discharges are anticipated to arise from:

- Chemicals associated with liquid radioactive effluent (noting that primary coolant may not be recycled after CSTS treatment if the treated effluent is not appropriate for re-use in the primary circuit)
- Effluent from the production of demineralised water
- Effluent from fouling treatments
- Water collected from rainwater drums, black and grey wastewater
- Water contaminated with oil and water used in production in the Turbine Hall

3.3.1.4 Radioactive gaseous effluent

56 The overall strategy for the management of gaseous radioactive waste is minimisation at source based on the design of the plant and operational practices; partitioning of radionuclides where appropriate; abatement with carbon delay beds, iodine traps and filtration; monitoring; and optimised discharge.

57 Gaseous radioactive effluent is anticipated to include:

- noble gases formed by fission;
- argon-41 formed by activation of natural argon-40;
- tritium formed mainly by fission and by activation of boron and lithium;
- carbon-14 formed mainly by activation of oxygen and nitrogen;
- radioactive iodine formed by fission; and
- aerosols comprising activation and fission products including radioactive cobalt and caesium.

58 Gaseous effluents are proposed to be filtered to remove particulates and, if necessary, treated to remove iodine, before discharge:

- Gaseous effluent from the primary circuit is anticipated to arise from degassing and head space ullage purging with nitrogen to avoid explosive concentrations of hydrogen building up, and is proposed to be treated in the GWPS with purge gas recovery, catalytic recombination of hydrogen and oxygen to water, drying and activated carbon delay beds before filtration in the ventilation system and discharge via the Nuclear Auxiliary Building (NAB) stack.
- Gaseous effluents from the secondary circuit, hot laundry, hot workshop, hot warehouse and decontamination facilities are proposed to be filtered in the NAB Ventilation System and discharged.
- Detailed design of the ISFS ventilation system has not yet been completed.
- NNB GenCo is not proposing to install a filtered ventilation system to treat gaseous effluent from the ISF for ILW.

59 Gaseous effluent treatment systems are proposed to be divided into:

- the systems for primary gaseous effluent treatment, i.e. the NVDS and the Gaseous Waste Processing System (GWPS); and
- those for other gaseous effluent proposed to be carried out by the ventilations systems, notably those for the Nuclear Auxiliary Building (NAB), Controlled Safeguard Building and Effluent Treatment Building (ETB).

3.3.1.5 Spent nuclear fuel strategy

60 The strategy for spent fuel management at HPC is to store the lifetime arisings of spent fuel from the two EPRs™ in an on site ISFS pending availability of a disposal route. NNB GenCo is proposing that during the main site decommissioning phase the ISFS would be modified to allow it to be a stand-alone facility after the rest of the site has been decommissioned, for the period up until removal of the spent fuel.

3.3.1.6 Solid radioactive waste strategy

61 NNB GenCo's Integrated Waste Strategy for HPC is described as being based on its integrated waste statement and principles, including implementation of the waste hierarchy and use of environmental optimisation through the application of Best Available Techniques (BAT) to ensure waste arisings from the management of discharges are optimised between solid, liquid and gaseous wastes to minimise the impacts of their disposal.

3.3.1.6.1 Low Level Radioactive Waste (LLW)

62 The strategy for solid LLW is disposal as soon as reasonably practicable where a viable disposal route is available.

63 The categories of LLW anticipated to be produced at HPC (with volumetric annual raw generation and lifetime packaged volume estimates from two EPRs™) include:

- Steam generator blowdown system ion-exchange resins (15 m^3/year, 1800 m^3 lifetime packaged)
- Wet sludge (1 m^3/year, 327 m^3 lifetime packaged)
- Evaporator concentrates (6 m^3/year, 1954 m^3 lifetime packaged)
- Air filters (6·8 m^3/year, 408 m^3 lifetime packaged)
- Water filters (1·3 m^3/year, 96 m^3 lifetime packaged)
- Dry active wastes (100 m^3/year, 7500 m^3 lifetime packaged)
- Oils and solvents (4 m^3/year, 320 m^3 lifetime packaged)
- Metallic wastes (12 m^3/year, 720 m^3 lifetime packaged)

64 An additional volume of LLW such as spent ion-exchange resins and filters may be generated during the operation of the ISFS, but NNB GenCo has not yet finalised the details.

65 It is proposed that operational LLW will be segregated, categorised and transferred to a temporary buffer store in the ETB adjoining EPR™ Unit 1. The waste's treatment route is proposed to be determined by monitoring and assay and the waste's physical and chemical characteristics. As soon as reasonably practicable , the waste will then undergo campaign processing including size reduction by shredding and low force compaction where appropriate, and packaging to meet the Conditions for Acceptance of the appropriate off-site treatment or disposal facility which may include super-compaction, metal treatment and recycling, incineration or transfers of waste off-site for incineration or final disposal at suitably permitted premises.

66 In order to meet disposal route Conditions for Acceptance, it is anticipated that some 'more difficult' LLW streams such as sludges, concentrates and resins would need to be conditioned through dewatering, drying and encapsulation in a mortar or epoxy matrix within a metallic drum waste disposal package.

67 A buffer store of LLW waste containers awaiting transfer off site is proposed.

3.3.1.6.2 Intermediate Level Radioactive Waste (ILW)

68 NNB GenCo proposes the adoption of a strategy based on the GDA reference case described as optimised for site-specific conditions at HPC (Ref. 49). NNB GenCo's strategy is to retrieve, condition and package ILW on site on a campaign basis throughout the operational phase, resulting in passively safe packages ready for interim storage in the ISF for ILW pending the availability of a disposal route. The strategy involves the conditioning of ILW using a polymer for ion-exchange resins and cementitious grouts for other ILW wastes within two types of reinforced-concrete C1 and C4 packages. The C1 and C4 containers are non-standard with respect to the current UK concept for geological disposal, and would require to complete the disposability assessment process for which a conceptual Letter of Compliance (LoC) has been issued. The strategy is described as NNB GenCo's preferred approach. I noted that alternative processes (German MOSAIK® casks; UK standard waste containers) are mentioned but systematic optioneering information is not provided.

69 The strategy provides arguments in support of further optimisation to utilise unconditioned decay storage of suitable non-mobile waste.

70 The categories of ILW anticipated to be generated at HPC (with volumetric annual raw generation and lifetime package estimates from two EPRs™ not taking account for decay storage to LLW) are:

- Ion-exchange resins (6 m^3/year, 900 lifetime packages)
- Cartridge filters (10 m^3/year, 1920 lifetime packages)
- Sludges (2 m^3/year, 480 lifetime packages)
- Operational wastes (2 m^3/year, 360 lifetime packages)

71 NNB GenCo suggests that an additional volume of ILW such as spent ion-exchange resins and filters may be generated during the operation of the ISFS but details have not yet been finalised.

72 NNB GenCo is proposing the use of two types of cylindrical pre-cast concrete casks, designated C1 and C4, which can include internal mild steel shielding of varying thicknesses to provide a degree of protection against gamma-emitting radionuclides. The C1 cask is 1·4 m in diameter, 1·3 m high, has a 0·15 m thick concrete shield wall and a mass of between 4·5 and 6·4 tonnes. The C4 cask has the same dimensions apart from the diameter which is 1·1 m and the mass of between 3 and 4 tonnes, and is proposed to be used typically for certain lower-activity filters. Operational ILW is proposed to be immobilised within the casks using epoxy polymer and hardener (for ion-exchange resin waste) or cement grout (other ILW streams). For cemented wastes, the container plus its contents would become a monolithic block of concrete and waste claimed to be suitable for storage and disposal. Ion-exchange resin wastes are proposed to be processed by in-container solidification using a polymer solidification process. NNB GenCo is considering different options for conditioning of sludges and concentrates including:

- blending of waste with hydraulic binder (sand, cement and lime) and water using a sacrificial paddle;
- drying and encapsulating dry waste;
- use of a mobile machine; and
- use of site-specific retractable equipment.

