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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 Stream B14, Radiation Protection**

Assessment Report: ONR-CNRP-AR-13-100  
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**EXECUTIVE SUMMARY**

This assessment report (AR) reviews that portion of the Hinkley Point C Pre-Construction Safety Report 2012 (HPC PCSR 2012) that falls within the scope of Work Stream B14 Radiological Protection. This material lies in HPC PCSR 2012 sub Chapters 12.2 and 12.6.

A final version of the Generic Design Assessment (GDA) Pre-Construction Safety Report (PCSR) issued in November 2012 formed the basis for issue by ONR on 13 December 2012 of a Design Acceptance Confirmation (DAC) for the UK EPR™ design. The 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 the GDA PCSR.

In contrast HPC PCSR2012 addresses the whole Hinkley Point C licensed site comprising the proposed twin UK EPR units and all ancillary installations. Some matters that were outside the scope of GDA PCSR are also addressed in HPC PCSR2012. As the generic features were addressed in the GDA process, my focus is on site-specific documentation that has not been formally assessed by ONR previously. The remaining, generic documentation has been copied into PCSR2012 from an earlier March 2011 GDA PCSR but this has now been superseded by the November 2012 GDA PCSR report. .

It is 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. NNB Genco intends to submit a major revision to HPC PCSR2012 before seeking consent for Nuclear Island construction which will fully integrate the final GDA PCSR and will be supported by other documentation

I have examined the changes in sub-Chapters 12.2 and 12.6 of PCSR 2012. I conclude that they are satisfactory, but reserve my position on the detailed supporting documents, which may merit a more detailed analysis later in the regulatory process. I do not have any Regulatory Findings as a result of the changes.

**LIST OF ABBREVIATIONS**

AF	Assessment Finding
BMS	(ONR) How2 Business Management System
DAC	Design Acceptance Confirmation
GDA	Generic Design Assessment
HSE	Health and Safety Executive
HPC PCSR2012	Hinkley Point C Pre-Construction Safety Report 2012
LC	Licence Condition
ONR	Office for Nuclear Regulation (an agency of HSE)
PCSR	Pre-construction Safety Report
SAP	Safety Assessment Principle(s) (HSE)
SSC	System, Structure and Component
TAG	Technical Assessment Guide(s) (ONR)

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## 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 Stream B14, Radiation Protection.

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 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 through Assessment Findings (AF) on matters that need to be addressed in the next revision of HPC PCSR

### 1.2 Scope

4 The scope of this report covers Work Stream B14, Radiation Protection. This material lies in HPC PCSR2012 Chapter 12.

5 A final version of the Generic Design Assessment (GDA) Pre-Construction Safety Report (PCSR) issued in November 2012 formed the basis for issue by ONR on 13 December 2012 of a Design Acceptance Confirmation (DAC) for the UK EPR design. The 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 the GDA PCSR.

6 In contrast HPC PCSR2012 addresses the whole Hinkley Point C licensed site comprising the proposed twin UK EPR units and all ancillary installations. Some matters that were outside the scope of GDA PCSR are addressed in HPC PCSR2012. As the generic features were addressed in the GDA process, attention has been concentrated here on site-specific documentation that has not been formally assessed by ONR previously. The remaining, generic documentation has been copied into PCSR2012 from an earlier March 2011 GDA PCSR but this has now been superseded by the November 2012 GDA report. The generic documentation has only been revisited if recent developments have materially affected the case being made.

7 It is 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 and NNB Genco intends to submit other supporting documentation. Note also that HPC PCSR2012 will be superseded by a further site-specific revision intended to fully reflect the final GDA PCSR and other design changes from Flammanville 3 which is the reference design for Hinkley Point C .

8 It should also be noted 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 Flammanville 3. The integration of the methodology agreed during GDA will be demonstrated in the next revision of HPC PCSR.

**1.3 Methodology**

- 9 The methodology for the assessment follows the requirements of the ONR BMS 'produce assessments' step in the nuclear safety permissioning process and Ref. 2 in particular in relation to mechanics of assessment.

## 2 ASSESSMENT STRATEGY

10 My assessment strategy is set out in this section. This identifies the scope of the assessment and the standards and criteria that have been applied.

