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 Essential Electrical Work Stream

Assessment Report: ONR-CNRP-AR-13-093
Revision 0
Version 2
17 February 2014

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EXECUTIVE SUMMARY

This assessment report (AR) reviews that portion of the Hinkley Point C Pre-Construction Safety Report 2012 (HPC PCSR2012) that falls within the scope of the Essential Electrical Work Stream. Most of this material lies in HPC PCSR2012 Chapter 8 but other material found in relevant sub chapters has also been reviewed.

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generic documentation has been copied into HPC PCSR2012 from an earlier March 2011 GDA PCSR but this has now been superseded by the November 2012 GDA PCSR report.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 assessed HPC PCSR2012 for compliance with the closure of GDA and have identified that the essential electrical safety case in the final GDA PCSR resulting from resolution of GDA issue GI-UKEPR-EE-01 is not incorporated in HPC PCSR2012. I expect this to be resolved in PCSR3 which should substantiate the design of the plant electrical distribution system by incorporating the HPC PCSR2012 and final GDA PCSR.

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LIST OF ABBREVIATIONS

AF	Assessment Finding
BMS	(ONR) How2 Business Management System
CAE	Claims, Arguments and Evidence
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
SSC	System, Structure and Component
TAG	Technical Assessment Guide(s) (ONR)
BMS	(ONR) How2 Business Management System

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1 INTRODUCTION

1.1 Background

1 This report presents the findings of my assessment of that portion of the Hinkley Point C Pre-Construction Safety Report 2012 (HPC PCSR2012), (Ref.1) that falls within the scope of the essential electrical work stream.

2 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). 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 recommendations on matters that need to be addressed in the next revision of HPC PCSR

1.2 Scope

4 The scope of this report covers the essential electrical work stream B11. Most of this material lies in HPC PCSR2012 Chapter 8 but other material found in the Head Document has also been reviewed.

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 focussed 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 Flamanville 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 Flamanville 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. 3), internal ONR Technical Assessment Guides (TAG), (Ref. 4), 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 Guide has been used as part of this assessment (Ref. 4):

- NS-TAST-GD-019 Revision 2 Essential Services

2.2.2 National and International Standards and Guidance

14 The following international standards and guidance have been used as part of this assessment (Ref. 5)

- Safety of Nuclear Power Plants: Design. Specific Safety Requirements. International Atomic Energy Agency (IAEA). Safety Standards Series No SSR-2/1R-1. IAEA. Vienna. 2012.

2.3 Use of Technical Support Contractors

15 No Technical Support Contractors were used during this assessment.

2.4 Integration with other Assessment Topics

16 This assessment does not involve any formal integration with other assessment topics.

2.5 Out-of-scope Items

17 There were no out-of-scope items associated with this assessment.

3 LICENSEE'S SAFETY CASE

3.1 HPC PCSR2012 Material Assessed

18 The majority of material relating to essential electrical work stream B11 is located in Chapter 8. Other relevant material is contained in the Head Document.

19 The changes assessed in HPC PCSR2012 are in the following sub chapters:

- 8.1 – External Power Supplies.
- 8.2 – Power supply to the conventional island and balance of plant.
- 8.3 – Nuclear Island Power Supply.
- 8.4 – Specific Design Issues.
- 8.5 – Installation.
- 8.6 – Prevention and protection against common cause failure

4 ONR ASSESSMENT

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

4.1 Scope of Assessment Undertaken

21 HPC PCSR2012 is based on GDA PCSR2011 incorporating site specific aspects of the design. The resolution of GDA Issue GI-UKEPR-EE-01 (Ref. 6) required the GDA PCSR2011 to be modified to provide the claims arguments and evidence to substantiate the design of the essential electrical system. The final GDA PCSR incorporates the modifications to GDA PCSR2011 resolve the GDA Issue.