73 ILW is mainly proposed to be conditioned to a passively safe form in the ETB, with some waste generated within the ISFS also packaged and processed in the ISFS prior to transfer to the ETB, before transfer to the ILW ISF.

74 Some activated core components with heat generation levels above the ILW categorisation level are proposed to be transferred to the reactor fuel pools to be held for a period of delay storage before processing.

75 It is proposed that some conditioned and packaged ILW containing relatively short-lived radionuclides such as cobalt-60, caesium-137 and iron-55 would undergo decay storage and would be recategorised as LLW following interim storage, removed from the ILW ISF and disposed of as LLW. NNB GenCo recognises that this approach would result in the early foreclosure of disposal options such as incineration, compaction and shredding for such waste streams containing relatively short-lived radionuclides, and is considering the options available for non-mobile elements of these wastes such as used filters and dry waste. NNB GenCo has not yet completely defined its strategy for decay recategorisation; it states that the option of unconditioned decay storage is to be considered for implementation (Ref. 5).

3.3.1.7 Solid waste treatment systems

76 Treatment of solid waste is proposed to be divided between:

- the Solid Waste Treatment System (SWTS) located in both units; and
- the ETB System located in the ETB adjoining Unit 1 to serve both units.

3.3.1.7.1 Solid Waste Treatment System (SWTS)

77 The SWTS would comprise unit systems located in the NAB of each unit and would handle filter replacement and transfer of resins from the NAB to the ETB. Resins produced in the NAB of Unit 2 are proposed to be flushed through piping in a gallery between Unit 2 and the ETB in Unit 1. Solid waste from Unit 2 (including ILW filters) is proposed to be pre-conditioned in the Unit 2 Waste Treatment Building in a concrete or shielded metallic drum with a temporary biological plug before being transported by vehicle from the Unit 2 NAB to the Unit 1 ETB.

78 The SWTS is proposed to treat the solid waste from the operation of the unit. It would comprise a filter loading/unloading machine and a spent resin piping collector. A filter handling machine would remove the used filter and place it in a concrete enclosure. Spent and contaminated resins would be flushed to the SWTS storage tanks in the ETB via the SWTS collector. Low activity resins would be filled into big bags or casks which would then be transferred for further treatment if necessary. The SWTS would also comprise a glove box to sort operational waste.

79 Further information on the treatment of ILW filters was presented (Ref. 50) as part of the GDA process.

3.3.1.7.2 Effluent Treatment Building (ETB) System

80 The ETB System in Unit 1 is proposed to treat the solid waste produced by the operation of the EPRs™, and would comprise effluent and spent ion exchange resin storage facilities; conditioning facilities including filter and dry active waste encapsulation, conditioning of evaporator concentrates and sludges; a shredder; concentrates storage tanks; a resin conditioning facility involving a mobile encapsulating machine; and an installation for compacting low-activity operational waste.

81 NNB GenCo provides the technical specification for the proposed Unit 2 Waste Treatment Building and its role (Ref. 51), and explains how it was designed in relation to the different ways proposed for processing and transporting waste. The building is proposed to perform pre-conditioning of ILW and LLW from Unit 2 before their transfer in concrete drums or metallic boxes to the Unit 1 Effluent Treatment Building (ETB).

82 NNB GenCo proposes that the ISFS will have its own solid treatment system for resins, but will rely on the conditioning installation of the ETB System for the remaining ISFS solid waste which is proposed to be pre-conditioned in temporarily sealed concrete containers that are proposed to be transferred by road from the ISFS to the ETB.

83 Additional information on the ETB was presented (Ref. 52) as part of the GDA process.

3.3.1.7.3 ALARP Demonstration for ILW Transfers from Unit 2 to Unit 1

84 The ALARP demonstration for solid ILW transfers from Unit 2 to Unit 1 (Ref. 53) considers three options:

1) Permanent seal and road transfer
2) Temporary seal and road transfer (base case)
3) Temporary seal and gallery transfer

85 The option of treating solid ILW in Unit 2 is not considered.

86 Options 1 and 3 are compared against the base case (Option 2, temporary seal and road transfer) using two weighted safety factors and twelve weighted commercial factors. The chosen scoring method, which I considered to be heavily weighted in favour of the commercial factors, is claimed by NNB GenCo to support the base case of temporary seal and road transfer and to represent the reduction of risks to ALARP.

3.3.1.7.4 ALARP Demonstration for Resin Transfers from Unit 2 to the ETB

87 The ALARP demonstration for resin transfers from Unit 2 to the ETB (Ref. 54) considers three options:

- Two effluent treatment buildings (one for each unit, Option 1);
- One effluent treatment building adjacent to Unit 1 with transfer of Unit 2 resin to this building by a single pipe through an underground gallery (Option 2.1, the base case); and
- One effluent treatment building adjacent to Unit 1 with transfer of Unit 2 resin to this building by on-site road transport in a shielded drum (Option 2.2).

88 Option 2.2 is assessed as providing a considerable safety disbenefit and is not considered further.

89 The possibility of pipe blockage for Option 2.1 is considered and largely discounted on the grounds of operational experience and management controls.

90 Option 1 is considered to have significant safety benefits and disbenefits, significant environmental disbenefits and significant commercial disbenefits. Although these are not quantified, the document claims that the costs associated with Option 1 are grossly disproportionate to the risks averted. It is claimed that the base case of a single effluent treatment building adjacent to Unit 1 with transfer of Unit 2 resin to this building by a pipe through an underground gallery (Option 2.1) represents the reduction of risks to ALARP.

3.3.2 Interim Storage Facility (ISF) for ILW

91 EDF and NNB GenCo are developing the design of an Interim Storage Facility (ISF) for ILW for HPC to store the ILW arising from two units operating for 60 years pending the availability of a disposal route. The ISF is being designed with a lifespan of 60 years with life extension beyond that a possibility via refurbishment or replacement. The design of a single-room storage facility with package stacking on three levels allowing segregation options for (i) decay of ILW to LLW within the interim storage period; and (ii) storage of unconditioned non-mobile wastes is currently at a conceptual level. NNB GenCo states that detailed information and safety analysis are not yet available, and certain features including lid design and reopening arrangements for the option of unconditioned decay storage have not yet been designed.

92 The conceptual design is expected to be able to store at least 2460 C1 packages and 1200 C4 packages, representing an annual input rate of about 70 packages, plus space for over-packaging of potentially defective packages.

3.3.2.1 HPC ILW interim storage facility – Forward work plan

93 NNB GenCo assumes that the ISF for ILW would need to be ready for HPC Reactor 1 criticality (Ref. 55). It notes that there would be contingency room in the ETB for buffer storage of ILW for up to two years of EPR™ operation, which means that the latest date for operation of the ISF for ILW would be two years after the EPR™ start. It is not expected that the first packages would be moved into the ISF for ILW until after the first refuelling outage.

94 The ISF for ILW is anticipated to be decommissioned at the same time as the EPR™. Civil work and embedded structures and equipment would have to be designed for a 100 year lifetime. Other structures and components designed for a NNB GenCo's proposed lifetime of 60 years would need to be adapted and refurbished as necessary.

95 NNB GenCo sets out the plan that prior to first nuclear island safety-related concrete, the design would need to be sufficiently developed and documented to ensure that the structures and equipment would be engineered to allow the facility to store and handle ILW packages in normal and accident conditions. As the facility would not need to be in operation before first EPR™ reactor criticality, it would not be necessary to prepare detailed specifications for the civil work, components for systems and equipment contracts before first nuclear island safety-related concrete.

3.3.3 Interim Spent Fuel Store (ISFS)

96 NNB GenCo is proposing the storage of spent fuel for a period after its discharge from the reactor in the fuel building, and thereafter in a dedicated Interim Spent Fuel Store (ISFS) using wet storage in pools pending the availability of a disposal route. The ISFS design is at the conceptual stage.

97 The ISFS conceptual design includes dedicated liquid effluent collection and treatment systems, gaseous waste treatment including a ventilation system to be exhausted via the ISFS stack, and the storage and treatment of ion-exchange resins.