### 2.1 Standards and Criteria

11 The relevant standards and criteria adopted within this assessment are principally the Safety Assessment Principles (SAP), Ref. 2, internal ONR Technical Assessment Guides (TAG), Ref. 3, relevant national and international standards and relevant good practice informed from existing practices adopted on UK nuclear licensed sites. The key SAPs and relevant TAGs are detailed within this section. National and international standards and guidance have been referenced where appropriate within the assessment report. Relevant good practice, where applicable, has also been cited within the body of the assessment.

### 2.2 Safety Assessment Principles

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

#### 2.2.1 Technical Assessment Guides

13 The following Technical Assessment Guides have been used as part of this assessment (Ref. 4):

- Radiological Protection. T/AST/038
- Radiological Analysis – Normal Operation. T/AST/043

### 2.3 Use of Technical Support Contractors

14 Technical support contractors were not used for this assessment.

### 2.4 Integration with other Assessment Topics

15 There were no interfaces with other topic areas within ONR for this assessment due to the very limited changes from the GDA PSR. Whilst the Environment Agency have an interest in this area they did not take part in the review of PCSR 2012.

### 2.5 Out-of-scope Items

16 Doses to persons off-site resulting from routine discharges of radioactive material are outside the scope of the assessment, as explained in section 4 below.

**3 LICENSEE'S SAFETY CASE**

**3.1 HPC PCSR2012 Material Assessed**

17 The material relating to Work Stream B14, Radiation Protection, is located in Chapter 12. However the majority of this chapter is unchanged from the GDA PCSR. The only documentation that has not been formally assessed by ONR previously, and therefore falls to me to consider, is in sub chapters 12.2 and 12.6. However even these chapters require little new assessment, the reasons for this are detailed in section 4 of this report.

#### 4 ONR ASSESSMENT

18 This assessment has been carried out in accordance with ONR HOW2 BMS policy (Ref. 2).

#### 4.1 Scope of Assessment Undertaken

19 I have considered sub chapters 12.2, Definition of Radioactive Sources in the Primary Circuit, and 12.6 Normal Operation Dose Assessment for Public.

#### 4.2 Assessment

##### 4.2.1 Sub-chapter 12.2: Definition of Radioactive Sources in the Primary Circuit

20 The quantification and use of the inventory of radioactive material is important in the estimation of radiation exposures, and its optimisation is a key factor in the achievement of maintaining doses as low as reasonably achievable (ALARP), which is fundamental to radiation protection. A great deal of work was put into this at GDA by the requesting parties, and by ONR in its assessment. In particular a regulatory observation, RO-UKEPR-73 (Ref. 5) was generated, and the response to this by the requesting parties was key to ONR's findings. The assessor's conclusion was "*In my opinion and in the opinion of the TSC, the evidence to substantiate the arguments relating to radiation sources regarding information on the source term, and reductions in the source term through selection of materials associated with the primary circuit, was suitable and sufficient.*" This is clearly important to my assessment of PCSR 12.

21 The assessor also made the finding "*The licensee shall provide procurement procedures that require a review of materials associated with the primary coolant before purchase of those materials from their supplier in order to identify if there are any improvements in reductions in levels of cobalt or any other elements in materials which might lead to further reductions in radiation exposure of workers, and which would not compromise the functionality of those materials. This shall be complete before mechanical, electrical and control and instrumentation systems are delivered to site.*" NNB Genco are currently working on resolution of this finding, and it will be of importance in respect of future submissions. However it does not impact on the 2012 version of the PCSR and I do not consider it further here.

22 NNB Genco have developed sub-chapter 12.2 of PCSR 2012 from GDA PCSR 2011 consolidating the primary source term information within this sub-chapter, incorporating information on the source term definition from GDA PCSR 2011 sub-chapter 11.1. The crucial information defining the radioactive sources in the primary circuit (the subject of this sub-chapter) is in tables 1 to 3 and figures 1 and 2. These give the specific concentrations of radionuclides in the primary circuit for steady-state operation and shutdown transient, and for corrosion product deposits in the primary loops. This information is identical to that in tables 1 and 2 of the GDA PCSR sub-chapter 11.1, table 3 of sub-chapter 12.2 and figures 1 & 2 of sub-chapter 11.1. Hence everything that flows from these figures, and was assessed in depth by ONR assisted by the TSC during GDA, is unchanged, and I do not need to revisit it.