22 The scope of my assessment covers the essential electrical aspects of the NNB Genco HPC PCSR2012. My assessment has been limited to the changes presented in HPC PCSR2012 Head Document, Chapter 8 and Sub Chapters. I have also considered progress on resolving GDA Assessment Findings and NNB Genco's ongoing work and organisational competency to further develop the HPC PCSR2012.

4.2 Assessment

4.2.1 Resolution of GDA Issue GI-UKEPR-EE-01

23 The HPC PCSR2012 does not incorporate the modifications made to the GDA PCSR 2011 to resolve GDA Issue GI-UKEPR-EE-01 (Ref. 6). This required the development of a revised PCSR containing the requisite claims, arguments and evidence to substantiate the design of the plant electrical distribution system in accordance with ONR SAPs. The final GDA PCSR and supporting Claims, Arguments and Evidence (CAE) document (Ref. 5) were produced by the Requesting Party to provide the substantiation of the design in accordance with the ONR SAPs. The ONR close-out report accepted the Requesting Party's submission subject to the resolution of a number of Assessment Findings.

24 As a result of these activities there are divergent versions of PCSR sub-chapters 8.1 and 8.2 as the CAE document is not incorporated in HPC PCSR2012 and important safety topics such as lightning protection design and the substantiation of significant safety provisions in the design are also not covered in HPC PCSR2012. I have identified the main implications of this under each sub chapter heading.

25 I require the licensee to provide in PCSR3 a consolidated document which incorporates the safety substantiations from HPC PCSR2012 and final GDA PCSR and CAE document (Ref.7). The PCSR3 should be accompanied by a CAE document to demonstrate that the electrical system fully meets the requirements of its safety role as specified in the PCSR.

4.2.2 Head Document Chapter 8

26 This describes the development of Chapter 8 of the PCSR which covers the essential electrical system. The scope of GDA PCSR 2011 is described together with the additional material covering site specific details in the HPC PCSR2012. Section 8.2.2 states that the consolidated GDA PCSR 2011 does not provide substantiating analyses to support the safety case.

27 The additional material included in HPC PCSR2012 is described in the Section 8.3 – Route Map. This includes additional material covering Hinkley Point C grid supplies and additional descriptions of site supplies. It does not include changes in the final GDA

PCSR resulting from GDA Issue GI-UKEPR-EE-01 (Ref. 6) which provide substantiations of the safety of the essential electrical system.

28 In the conclusion in section 8.4 there is a statement that a suitable safety justification has been provided for this stage of the design process. I do not agree with this statement as the requisite safety justification for the essential electrical work stream has been provided in the final GDA PCSR which is not incorporated in HPC PCSR2012. I expect this justification to be provided in PCSR3.

4.2.3 Sub Chapter 8.1 - External Power Supply

29 I have assessed the material in Sub Chapter 8.1 which covers the connection of Hinkley Point C to the UK Grid and compliance with the UK Grid Code (Ref. 8). This was identified as outside the scope of GDA as the grid connection is site specific. The generic provisions associated with the provision of a grid connection were considered in GDA as this did have an impact on the electrical system design.

30 I am satisfied that the design of external power supply and grid connections as described in the HPC PCSR2012 provide a robust grid connection to support plant safety.

31 The process for achieving compliance with the UK Grid Code is described. I am satisfied that the process is appropriate for meeting the requirements of National Grid for connection to the UK transmission network. The compliance status at the publication of HPC PCSR2012 is described with some areas identified where interactions are continuing. As this process will continue during detail design of Hinkley Point C future HPC PCSR updates will be required to describe the status of Grid Code compliance. Assessment Finding AF-UKEPR-EE-10 was raised during GDA Step 4 assessment (Ref. 9) requiring the Licensee to ensure Grid Code compliance during detailed design.

32 Sub chapter 8.1 is revision 1.0 of the document. However, revision 0.4 from the GDA PCSR is not incorporated in the HPC PCSR2012. I expect this to be resolved in PCSR3.

33 In conclusion, subject to the future updates of the HPC PCSR I am satisfied with the external power supply arrangements and the process being followed for achieving UK Grid Code (Ref. 8) compliance.