98 NNB GenCo has carried out optioneering studies on the treatment of radioactive solid waste that would be generated in the ISFS, comparing conditioning in the ISFS against using the EPR™ unit facilities for waste treatment within the Effluent Treatment Building (ETB). NNB GenCo is proposing that ion-exchange resins would be encapsulated within the ISFS using the MERCURE mobile conditioning plant (on the basis that there will be a continued need for encapsulation in the ISFS after decommissioning of the ETB in Unit 1, the ability to optimise the encapsulation process using operational feedback from the ETB, and NNB GenCo's statement that resin transfer in galleries represents engineering complexity and increased costs). Dry solid waste would be transferred in temporarily sealed concrete containers by road vehicles to the ETB for treatment (on the basis of NNB GenCo's claim of current best practice, simplicity and avoiding the need to duplicate equipment).

99 NNB GenCo explains its proposal that for HPC wet storage in pools provides the best solution for interim storage of spent fuel (Ref. 56). I noted that radioactive discharges and waste generation were considered as part of the decision-making process, but these factors were not considered to provide any significant differentiation of the options. I noted that decommissioning did not appear to be a significant factor in the decision.

3.3.3.1 Conceptual design of the underwater spent fuel interim storage facility: synthesis report

100 This synthesis report (Ref. 57) provides a description of the conceptual design for the proposed ISFS for HPC.

101 The report confirms that the ISFS would generate:

- Liquid effluents from package preparation, leak recovery, purging, draining, package decontamination, laundry, changing rooms and ventilation
- Solid waste including filters, filter cartridges, ion-exchange resins and wastes resulting from operator interventions
- Gaseous effluents discharged through a stack

102 The report confirms that decommissioning of the ISFS has been taken into account:

- Radioactive matter would be confined to a metallic liner surrounding the concrete structure of the pool, racks and movable gates and immersed heat sink equipment such as heat exchangers and circulation pumps.
- The amount of radioactive waste from the ISFS is claimed to be likely to be small due to the compact nature of the design.
- The ISFS would use lightweight concrete instead of high-density concrete to facilitate decommissioning.

3.3.3.2 Safety Considerations for the ISFS at HPC in the Conceptual Design Stage

103 This document (Ref. 58) provides the safety analysis for the ISFS including the safety approach used to carry out the study, design basis incidents and accidents and design extension conditions. I noted that the document has been produced at the conceptual design stage, and does not include substantial content relating to the safety of proposed waste or decommissioning activities.

3.3.3.3 Data required for interface contracts with the ISFS

104 NNB GenCo defines the proposed ISFS interfaces with the site galleries and buried networks necessary for the definition of construction contracts (Ref. 59). The interfaces include those for liquid effluent and waste water systems. Storage, treatment and removal of solid wastes is not intended to require an interface with the EPR™ units.

3.3.3.4 Management of solid waste arising from the operation of the ISFS

105 NNB GenCo describes options for the management of solid waste arising from the ISFS (Ref. 60), and presents the proposed strategy:

- Ion exchange resins are proposed to be encapsulated in the ISFS on the basis that:
    - this would represent a robust choice with respect to the future autonomous operation of ISFS after EPR™ shutdown and dismantling;
    - it would allow the transfer of passively safe sealed waste;
    - the need for resin transfer would be avoided; and
    - operational feedback from the EPR™ units would help to optimisation the ISFS encapsulation process.

- Solid waste is proposed to be transferred in temporarily sealed concrete casks to the Effluent Treatment Building (ETB) in EPR™ Unit 1 on the basis that:
  - it is current practice at other EDF stations;
  - it would provide simplicity; and
  - it would allow the use of equipment proposed to be installed in Unit 1, thereby avoiding the need to install additional equipment in the ISFS;
  - however additional equipment would require to be installed in ISFS after it became autonomous.

106 NNB GenCo provides an identification and analysis of the options available to transfer spent fuel from Units 1 and 2 to the ISFS (Ref. 61). It concludes that dry horizontal transfer is the best available technique. I noted that the proposed option avoids the potential for leakage during wet transfer; waste generation and decommissioning factors do not appear to feature in the analysis.

3.3.4 Disposability

107 NNB GenCo describes its discussions with the Nuclear Decommissioning Authority regarding the off-site disposability of UK EPR™ solid radioactive waste and spent fuel (Ref. 62).

108 NNB GenCo claims that disposability in principle has been confirmed for its operational LLW for disposal to land, incineration, Very Low Level Radioactive Waste (VLLW) landfill, metal treatment and super-compaction. NNB GenCo is proposing to use C1 and C4 concrete packages which would require additional development work to demonstrate disposability, and has obtained a conceptual Letter of Compliance (LoC) for the use of these packages.

109 NNB GenCo presented additional information to ONR on its prioritisation and forward work plan for the Action Points for its conceptual LoC (Ref. 63)

3.4 Decommissioning

3.4.1 Sources of Radioactivity in Decommissioning

110 NNB GenCo describes in outline the inventory of radioactive materials expected to be present following the final shutdown of the HPC reactors (Ref. 64):

- Fission products such as caesium-137 and technetium-99
- Corrosion products, largely cobalt-60
- Primary coolant activation products including tritium and carbon-14
- Actinides mostly resulting from neutron activation of uranium
- Spent fuel, which at end of generation is proposed to be transferred to the Fuel Building Spent Fuel Pool and after an initial cooling period of approximately 3 years transferred to be stored in the newly-autonomous ISFS for a period expected to be greater than 50 years
- Accumulated operational wastes in the ISF for ILW (expected to be 3660 packages) plus final arisings of operational ILW and LLW (estimated raw waste volumes of 100 m^3 and 1022 m^3 respectively)

- Fixed activated structures: ILW (approximately 1600 tonnes); LLW (approximately 5200 tonnes); and VLLW (approximately 3100 tonnes)
- Contaminated structures and materials
- Other nuclear island equipment (LLW approximately 3700 tonnes; VLLW 11,000 tonnes) and site building wastes (ILW 1600 tonnes; LLW 9500 tonnes; VLLW 18,000 tonnes)
- Wastes generated during decommissioning (LLW approximately 1500 tonnes; VLLW 8400 tonnes)

111 There is an apparent omission from the current inventory presented in HPC PCSR2012 in that no information is provided on irradiated control rods. I noted that information on the control rods, their composition, how they will be stored and disposed of will be required.

3.4.2 General Procedures for Decommissioning

112 NNB GenCo outlines the significant aspects of the decommissioning strategy for HPC and describes the decommissioning plan for the dismantling of the site in accordance with that strategy (Ref. 65).

113 The proposed strategy for HPC is early site clearance with prompt reactor dismantling following end of generation. NNB GenCo does not propose any deferral or care and maintenance period to allow radioactivity levels to further reduce. Decommissioning of the plant excluding the ISFS is expected to take around 20 years.

114 As the site transitions from operational into and throughout the decommissioning phase NNB GenCo expects various changes to the management and staff structures in place, and intends that each change will be subject to a managed change under LC36 compliance arrangements.

115 NNB GenCo describes many design features intended to facilitate decommissioning:

- Improved accessibility, and the modular nature of the reactor and other primary circuit components
- Use of shielding to minimise neutron activation of plant and equipment and contamination barriers to minimise contamination spread
- System design to minimise the creation, transportation and deposition of radioactivity
- Use of materials which minimise the creation of activation products
- Measures to facilitate electrical isolation of buildings
- Ease of removal of major process components
- Submerged disassembly of reactor pressure vessels
- Modular thermal insulation
- Fuel cladding integrity
- Minimisation of hazardous materials

116 Over its lifetime the ISFS is anticipated to store 6800 spent fuel assemblies (3600 tonnes). After the fuel cooling period and its transport to the final disposal route, the ISFS is proposed to be drained, decontaminated, dismantled and demolished.

117 Once the ISF for ILW is emptied of its waste packages, it is expected to be radiologically clean, and conventional demolition techniques would be able to be used for its demolition and decommissioning.