23 The rest of the changes in sub-chapter 12.2 are largely corrections, clarifications and amplifications. However, further references have been added, one of which is *Analysis of UK EPR Source Term: Identification, Quantification and Characterisation* (Ref 6), which provides analyses to substantiate the primary circuit source term. This is a major (154 pages) highly technical report covering a wide range of technical disciplines. Detailed

assessment of this would require a review by a TSC. In view of what was done for GDA as described above, I do not consider that this would be proportionate or well targeted at this juncture. However this does not preclude commissioning such a review at a later stage in the development of the design and the safety case.

#### **4.2.2 Sub-chapter 12.6: Normal Operation Dose Assessment For Public**

- 24 This sub-chapter is new; there was no equivalent sub chapter in the GDA PCSR. Notwithstanding this, an assessment was carried out by ONR for GDA (Ref 7).
- 25 Routine exposures of the public are regulated by the environment agency, with the exception of direct radiation originating within the licensed site boundary, which falls to ONR. My assessment is limited to this aspect, which is covered in section 4.4.2 and table 4 of sub-chapter 12.6 of PCSR 2012.
- 26 The licensee estimates conservatively that the most exposed member of the public for direct radiation would receive an exposure of 1.5 microsievert per year. The numerical values in the SAPs give the target and a legal limit for effective dose in a calendar year for any person off the site from sources of ionising radiation originating on the site as a BSL of 1000 microsievert and BSO of 20 microsievert. Thus the licensee's conservative estimate is more than a factor of 10 below the BSO.
- 27 HSE's SAPs state: "*The BSOs also recognise that there is a level beyond which further consideration of the case would not be a reasonable use of NII resources, compared with the benefit of applying the effort to other tasks. Inspectors need not seek further improvements from the dutyholder but can confine themselves to assessing the validity of the arguments that the dutyholder has presented.*" In accordance with this I have restricted my assessment to the simple question of whether the figure of 1.5 microsievert per year is the right order of magnitude. This is clearly the case based on the assessment done by ONR and calculations performed by its TSC for GDA (Ref 7) and the fact that the assumptions on distance and occupancy were more conservative than the real situation at Hinkley.
- 28 I therefore conclude that the changes introduced in PCSR 2012 are satisfactory.

**5 CONCLUSIONS AND RECOMENDATIONS**

**5.1 Conclusions**

29 I have examined the changes in sub-Chapters 12.2 and 12.6 of PCSR 2012 compared with the GDA PCSR. I conclude that they are satisfactory, but reserve my position on the detailed supporting documents, which may merit a more detailed analysis later in the regulatory process. I do not need to make any Regulatory Findings as a result of the changes. No recommendations are necessary.

## 6 REFERENCES

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- 1 NNB GenCo Submission of HPC PCSR 2012, Letter NNB-OSL-RIO-000322, ONR-HPC-20337N, 6 December 2012, TRIM 2013/16143
- 2 *ONR How2 Business Management System*. Guidance on Production of Reports, AST/003 Revision 7, September 2013
- 3 *Safety Assessment Principles for Nuclear Facilities*. 2006 Edition Revision 1. HSE. January 2008. [www.hse.gov.uk/nuclear/SAP/SAP2006.pdf](http://www.hse.gov.uk/nuclear/SAP/SAP2006.pdf)
- 4 *Technical Assessment Guides (TAGs)*. [www.hse.gov.uk/nuclear/tagsrevision.htm](http://www.hse.gov.uk/nuclear/tagsrevision.htm)
- 5 *RO-UKEPR-73.A1- Source term*. Letter from EDF AREVA Project Front Office to ND. EPR00518N. 10 August 2010. TRIM Ref. 2010/349163
- 6 *Analysis of UK EPR source term: identification, quantification and characterisation*, July 2011, EDF EDF NNB ECEF110448 Revision A
- 7 *Step 4 Radiological Protection Assessment of the EDF and AREVA UK EPR™ Reactor*. ONR Assessment Report ONR-GDA-AR-11-025 Revision 0. TRIM Ref. 2010/581507.

**Table 1**  
Relevant Safety Assessment Principles Considered During the Assessment

<b>SAP No.</b>	<b>SAP Title</b>	<b>Description</b>
NT.1	Assessment against targets	A safety case should be assessed against numerical targets and legal limits for normal operation, design basis faults, and radiological accident risks to people on and off the site.