4.2.4 Sub Chapter 8.2 – Power supply to the Conventional Island and Balance of Plant

34 I have assessed the material in Sub Chapter 8.2 covering power supplies to the conventional island and balance of plant which has been included in the HPC PCSR2012 by adding to the original GDA 2011 PCSR information. This provides additional design descriptions covering supplies to such as radwaste building and steam boiler heaters.

35 I am satisfied with the additional details provided which adequately represent the changes.

36 Sub chapter 8.2 is revision 1.0 of the document. However, revision 0.4 from the final GDA PCSR is not incorporated in the HPC PCSR2012. I expect this to be resolved in PCSR3.

4.2.5 Sub Chapter 8.3 – Nuclear Island Power Supply

37 Sub Chapter 8.3 is revision 03 of the document. No site specific changes have been made to this sub chapter in HPC PCSR 2012. However, revisions 04, 05 and 06 in the final GDA PCSR have not been incorporated in HPC PCSR2012. These revisions in the final GDA PCSR include significant additions to the sub chapter covering defence in depth, common cause failure and linking to the CAE document (Ref. 7). I expect these revision anomalies to be resolved in PCSR3.

4.2.6 Sub Chapter 8.4 – Specific Design Issues

38 Sub Chapter 8.4 is revision 03 of the document. No site specific changes have been made to this sub chapter in HPC PCSR2012. However, revision 04 in the final GDA PCSR has not been incorporated in HPC PCSR2012. These revisions include the following:

- Addition of descriptions on earth fault monitoring and alarms.
- Rewrite of the section on insulation coordination including descriptions of the protective measures.
- Addition of details on the design measures to protect against lightning.

39 I expect these topics to be included in PCSR3.

4.2.7 Sub Chapter 8.5 – Installation

40 No changes have been made to Sub Chapter 8.5 for HPC PCSR2012 or final GDA PCSR. I have no comments on this section.

4.2.8 Sub Chapter 8.6 – Prevention and Protection against Common Cause Failure

41 Sub Chapter 8.6 included in the HPC PCSR2012 submission is Revision 00 of the document. No site specific changes have been made to this sub chapter in PCSR2012. However, the final GDA PCSR includes revision 01 of this document which has not been included in the HPC PCSR2012 submission. These revisions include significant modifications and additions covering human factors, fast transients, segregation, separation and diversity. I expect these topics to be fully covered in PCSR3.

4.2.9 GDA Assessment Findings

42 The substantiation of claims made within the HPC PCSR2012 requires the resolution of Assessment Findings raised during GDA. The Resolution Plans for these are currently outstanding. I require robust Resolution Plans to be developed for all Assessment Findings which support the safety claims made in HPC PCSR2012.

4.2.10 Conclusion

43 I conclude the following from my assessment of the HPC PCSR2012:

- The HPC PCSR2012 adequately represents the site specific aspects of the electrical design case for Hinkley Point C.
- The HPC PCSR2012 does not provide adequate safety justification for the essential electrical work stream for Hinkley Point C.
- The final GDA PCSR and supporting CAE document have not been incorporated in the document and I expect these issues to be resolved in PCSR3.
- The substantiation of claims made within HPC PCSR2012 requires development and implementation of Resolution Plans for Assessment Findings raised during GDA assessment. I expect these Resolution Plans to be completed to support the claims.

5 CONCLUSIONS AND RECOMENDATIONS

5.1 Conclusions

44 This report presents the findings of the ONR assessment of the site specific elements of Hinkley Point C essential electrical work stream within HPC PCSR2012.

45 I am not satisfied that HPC PCSR2012 substantiates the Licensee's safety case for the site specific aspects of Hinkley Point C. This should be addressed in the PCSR3 submission.

46 The claims, arguments and evidence for the generic design are adequately covered in the final GDA PCSR and should be developed into a consolidated PCSR3 to provide the required safety justification.