118 NNB GenCo describes (Ref. 65) its proposed approaches to:

- General hazard reduction and safety
- Radiological hazard reduction and safety
- Decommissioning sequence
- Methodology (e.g. remote handling, manual dismantling, conversion of Unit 1 Turbine Hall into a Decommissioning Waste Management Facility (DWMF), cutting of components, removal of large items, chemical decontamination in situ, removal of structures to one metre below ground level)
- Shielding and containment requirements
- Decommissioning technologies and techniques
- Strategy for safety systems
- Decommissioning waste management

119 NNB GenCo proposes that site clearance and release for re-use are proposed to be undertaken in two phases:

- The first and largest phase is proposed to be undertaken following decommissioning of the power generation plant and ISF for ILW.
- The second phase is proposed to be undertaken after emptying and decommissioning of the ISFS.

3.4.3 Records and Knowledge Management for Decommissioning

120 NNB GenCo describes the characteristics of the records, information and knowledge management systems that it is proposing to use to ensure secure retention of relevant records and knowledge and to facilitate its transfer between all stages of the lifecycle (Ref. 66). The management of records for decommissioning are described, including how records are proposed to be used, systems for retention and transfer, preservation, dealing with obsolescence, protection of records against hazards, security and usability. Transfer of recorded knowledge from designer to operator to decommissioning organisation is considered, together with retention of competencies for decommissioning.

3.4.4 Hazards during Decommissioning

121 NNB GenCo provides an outline hazard assessment for the proposed decommissioning of HPC intended to demonstrate that it can be decommissioned in a safe manner (Ref. 67). A detailed assessment of hazards and risks has not been undertaken.

122 NNB GenCo's outline hazard assessment considers internal and external hazards to plant during decommissioning and includes:

- Missiles
- Failures of tanks, pipework and pressurised components
- Collapse of structures and falling objects
- Impacts from heavy internal transportation
- Explosions
- Electromagnetic interference
- Fire
- Flooding
- Release of corrosive, toxic, radioactive and asphyxiant substances
- Loss of services
- Earthquake
- Aircraft crash
- Industrial hazards
- Extreme climatic conditions
- Lightning
- Ground engineering hazards
- Radiological hazards to workers and public
- Human and organisational events
- Conventional non-radiological health and safety hazards

3.4.5 Faults during Decommissioning

123 NNB GenCo identifies and outlines potential faults and their consequences where there could be a significant exposure to the workforce or releases of radioactivity during decommissioning, and the precautions taken to avoid their occurrence and mitigate their consequences (Ref. 68). The key decommissioning safety functions are described as criticality control, decay heat removal, containment, shielding and distance.

124 Significant faults identified during spent fuel management include loss of primary coolant outside containment, pipework or valve failure on a system connected to the Reactor Building Fuel pool or ISFS, and fuel handling faults. Those identified during site operation and plant preparation include loss of primary circuit cleaning liquor, loss of power supply and wound injury to worker in a controlled area. Faults identified during management of operational wastes include raw waste handling or processing faults and dropped conditioned ILW package. Faults associated with plant decommissioning include:

- Removal of highly activated components from reactor internals without adequate shielding or failure of shielding
- Spread of contamination from failure of techniques, equipment or handling of highly contaminated components from the reactor
- Leak in the gaseous or liquid waste processing systems, storage vessels or Decommissioning Waste Management Facility (DWMF)
- Rupture of systems containing radioactivity in the Nuclear Auxiliary Building (NAB)
- Dropped item and/or impact to plant or equipment containing radioactive material or activated plant
- Fire in DWMF
- Failure of ventilation in DWMF

3.4.6 Post Accident Decommissioning

125 NNB GenCo considers the decommissioning tasks required to tackle the plant degradation and radiological consequences of design basis faults (Ref. 69). It considers design features claimed to assist post fault decommissioning including remote viewing systems, radiation monitoring systems, ventilation systems and containment spray systems. It also describes the general approach to preparing a post accident decommissioning plan which may include the depressurisation of reactor building containment, decontamination of walls and surfaces, provision of lighting, ventilation, communications and power, lifting equipment, shielding and defueling. NNB GenCo suggests that this may also involve increased solid waste arisings and additional volumes of contaminated liquid arisings.

3.4.7 Detailed Decommissioning and Waste Management Plan ((D)DWMP)

126 This plan, prepared to meet requirements of the Energy Act 2008, was produced to:

- provide an initial decommissioning plan to be used by NNB GenCo to comply with the requirements of Licence Condition 35 (LC35, Decommissioning) of its site licence;
- provide a technical basis for the establishment of a robust estimate of the costs of decommissioning and waste management;
- provide a record of the proposed decommissioning plan to the site’s engineering and waste management teams; and
- reduce decommissioning uncertainties.

127 The programme covered by the (D)DWMP includes:

- Pre-closure planning
- Management and operation of the shut-down site during decommissioning
- Spent fuel management after end of generation, including interim storage and disposal
- Management of operational wastes after end of generation
- Decommissioning of all plant, equipment, building and facilities and management and disposal of the radioactive and other hazardous wastes arising
- Remediation and delicensing, and return of the site to the agreed end state

128 The (D)DWMP is intended to provide a major component of NNB GenCo's arrangements for compliance with LC35, through:

- Setting out the arrangements for decommissioning of HPC
- Providing a schedule for the decommissioning of HPC
- Setting out the plan and schedule as a series of activities in sufficient detail to allow hold points to be established and agreed with ONR
- Providing an overview of radiological, conventional and environmental safety, including proposals for a qualitative analysis of ‘cross-category’ hazards (e.g. human factors, including conditions for working in confined spaces, or moving around congested or tight spaces)

4 ASSESSMENT

129 Within my assessment I have raised Level 4 Issues where I expect NNB GenCo to track, and ONR to monitor, NNB GenCo’s progress in closing out each issue within the required timescale.

130 Within my assessment I have also made observations and identified apparent inconsistencies in NNB GenCo’s HPC PCSR2012 and supporting documentation. Although I expect NNB GenCo to consider and address these appropriately, I do not consider formal progress tracking to be necessary at the current time. Should the need arise, these observations and apparent inconsistencies can be elevated to the status of requiring progress tracking as part of NNB GenCo’s routine engagement process with ONR during the future development of the PCSR and subsequent safety cases.

4.1 Assessment of Proposals for Radioactive Discharges and Waste

4.1.1 Comparison with Standards, Guidance and Relevant Good Practice

4.1.1.1 Production and implementation of the strategy for the management of radioactive waste on the site

131 I found that, to the extent appropriate to the current stage of development, NNB GenCo’s strategy contained in section 4 of HPC PCSR2012 sub-chapter 11.2 (Ref. 46), sections 0 and 3 of sub-chapter 11.3 (Ref. 47) and NNB GenCo’s *Management Strategy for Operational Intermediate Level Waste* (Ref. 49):

- is consistent with Government radioactive waste management and disposal policies;
- includes descriptions of NNB GenCo’s policy and objectives and is adequately integrated with its decommissioning and other strategies;
- adequately covers the proposed future inventory of operational radioactive waste, considers timescales for its management, and adequately plans the management of each radioactive waste stream from generation through to final management, taking account of off- and on-site interdependencies, to ensure that unmanageable waste should not be created;
- adequately takes account of biological, chemical and other hazards;
- appears to be compatible with the other parts of the developing safety case; and
- clearly sets out the assumptions made.

4.1.1.1.1 Level 4 Issue RW-01 (Optioneering of waste containers)

132 I noted that although the strategy clearly identifies the chosen waste management route, NNB GenCo's approach to optioneering does not fully meet regulatory expectations in that, on the basis of the information provided, its preferred option for packaging in C1 and C4 casks does not appear to have been compared systematically with the advantages and disadvantages of the other options identified. NNB GenCo's presentation of its proposed choice of shielded concrete casks in its operational ILW management strategy (Ref. 49) does not provide sufficient detail on the decision-making process followed. NNB GenCo needs to demonstrate that the relevant factors set out in regulatory guidance (including consideration of packaged waste volumes) have been taken into account and that the advantages and disadvantages of other options are assessed and documented. I raised this as **Level 4 Issue RW-01** to be addressed by NNB GenCo by the end of March 2016.

