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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 – Summary Assessment Report

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EXECUTIVE SUMMARY

This report summarises the Office for Nuclear Regulation (ONR) assessment of the Hinkley Point C Pre-Construction Safety Report 2012 (HPC PCSR 2012) which was released to ONR in December 2012. It is a high level summary of 18 individual assessment reports (ARs) all of which have been published together with this report on ONR's website. One additional report on the topic of mechanical engineering and systems engineering will be published later. This delay is judged acceptable because the highest safety class mechanical systems were covered during ONR's Generic Design Assessment (GDA) and although there have been site specific developments since that time it is judged that these will not significantly affect the main conclusions stated in this report. The mechanical engineering and balance of plant report will be published by the end of June 2014 and this summary report will also be updated and re-published at the same time.

HPC PCSR 2012 addresses the safety of a twin UK EPRTM reactor unit facility proposed for construction by NNB GenCo Ltd adjacent to the existing nuclear facilities Hinkley Point A and Hinkley Point B near Bridgwater in Somerset.

It is important to note that HPC PCSR 2012 is not sufficient to inform a future ONR decision on whether to permission the activity of Nuclear Island concrete pour for Hinkley Point C. NNB GenCo intends to submit a major revision to its HPC Pre-Construction Safety Report (PCSR) before seeking consent for that activity. ONR's future decision on whether to grant its consent for the nuclear island first safety related concrete pour will not only be based on its assessment of the revised PCSR but also its assessments of a wide range of other legal, organisational and site related activities.

A final version of the UK EPRTM Generic Design Assessment (GDA) PCSR issued in November 2012 formed the basis for issue by ONR on 13 December 2012 of a Design Acceptance Confirmation (DAC) for the generic UK EPRTM design. The GDA PCSR addressed only the key elements of the design of a single UK EPRTM 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. Other matters, for example the turbine hall and conventional island, were also deemed to be outside the scope of the GDA PCSR.

In contrast HPC PCSR 2012 addresses the whole Hinkley Point C licensed site comprising the proposed twin UK EPRTM units and all ancillary installations. HPC PCSR 2102 is an integration of an earlier 2011 GDA PCSR and new material addressing broader site specific matters not covered during GDA such as the fact that HPC is a twin EPRTM unit site and the selection of heat sink design. As the generic features were addressed by ONR's GDA process, the focus of its assessment of HPC PCSR 2012 was on site-specific documentation that has not been formally assessed previously. Parts of the generic documentation in HPC PCSR 2012 have now been superseded by those in the final GDA PCSR report issued in November 2012 (note that HPC PCSR 2012 and the final GDA PCSR report were prepared concurrently). The next issue of HPC PCSR will fully integrate the new generic material from the final GDA PCSR in addition to integrating design changes arising from the reference design for the UK EPRTM namely Flamanville 3.

In the earlier GDA process assessment findings (AFs) were used to indicate future actions placed on a potential licensee. NNB GenCo is now a licensee and ONR is using its normal operational regulatory processes whereby issues raised by individual assessment activities will be tracked using ONR's Issues database.

There is a common theme in many of the ARs that are summarised in this report in that they call for more detailed safety justification. This is an inevitable stage in the process of a licensee taking a generic design and converting it into a more detailed site specific engineering design.

Taken together, ONR's ARs show that HPC PCSR 2012 is a significant step forwards towards producing a final PCSR for Hinkley Point C. Progress to date is consistent with ONR's expectations for this project. The next revision of the HPC PCSR will fully integrate the site-specific information with the final GDA PCSR generic material and other design changes arising from experience gained at Flamanville 3.