5.2 Recommendations

47 My recommendations are as follows, these have not been included as ONR Issues as they are already covered by NNB Genco resolution plans:

- **Recommendation 1**: The licensee should develop a consolidated PCSR3 for the essential electrical systems topic area; this should be based on the site specific aspects of HPC PCSR2012 and the final GDA PCSR to provide a safety case in a claims, arguments and evidence format.
- **Recommendation 2**: The licensee should develop and implement resolution plans for GDA Assessment Findings to support the claims made in HPC PCSR2012.

6 REFERENCES

1 NNB GenCo Submission of HPC PCSR2012, 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

4 *Technical Assessment Guides (TAGs)*. www.hse.gov.uk/nuclear/tagsrevision.htm

5. Safety of Nuclear Power Plants: Design. Specific Safety Requirements SSR-2/1. January 2012.

6. GDA Issue GI-UKEPR-EE-01 Revision 1. PCSR Presentation of Claims Arguments and Evidence. ONR June 2011. TRIM Ref. 2011/324866

7. UK EPR GDA Electrical System CAE Document. 17074-709-000-RPT-0002. October 2012 TRIM Ref. 2012/332670

8. The Grid Code. Issue 5 Revision 6. National Grid Electricity Transmission PLC. December 2013

9. Step 4 Electrical Systems Assessment of the EDF and Areva UK EPR™ Reactor ONR Assessment Report ONR-GDA-AR-11-023 Revision 0. Nov 2011. TRIM Ref. 2010/581509.

Table 1

Relevant Safety Assessment Principles Considered During the Assessment

SAP No.	SAP Title	Description
EQU.1	Qualification Procedures	Qualification procedures should be in place to confirm that structures, systems and components that are important to safety will perform their required safety function(s) throughout their operational lives
EDR.1	Failure to safety	Due account should be taken of the need for structures, systems and components important to safety to be designed to be inherently safe or to fail in a safe manner and potential failure modes should be identified, using a formal analysis where appropriate
EDR.2	Redundancy, diversity and segregation	Redundancy, diversity and segregation should be incorporated as appropriate within the designs of structures, systems and components important to safety
EDR.3	Common cause failure	Common cause failure (CCF) should be explicitly addressed where a structure, system or component important to safety employs redundant or diverse components, measurements or actions to provide high reliability
EDR.4	Single failure criterion	During any normally permissible state of plant availability no single random failure, assumed to occur anywhere within the systems provided to secure a safety function, should prevent the performance of that safety function.
ERL.2	Measures to achieve reliability	The measures whereby the claimed reliability of systems and components will be achieved in practice should be stated
ERL.4	Margins of conservatism	Where multiple safety-related systems and/or other means are claimed to reduce the frequency of a fault sequence, the reduction in frequency should have a margin of conservatism with allowance for uncertainties.
EMT.1	Identification of requirements	Safety requirements for in-service testing, inspection and other maintenance procedures and frequencies should be identified in the safety case.
EMT.3	Type-testing	Structures, systems and components important to safety should be type tested before they are installed to conditions equal to, at least, the most severe expected in all modes of normal operational service.
EMT.6	Reliability claims	Provision should be made for testing, maintaining, monitoring and inspecting structures, systems and components important to safety in service or at intervals throughout plant life commensurate with the reliability required of each item.
EMT.7	Functional testing	In-service functional testing of systems, structures and components important to safety should prove the complete system and the safety-related function of each component