4.1.1.1.2 Legislative and regulatory requirements

133 I noted that section 3.2 of NNB GenCo's safety requirements document for discharges and radioactive waste management (Ref. 45) contains a simple list of legislation titles and lacks overview or detail of actual legislative and regulatory requirements.

4.1.1.1.3 Level 4 Issue RW-02 (Decommissioning wastes)

134 NNB GenCo's radioactive wastes arising from future decommissioning operations are not yet covered in detail in its strategy; they are currently addressed in concept only within HPC PCSR2012 Chapter 20 (Ref. 64). I raised this as **Level 4 Issue RW-02** to be addressed by NNB GenCo by the end of March 2016. An increasing level of detail on NNB GenCo's radioactive waste management strategy for decommissioning wastes will be required for the next stage of the PCSR and as the safety case develops further.

4.1.1.1.4 Level 4 Issue RW-03 (Letter of Compliance future work)

135 NNB GenCo is currently at the conceptual stage in the Letter of Compliance (LoC) assessment process for its proposed waste packages. I observe that significant further work will be required to obtain a final LoC, and I raised this as **Level 4 Issue RW-03** with NNB GenCo's submission for an interim LoC expected to be required by the end of March 2018. However, taking into account the nature of the action points arising from the issue of the conceptual LoC, I view as reasonable NNB GenCo's claim that it should be able to complete this work to obtain a full LoC by the time of active commissioning of the Waste Treatment Building.

4.1.1.1.5 Level 4 Issue RW-04 (Strategy review)

136 The radioactive waste strategy does not appear to address the need to review at appropriate intervals: (i) the adequacy of storage capacity; and (ii) the strategy itself. I raised this as **Level 4 Issue RW-04** to be addressed by NNB GenCo by the end of March 2016.

4.1.1.1.6 Link between strategy and safety management system

137 The radioactive waste strategy does not appear to make an explicit link to NNB GenCo's safety management system.

4.1.1.1.7 Uncertainties and project risks

138 The uncertainties and project risks associated with the achievement of the radioactive waste strategy, and how these will be managed, require more detailed consideration within the future development of the PCSR and subsequent safety cases.

4.1.1.2 Minimisation in terms of quantity and activity of the radioactive waste generated and accumulated

139 In general I did not assess the rate of production of gaseous and liquid radioactive waste within the EPRs™ as this is largely a matter covered in the assessments of reactor operations and chemistry, although I noted NNB GenCo's emphasis on recycling liquid effluents where possible to the primary and secondary circuits.

140 In the areas I assessed (generation of solid waste) I found that NNB GenCo's proposals in HPC PCSR2012 generally indicate that design provisions for waste minimisation are included, and the rate of raw waste production has been minimised. In particular, NNB GenCo's decommissioning proposals indicate that considerable effort has been expended at the design stage to avoid and minimise the creation of radioactive waste during the decommissioning phase through materials selection and construction methods.

141 NNB GenCo's proposals for minimisation of accumulation of LLW and VLLW appear to be generally adequate, apparently making use of appropriate permitted and exempt disposal routes where this is the most appropriate management option.

142 Observations and recommendations connected with the lack of a 'chemistry control' sub-chapter with Chapter 11 of HPC PCSR2012 have been identified within ONR's assessment of the reactor chemistry work stream (Ref. 11). This appears to have been an omission as chemistry control is an important aspect of the minimisation of generation of radioactive waste within the gaseous and liquid radioactive waste systems.

4.1.1.2.1 Minimisation of packaged waste volume

143 I note that in its decision document for the granting of the environmental permit to carry on radioactive substances activities at HPC (Ref. 70), the Environment Agency concluded that the proposed techniques for treating solid waste were best available techniques (BAT), subject to the future operator providing site-specific detail that will only be available when the detailed design is developed. NNB GenCo's preferred approach to packaging of ILW does not appear to minimise the generation of packaged radioactive waste in a direct volumetric comparison with the packaged waste that would be generated by the other packaging options identified. Completion of suitable optioneering work including a systematic comparison with the other options identified would be expected to provide analysis of whether any advantages of NNB GenCo's preferred approach outweigh the increase in packaged waste volume and any other disadvantages. Such an analysis is needed to form the basis for a specific overall demonstration of whether the rate of production of radioactive waste has been minimised, assisting in meeting licence condition requirements and regulatory expectations, and NNB GenCo needs to include this within the resolution of Level 4 Issue RW-01 (Optioneering of waste containers).

4.1.1.2.2 Level 4 Issue RW-05 (Optioneering of ILW and LLW sludges and evaporator concentrate processing)

144 Optioneering, design and assessment work remains to be completed for proposed ILW and LLW sludges and evaporator concentrate processing. I raised this as **Level 4 Issue RW-05** to be addressed by NNB GenCo by the end of March 2016.

4.1.1.2.3 Trend monitoring and effectiveness review

145 NNB GenCo's proposals do not yet appear to address the regulatory requirements for trend monitoring for the generation of radioactive waste, the demonstration of the effectiveness of the waste minimisation measures applied, or reviews of the opportunity for radioactive waste reduction. Proposals to meet these requirements would be expected to be developed during the operational phase.

4.1.1.3 Characterisation and segregation to facilitate subsequent safe and effective management

146 NNB GenCo's proposals for waste characterisation and segregation appear to be adequate, through the provision of design features, locations, equipment and arrangements.

4.1.1.3.1 Apparent inconsistency in HLW generation

147 Chapter 11.3 of HPC PCSR2012 (Ref. 47) indicates that high level radioactive waste (HLW) is not generated during operations at HPC (page 69, Table 3, row 4, 'Description' column) but also states that activated core components with heat-generating levels above the ILW threshold (i.e. HLW) would be transferred to the reactor fuel pools where they would be held for a period of delay storage before processing (page 73, Table 7, row 4, 'HPC Processing Strategy' column). NNB GenCo needs to resolve this apparent inconsistency.

4.1.1.3.2 Level 4 Issue RW-06 (Inventory, non-compliant waste and mixing of wastes)

148 NNB GenCo does not provide detail on its proposals for:

- reviewing and maintaining its inventory of radioactive waste during operations;
- identifying, assessing and dealing with any radioactive waste that does not meet process specifications or disposal criteria; and
- criteria to be used for decision making on mixing radioactive waste streams (where appropriate).

149 I raised this as **Level 4 Issue RW-06** to be addressed by NNB GenCo by the end of March 2016.

4.1.1.4 Processing into a passively safe state and storage in accordance with good engineering practice

150 NNB GenCo's current progress through the LoC assessment process for its C1 and C4 packages and towards resolving the action points arising from the issue of the conceptual LoC appear to be adequate.

151 NNB GenCo's proposals for waste processing are generally adequate in terms of good engineering practice and in the production of packages that would be ultimately passively safe. However, there are significant areas where I do not consider that NNB GenCo's optioneering studies presented in HPC PCSR2012 adequately substantiate NNB GenCo's proposals and these are set out below.

4.1.1.4.1 Level 4 Issue RW-07 (Optioneering of management of Unit 2 ILW resins)

152 I note that ONR's assessment of radioactive waste management and decommissioning work streams in support of the licensing of the HPC site to NNB GenCo (Ref. 42) recognised that the transfer of ILW ion-exchange resins via underground pipe can constitute relevant good practice. However, NNB GenCo's proposal to flush ILW resin from the Unit 2 Nuclear Auxiliary Building (NAB) through 270 m of piping in a gallery to the Effluent Treatment Building (ETB) of Unit 1 is not substantiated in sufficient detail. The ALARP demonstration (Ref. 54) draws the conclusion that the cost of establishing an ETB in Unit 2 would be grossly disproportionate to the risk averted, despite arriving at an apparently opposing conclusion to that for the proposed transfer of ILW resin from the ISFS to the Unit 1 ETB where encapsulation is proposed instead. As neither the costs nor the doses and risks potentially averted are quantified in the ALARP demonstration for Unit 2 ILW resin management, I do not view the conclusion of the ALARP demonstration is substantiated. I raised this as **Level 4 Issue RW-07** to be addressed by NNB GenCo by the end of March 2016.

4.1.1.4.2 Level 4 Issue RW-08 (Optioneering of management of Unit 2 solid wastes)

153 NNB GenCo's proposals to transfer solid wastes in temporarily sealed concrete containers from Unit 2 and the ISFS to Unit 1's ETB is not substantiated in sufficient scope or detail. In particular, the ALARP demonstration (Ref. 53) does not consider a full range of options including for example the conditioning of solid ILW waste within an Effluent Treatment Building in Unit 2, and does not consider vehicle loading and unloading activities and their associated risks within the scope of the comparison. Also, the numbers of attributes considered in the analysis are disproportionately skewed towards commercial factors (11 attributes) in comparison with safety and environmental factors (3 attributes), resulting in an analysis which inevitably would favour commercially-attractive options over those that would have greater safety benefits. Finally, the presentation of the advantages and disadvantages of the qualitative options in Appendix 1 lacks clarity in terms of format and communication of significant messages. NNB GenCo needs to consider the full range of options, including for example the encapsulation of operational solid waste in the ISFS, especially as NNB GenCo is proposing that a solid waste encapsulation facility is proposed to be installed in the ISFS for the period when it is proposed to operate autonomously after the end of generation. I raised this as **Level 4 Issue RW-08** to be addressed by NNB GenCo by the end of March 2016.

4.1.1.4.3 Apparent inconsistency in optioneering of ILW resin management

154 In the optioneering study on transport of solid waste from the ISFS to the Unit 1 ETB in section 2.3.8 on page 28 of sub-chapter 11.5 (Ref. 62), resin transfer in galleries is considered to represent 'engineering complexity and increased costs', and encapsulation is described as a simple alternative (compared with an underground gallery) while at the same time guaranteeing appropriate shielding and confinement. However in the optioneering for transport of resin from the Unit 2 NAB to the Unit 1 ETB, transfer by piping in a gallery is favoured over encapsulation. NNB GenCo needs to consider all relevant factors set out in regulatory guidance for such optioneering studies to consider whether this represents an inconsistent approach. This apparent inconsistency needs to be addressed as part of the resolution of Level 4 Issue RW-08.

4.1.1.4.4 Temporary biological plugs

155 Little detail is provided on the design and expected performance of the temporary biological plugs for concrete casks.

4.1.1.4.5 Level 4 Issue RW-09 (Optioneering of campaign processing and decay storage)

156 The proposals for following a campaign basis for encapsulation of ILW (including ion-exchange resins through the occasional use of the MERCURE mobile packaging plant) mean that unconditioned and potentially mobile wastes would exist in tanks and temporary buffer stores for periods extending up to several years (possibly eight years).

157 Also, NNB GenCo's more tentative proposals to store certain non-mobile ILW until it decays to become LLW would result in the storage of waste that was less passively safe during that period than if it had been conditioned and encapsulated. A more rigorous demonstration of the adequacy of NNB GenCo's tentative proposal for unconditioned decay storage to allow recategorisation of certain non-mobile wastes from ILW to LLW is required. The claimed advantage of NNB GenCo's ultimate ability to dispose of such wastes as LLW rather than ILW needs to be considered carefully against the increase in risk of storing unconditioned wastes in a less passively safe state for the decay period. In the event that the expected decay to LLW does not materialise, encapsulation or another form of treatment would be required at a future date.

158 Both of these proposals (campaign processing and decay storage to LLW) require more rigorous optioneering and optimisation to enable NNB GenCo to be able to demonstrate that its proposals to defer progress with packaging wastes are compatible with regulatory guidance on passive safety and minimisation of the need for active safety systems and monitoring. Such a demonstration is needed for NNB GenCo to ensure it is able to demonstrate compliance with licence conditions including LC32 (*Accumulation of radioactive waste*), and with sections 2 and 3 of the Health and Safety at Work etc. Act 1974 (Ref. 71) to ensure, so far as is reasonably practicable, the health, safety and welfare at work of employees and that persons other than employees who may be affected are not exposed to risks to their health or safety.

159 While recognising that ONR is content to support in principle appropriate strategies for campaign processing and decay storage, NNB GenCo's proposals to store unconditioned wastes for several years, and more tentative proposals to decay store certain non-mobile ILW for ultimate disposal as LLW are not yet substantiated by adequate optioneering. NNB GenCo should present fully-formed descriptions of, and justifications for, these proposals setting out a proportionate level of quantitative detail on the relevant factors set out in regulatory guidance (including additional levels of hazard and risk, time at risk, waste degradation, lid design and any proposals for segregation from conditioned ILW for disposal). I raised this as **Level 4 Issue RW-09** to be addressed by NNB GenCo by the end of March 2019.

4.1.1.4.6 Level 4 Issue RW-10 (Design progress for ISFS and ISF for ILW)

160 The designs for the Interim Storage Facility (ISF) for ILW and the Interim Spent Fuel Store (ISFS) are current at an early conceptual stage. However, the ISF for ILW and the ISFS would have an interface with many of the proposed EPR™ facilities and systems (e.g. those relating to water treatment facilities, ISFS ventilation, ion-exchange resin treatment, waste package numbers, etc.). For those interfaces, the current lack of design maturity means that NNB GenCo is not yet able to demonstrate compliance with regulatory requirements relating to radioactive waste management and decommissioning. I raised this as **Level 4 Issue RW-10** to be addressed by NNB GenCo by the end of March 2016.

4.1.1.4.7 Level 4 Issue RW-11 (Operational limits and conditions for storage)

161 As the design develops, it will be important for NNB GenCo to identify as part of its safety case any operational limits and conditions that will be required for the safe storage of packaged waste in the ISF for ILW. These may include environmental conditions (such as temperature and humidity), heat generation, gas generation and radiological hazards. Such operational limits and conditions will also be required to be identified where necessary for temporary buffer storage areas and storage tanks for radioactive waste. I raised this as **Level 4 Issue RW-11** to be addressed by NNB GenCo by the end of March 2016.

4.1.1.4.8 Package marking, acceptance criteria and degradation

162 NNB GenCo's developing proposals for the inspection and retrieval of individual stored packages, including the availability of reserve storage space, appear to be adequate. The developing design for the ISF for ILW appears to have adequate provision to enable intervention in the event of unexpected faults or accidents; NNB GenCo will need to provide more detail as the design develops on its package marking system, acceptance criteria and its provisions for dealing with radioactive waste packages showing signs of unacceptable degradation.

4.1.1.4.9 Level 4 Issue RW-12 (Temporary storage of high-dose-rate activated components)

163 Very little detail is provided on the arrangements for temporary storage of activated components with higher dose rates generated during maintenance operations which are temporarily placed into the reactor fuel pools to allow for a period of radioactive decay in order to minimise dose to workers. No designs or assessments appear to be provided for components with heat generating levels above the ILW threshold. I raised this as **Level 4 Issue RW-12** to be addressed by NNB GenCo by the end of March 2016.

4.1.1.5 Recording and preservation of information that might be required in the future for the safe management of radioactive waste

164 NNB GenCo's proposals in sub-chapter 20.4 for records and knowledge management are adequate for its current stage of development for decommissioning planning, and briefly mention waste management. GDA assessment finding AF-UKEPR-RW-03 addresses this in more detail.

4.1.2 Relevant GDA Assessment Findings (AFs)

165 Of the twelve GDA AFs issued in this area, three are relevant within the timescale of my assessment:

4.1.2.1 AF-UKEPR-RW-01

166 GDA assessment finding AF-UKEPR-RW01 requires the licensee to "*produce an RWMC for all of the wastes that their UK EPR will produce. This will be complete prior to the pouring of nuclear island safety related concrete*".