Table 1

Relevant Safety Assessment Principles Considered During the Assessment

SAP No.	SAP Title	Description
ELO.1	Access	The design and layout should facilitate access for necessary activities and minimise adverse interactions during such activities.
EHA.10	Electromagnetic interference	The design of facility should include protective measures against the effects of electromagnetic interference
ESS.1	Requirement for safety systems	All nuclear facilities should be provided with safety systems that reduce the frequency or limit the consequences of fault sequences, and that achieve and maintain a defined safe state
ESS.2	Determination of safety system requirements	The extent of safety system provisions, their functions, levels of protection necessary to achieve defence in depth and required reliabilities should be determined
ESS.3	Monitoring of plant safety	Adequate provisions should be made to enable the monitoring of the plant state in relation to safety and to enable the taking of any necessary safety actions.
ESS.7	Diversity in the detection of fault sequences	The protection system should employ diversity in the detection of fault sequences, preferably by the use of different variables, and in the initiation of the safety system action to terminate the sequences
ESS.8	Automatic initiation	A safety system should be automatically initiated and normally no human intervention should be necessary following the start of a requirement for protective action.
ESS.9	Time for Human Intervention	Where human intervention is necessary following the start of a requirement for protective action, then the time before such intervention is required should be demonstrated to be sufficient.
ESS.10	Definition of capability	The capability of a safety system, and of each of its constituent sub-systems and components, should be defined.
ESS.11	Demonstration of adequacy	The adequacy of the system design as the means of achieving the specified function and reliability should be demonstrated for each system.
ESS.12	Prevention of service infringement	Adequate provisions should be made to prevent the infringement of any service requirement of a safety system, its sub-systems and components.
ESS.15	Alteration of configuration, operational logic or associated data	No means should be provided, or be readily available, by which the configuration of a safety system, its operational logic or the associated data (trip levels etc) may be altered, other than by specifically engineered and adequately secured maintenance/testing provisions used under strict administrative control

Table 1

Relevant Safety Assessment Principles Considered During the Assessment

SAP No.	SAP Title	Description
ESS.16	No dependency on external sources of energy	Where practicable, following a safety system action, maintaining a safe facility state should not depend on an external source of energy
ESS.19	Dedication to a single task	A safety system should be dedicated to the single task of performing its safety function
ESS.20	Avoidance of connections to other systems	Connections between any part of a safety system (other than the safety system support features) and a system external to the plant should be avoided
ESS.21	Reliability	The design of a safety system should avoid complexity, apply a fail-safe approach and incorporate the means of revealing internal faults from the time of their occurrence
ESS.23	Allowance for unavailability of equipment	In determining the safety system provisions, allowance should be made for the unavailability of equipment
ESS.24	Minimum operational equipment requirements	The minimum amount of operational safety system equipment for which any specified facility operation will be permitted should be defined and shown to meet the single failure criterion.
EES.1	Provision	Essential services should be provided to ensure the maintenance of a safe plant state in normal operation and fault conditions
EES.2	Sources external to the site	Where a service is obtained from a source external to the nuclear site, that service should also be obtainable from a back-up source on the site.
EES.3	Capacity, duration, availability and reliability	Each back-up source should have the capacity, duration, availability and reliability to meet the maximum requirements of its dependent systems
EES.4	Sharing with other plants	Where essential services are shared with other plants on a multi-facility site, the effect of the sharing should be taken into account in assessing the adequacy of the supply
EES.5	Cross-connections to other services	The capacity of the essential services to meet the demands of the supported safety functional requirement(s) should not be undermined by making cross-connections to services provided for non-safety functions.
EES.6	Alternative sources	Alternative sources of essential services should be designed so that their reliability would not be prejudiced by adverse conditions in the services to which they provide a back-up
EES.7	Protection devices	Protection devices provided for essential service components or systems should be limited to those that are necessary and that are consistent with facility requirements

Table 1

Relevant Safety Assessment Principles Considered During the Assessment

SAP No.	SAP Title	Description
EES.8	Sources external to the site	Where a source external to the nuclear site is employed as the only source of the essential services needed to provide adequate protection, the specification and in particular the availability and reliability should be the same as for an on-site source.
EES.9	Loss of service	Essential services should be designed so that the simultaneous loss of both normal and back-up services will not lead to unacceptable consequences.
EKP.3	Defence in Depth	A nuclear facility should be so designed and operated that defence in depth against potentially significant faults or failures is achieved by the provision of several levels of protection
EKP.5	Safety measures	Safety measures should be identified to deliver the required safety function(s).

…