167 Production of an RWMC does not feature prominently in NNB GenCo's HPC PCSR2012, and NNB GenCo presented information (Ref. 72) to me on its progress towards its RWMC at a meeting held on 25 October 2013. Although not a statutory requirement, regulatory guidance (Ref. 22) emphasises the importance that safety and environmental regulators place on the development of an effective RWMC. I noted NNB GenCo's plans to close out this AF by the end of 2015 which can be reviewed by ONR at the next stage of its assessment of NNB GenCo's PCSR.

4.1.2.2 AF-UKEPR-RW-03

168 GDA assessment finding AF-UKEPR-RW03 requires the licensee to "*implement a records management procedure for waste management and decommissioning that incorporates the principles established in the AREVA report on the Management of Records and UKEPR-0016-001. This will be complete prior to the pouring of nuclear island safety related concrete*".

169 The AF was discussed in my meeting with NNB GenCo on 25 October 2013 (Ref. 12); NNB GenCo subsequently produced a revised resolution plan (Ref. 73) to produce a technical report describing its arrangements for record keeping in this area prior to first nuclear island safety-related concrete which appeared to be a satisfactory proposal to close out the AF.

4.1.2.3 AF-UKEPR-RW-06

170 GDA assessment finding AF-UKEPR-RW06 requires the licensee to "*produce a safety report for the processing and long-term storage of the ILW. The report will contain information equivalent to that of a Preliminary Safety Case as defined in Guidance on the Purpose, Scope and Content of Nuclear Safety Cases, and be complete prior to the pouring of nuclear island safety related concrete*".

171 This AF was also discussed in my meeting with NNB GenCo on 25 October 2013 (Ref. 12). NNB GenCo sought ONR's view on whether the information provided in HPC PCSR2012 was equivalent to that needed in a Preliminary Safety Case, and suggested that if further detail is required to close out the AF it would be provided through the next stage of its PCSR.

172 I took an action to consider this as part of my assessment. I assess that the information provided in HPC PCSR2012 is broadly equivalent to, or in excess of, that that needed for a Preliminary Safety Case. However there are some areas covered by my assessment where more coverage and detail is required before the AF can be closed out:

- NNB GenCo's approach to optioneering within HPC PCSR2012 in several areas is not consistent with that which would be expected to be set out in a Preliminary Safety Case (e.g. choice of waste containers, Unit 2 waste proposals, campaign processing, decay storage).
- In some areas of the developing conceptual designs for the ISF for ILW and the ISFS, more detail is required to provide confidence that safety principles and criteria are likely to be met.

4.1.3 ONR's assessment of the radioactive waste management work stream in support of the licensing of the HPC site to NNB GenCo

173 I reviewed ONR's assessment of NNB GenCo's radioactive waste work stream in support of the licensing of the HPC site (Ref. 42) in the light of the material presented in HPC PCSR2012.

174 I am content that ONR's relevant conclusion in that previous assessment remains broadly valid, i.e. the overall strategy for management of ILW is in general accordance with national and regulatory policy and strategy, and the proposals presented are feasible. The findings of my assessment consider areas where further work is required to ensure that NNB GenCo's proposals are fully consistent with regulatory expectations.

4.2 Assessment of Proposals for Decommissioning

4.2.1 Comparison with Standards, Guidance and Relevant Good Practice

4.2.1.1 Design and operation of facilities

175 On the basis of the information provided in Chapter 20 of HPC PCSR2012 and NNB GenCo's Detailed Decommissioning and Waste Management Plan ((D)DWMP, Ref. 39), and for the current stage of the development, I assessed as adequate NNB GenCo's proposals for the design and operation of HPC facilities such that they would be able to be safely decommissioned. I noted that NNB GenCo is taking account of the need for decommissioning and waste retrieval during its planning and design activities, including design measures to:

- Minimise activation
- Reduce the spread of contamination
- Facilitate decommissioning
- Reduce dose uptake by decommissioning workers
- Minimise the generation of radioactive waste

4.2.1.1.1 Level 4 Issue DC-01 (Irradiated control rods)

176 There is an apparent omission from the decommissioning inventory in that no information is provided on irradiated control rods; NNB GenCo needs to provide information on irradiated control rods, their composition, how they will be stored and disposed of. I raised this as **Level 4 Issue DC-01** to be addressed by NNB GenCo by the end of March 2016.

4.2.1.1.2 Level 4 Issue DC-02 (Decommissioning dose assessments)

177 Workforce and public dose assessments from proposed decommissioning activities have not yet been carried out. I raised this as **Level 4 Issue DC-02** to be addressed by NNB GenCo by the end of March 2016.

4.2.1.2 Preparation and maintenance of the decommissioning strategy

178 I noted that a decommissioning strategy adequate for the current stage of development has been prepared, which:

- is consistent with Government policy;
- sets out appropriate objectives;
- describes the end state and timescales;
- appears to take relevant factors into account; and
- describes assumptions made and project risk management arrangements.

179 Interdependencies appear to have been taken into account, and the strategy appears to be adequately integrated with other relevant strategies such as that for radioactive waste management.

180 NNB GenCo's proposed timing of decommissioning is consistent with Government policy and regulatory guidance.

4.2.1.3 Production and implementation of the strategy for the management of radioactive waste from decommissioning

4.2.1.3.1 Stakeholder engagement

181 It is not immediately apparent to me how the regulatory requirement within SAP DC.2 (Ref. 3) has been addressed on how stakeholder views have been or are intended to be taken into account in the preparation and future development of NNB GenCo's decommissioning strategy. Proposals to address stakeholder views in NNB GenCo's review and maintenance of the strategy will be sought by ONR in due course.

4.2.1.4 Preparation and maintenance of the decommissioning plan and programme

4.2.1.4.1 Review and updating of (D)DWMP

182 For the current stage of the HPC development, NNB GenCo's (D)DWMP provides an adequate plan and programme to show that it can be safely decommissioned, but NNB GenCo has not yet provided substantive information on how it proposes to review, update and develop the plan, including the proposed timing of the necessary detailed characterisation survey, and this will be sought by ONR in due course.

4.2.1.5 Identification, preparation, updating and retention of documents and records required for decommissioning

183 NNB GenCo's proposals for record keeping and knowledge management in relation to decommissioning are generally adequate.

4.2.1.6 Establishment and maintenance of organisational arrangements

184 NNB GenCo's proposals for organisational arrangements for decommissioning are adequate for the current stage of development.

4.2.1.7 Review and modification of the safety management system

4.2.1.7.1 Level 4 Issue DC-03 (Review of safety management system for decommissioning)

185 Although some oblique references appear within Chapters 7, 8 and 14 of the (D)DWMP, it is not apparent what NNB GenCo's proposals are for the periodic review and maintenance of its safety management system as necessary prior to and during decommissioning, or what its proposals and timescale are for preparing and updating its decommissioning plan prior to the end of generation. I raised this as **Level 4 Issue DC-03** to be addressed by NNB GenCo by the end of March 2016.

4.2.2 Relevant GDA Assessment Findings (AFs)

186 Of the GDA AFs, two are relevant to decommissioning and have milestones within the timeframe of my assessment:

4.2.2.1 AF-UKEPR-RW-02

187 GDA assessment finding AF-UKEPR-RW02 requires the licensee to "*review the construction activities to identify any actions that could be taken during construction that would be beneficial to the decommissioning process. (For example is it appropriate to leave lifting lugs on vessels?). This will be complete prior to the pouring of nuclear island safety related concrete*".

188 NNB GenCo provided further detail in sub-chapters 20.3 and 20.4 of HPC PCSR2012 (Refs. 65 & 66) and has requested contractors to provide further demonstrations of their consideration of decommissioning, but expects that only limited information will be available prior to the milestone of first nuclear concrete. NNB GenCo is proposing to close out the AF through the incorporation of additional information from contracts into the next stage of its PCSR, and this will be reviewed by ONR at that time. I took an informal action (131025-3, Ref. 74) at my meeting with NNB GenCo on 25 October 2013 (Ref. 12) to provide the licensee with more information on ONR's expectations with regard to the close-out of this AF.

4.2.2.2 AF-UKEPR-RW-03

189 This AF relates to the implementation of a records management procedure for radioactive waste management and decommissioning, and is covered in section 4.1.2.2.

4.2.3 ONR's assessment of the decommissioning work stream in support of the licensing of the HPC site to NNB GenCo

190 I reviewed ONR's assessment of NNB GenCo's decommissioning work stream in support of the licensing of the HPC site (Ref. 42) in the light of the material presented in HPC PCSR2012.

191 I am content that ONR's relevant conclusion in that previous assessment remains valid, i.e. the overall strategy for decommissioning is in accordance with national and regulatory policy and strategy, and the proposals presented are feasible.

4.3 Assessment of NNB GenCo's 'intelligent customer' status

192 In my assessment work I was content that NNB GenCo appeared to be undertaking fully the 'intelligent customer' role in relation to ensuring integration of material provided by different third parties (such as EDF), and appears to be meeting regulatory expectations in this regard.

4.4 Assessment of presentation of HPC PCSR2012

193 The presentation of the radioactive waste and decommissioning sections of NNB GenCo's HPC PCSR2012 and supporting documents is largely logical and clear, with only one minor area where translation from French had not occurred. The next stage of its PCSR will give NNB GenCo the opportunity to integrate further relevant supporting documents, in particular the Detailed Decommissioning and Waste Management Plan ((D)DWMP).

4.5 Assessment Finding

194 My overall assessment rating for NNB GenCo's radioactive discharges, waste and decommissioning work streams is 3 (adequate).

5 CONCLUSIONS AND RECOMENDATIONS

5.1 Conclusions

195 For the current stage of its development, NNB GenCo has generally produced adequate proposals for:

- Producing and implementing radioactive waste and decommissioning strategies
- Waste minimisation, characterisation, segregation, processing and passively safe storage
- Design and operation of facilities to promote their safe decommissioning
- Record keeping and knowledge management for radioactive waste management

5.1.1 Level 4 Issues, observations and apparent inconsistencies

196 There are a total of fifteen Level 4 Issues to be progressed through routine future regulatory work. These are presented in Table 2.

197 Within my assessment I have also made observations and identified apparent inconsistencies in NNB GenCo's HPC PCSR2012 and supporting documentation. Although I expect NNB GenCo to consider and address these appropriately, I do not consider formal progress tracking to be necessary at the current time. Should the need arise, these observations and apparent inconsistencies can be elevated to the status of requiring progress tracking as part of NNB GenCo's routine engagement process with ONR during the future development of the PCSR and subsequent safety cases.

5.2 Recommendations

198 There are no formal recommendations from my assessment.

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Table 1

Relevant Safety Assessment Principles (SAPs) Considered During the Assessment

SAP No.	SAP Title	Description
RW.1	Strategies for radioactive waste	A strategy should be produced and implemented for the management of radioactive waste on a site.
RW.2	Generation of radioactive waste	The generation of radioactive waste should be prevented or, where this is not reasonably practicable, minimised in terms of quantity and activity.
RW.3	Accumulation of radioactive waste	The accumulation of radioactive waste on site should be minimised.
RW.4	Characterisation and segregation	Radioactive waste should be characterised and segregated to facilitate subsequent safe and effective management.
RW.5	Storage of radioactive waste and passive safety	Radioactive waste should be stored in accordance with good engineering practice and in a passively safe condition.
RW.6	Passive safety timescales	Radioactive waste should be processed into a passively safe state as soon as is reasonably practicable.
RW.7	Records for management of radioactive waste	Information that might be required now and in the future for the safe management of radioactive waste should be recorded and preserved.
DC.1	Design and operation	Facilities should be designed and operated so that they can be safely decommissioned.
DC.2	Decommissioning strategies	A decommissioning strategy should be prepared and maintained for each site and should be integrated with other relevant strategies.
DC.3	Timing of decommissioning	Decommissioning should be carried out as soon as is reasonably practicable taking relevant factors into account.
DC.4	Planning for decommissioning	A decommissioning plan and programme should be prepared and maintained for each nuclear facility throughout its life-cycle to demonstrate that it can be safely decommissioned.
DC.5	Passive safety	The facility should be made passively safe before entering a care and maintenance phase.
DC.6	Records for decommissioning	Throughout the whole life-cycle of a facility the documents and records that might be required for decommissioning purposes should be identified, prepared, updated and retained.
DC.7	Decommissioning organisation	Organisational arrangements should be established and maintained to ensure safe and effective decommissioning of facilities.
DC.8	Safety arrangements	The safety management system should be periodically reviewed and modified as necessary prior to and during decommissioning.

Table 2

Level 4 Issues Raised During the Assessment

No.	Title	Issue	Level	Who	Completion / review date
Optioneering					
2065	Optioneering of waste containers	NNB GenCo needs to carry out a systematic comparison of the advantages and disadvantages of appropriate packaging options (including the minimisation of packaged waste volume) in support of its chosen waste management route.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016
2066	Optioneering of ILW and LLW sludges and evaporator concentrate processing	NNB GenCo needs to complete optioneering, design and assessment work for proposed ILW and LLW sludges and evaporator concentrate processing.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016
2067	Optioneering of management of Unit 2 ILW resins	NNB GenCo needs to substantiate in detail its ALARP demonstration for its proposal for Unit 2 ILW resin management.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016
2068	Optioneering of management of Unit 2 solid wastes	NNB GenCo needs to substantiate in detail its ALARP demonstration for its proposal for Unit 2 solid waste management.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016
2072	Optioneering of campaign processing and decay storage	NNB GenCo needs to provide more rigorous optioneering and optimisation to substantiate its proposals for campaign processing and decay storage.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2019

Table 2

Level 4 Issues Raised During the Assessment

No.	Title	Issue	Level	Who	Completion / review date
Waste inventory					
2076	Decommissioning wastes	NNB GenCo needs to provide an appropriate level of detail on its radioactive waste management strategy for decommissioning wastes.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016
2078	Inventory, non-compliant waste and mixing of wastes	NNB GenCo needs to provide detail on its proposals for inventory review and maintenance, non-compliant waste and waste mixing.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016
2080	Irradiated control rods	NNB GenCo needs to provide information on irradiated control rods including their composition, how they will be stored and disposed of.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016
Waste disposability					
2081	Letter of Compliance future work	NNB GenCo expects to need to be ready to make its submission for an interim Letter of Compliance (LoC).	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2018
Waste strategy					
2082	Strategy review	NNB GenCo needs to include review requirements in its radioactive waste strategy.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016
Design					
2083	Design progress for ISFS and ISF for ILW	NNB GenCo needs to produce designs of sufficient maturity for its proposed Interim Storage Facility (ISF) for ILW and Interim Spent Fuel Store (ISFS) and their interfaces to demonstrate compliance with regulatory requirements relating to radioactive waste management and decommissioning.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016

Table 2

Level 4 Issues Raised During the Assessment

No.	Title	Issue	Level	Who	Completion / review date
Waste storage					
2084	Operational limits and conditions for storage	NNB GenCo needs to identify as part of its safety case any operational limits and conditions that will be required for the safe storage of packaged waste in the ISF for ILW.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016
2085	Temporary storage of high-dose-rate activated components	NNB GenCo needs to provide detail on the arrangements for temporary storage in reactor fuel pools of activated components with higher dose rates generated during maintenance operations.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016
Dose assessment					
2086	Decommissioning dose assessments	NNB GenCo needs to provide workforce and public dose assessments from proposed decommissioning activities.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016
Decommissioning planning and safety management					
2087	Decommissioning planning and safety management	NNB GenCo needs to provide proposals for the periodic review and maintenance of its safety management system prior to and during decommissioning, and its proposals for preparing and updating its decommissioning plan prior to the end of generation.	4	Richard Parlone, Environmental Arrangements Manager, NNB GenCo	31/3/2016