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LIST OF ABBREVIATIONS

AF	Assessment Finding (from the GDA process)
ALARP	As Low As Reasonably Practicable
AR	Assessment Report (ONR)
BMS	(ONR) How2 Business Management System
C&I	Control and Instrumentation
CSJ	Construction Safety Justification
DAC	Design Acceptance Confirmation
DBA	Design Basis Analysis
EDF NNB	Electricite de France New Nuclear Build
EPR TM	The generic design of pressurised water reactor submitted for GDA
GDA	Generic Design Assessment
HF	Human Factors
HIC	High Integrity Component
HPC	Hinkley Point C
HSE	Health and Safety Executive
PCSR2	Working title for document that became HPC PCSR 2012
PCSR3	Working title for document that will succeed HPC PCSR 2012
HPC PCSR 2012	Hinkley Point C Pre-Construction Safety Report 2012
IIS	Integrated Intervention Strategy (Rating) – an ONR metric on submission quality
ISFS	Interim Spent Fuel Storage Facility
LC	Licence Condition
NNB Genco	New Nuclear Build Generation Company Limited
ONR	Office for Nuclear Regulation (an agency of HSE)
PCSR	Pre-construction Safety Report
PSA	Probabilistic Safety Analysis
RPV	Reactor Pressure Vessel
SAA	Severe Accident Analysis
SAP	Safety Assessment Principle(s) (HSE)
SSC	System, Structure or Component
TAG	Technical Assessment Guide(s) (ONR)
UK	United Kingdom

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1 INTRODUCTION

1.1 Background

1.1.1 Report Purpose

- 1 This report summarises the findings of ONR's assessment of the Hinkley Point C Pre-Construction Safety Report 2012 (HPC PCSR 2012, Ref. 1). It summarises 18 detailed assessment reports all of which have been published on ONR's website. A report on mechanical engineering aspects and systems engineering could not be completed in time for this report. This report will be published by the end of June 2014 and an update of this summary report will be produced at the same time.
- 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). ONR's 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 Summary Assessment Report addresses whether HPC PCSR 2012 demonstrates suitable progress towards meeting ONR's expectations for an adequate Pre-Construction Safety Report. To this end this AR provides a high level overview of all of the 18 detailed ARs. Technical issues raised in each of the ARs will be tracked using ONR's routine regulatory process as described in its business management system (Ref. 2).

1.1.2 Background

- 4 A final version of the Generic Design Assessment (GDA) Pre-Construction Safety Report (PCSR) issued in November 2012 (Ref. 5) formed the basis for issue by ONR on 13 December 2012 of a Design Acceptance Confirmation (DAC) for the UK EPR™ design (Ref. 6). 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 and other site specific matters that a potential purchaser of the design could choose after taking the site location into account.
- 5 In contrast HPC PCSR 2012 addresses the whole Hinkley Point C licensed site comprising the proposed twin UK EPR™ units, all ancillary installations and other matters that were outside the scope of GDA PCSR. However HPC PCSR 2012 was based on an earlier March 2011 GDA PCSR, not the final version issued in November 2012. A consequence of this is that another revision of the HPC PCSR will have to be produced in due course. This revised PCSR will not only integrate the final November 2012 GDA PCSR but will also take the opportunity to update the site specific safety case to take into account a number of design changes to the reference plant for the UK EPR™ which is Flamanville 3. As the generic features were addressed in the GDA process, attention has been concentrated on site-specific documentation that has not been formally assessed by ONR previously. The generic documentation has only been revisited if recent developments have materially affected the case being made.
- 6 To summarise, HPC PCSR 2012 is an interim stage in the process of submitting a full PCSR for Hinkley Point C. It is an important document in that it does integrate many of the outcomes from the GDA process, although some key safety related design changes that were introduced towards the end of the GDA process came too late to influence HPC PCSR 2012. NNB GenCo has also taken the opportunity to update the design (as distinct from the safety case set out in HPC PCSR 2012) from the lessons learned at Flamanville 3 and will include a number of design changes from that facility into its HPC design. NNB

GenCo intends to undertake a revision to HPC PCSR 2012 to fully integrate the November 2012 GDA PCSR and to reflect the design changes to the reference Flamanville 3 facility. It is this next revision to the HPC PCSR (working title PCSR3) that when submitted to ONR will form a part of the basis for ONR's decision on whether to grant consent for pouring of the first nuclear island safety-related concrete.

1.2 Scope

7 The scope of this report covers all parts of HPC PCSR 2012 and in particular how well it meets ONR's requirements for an adequate Pre-Construction Safety Report for Hinkley Point C.

1.3 Methodology

8 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

9 The assessment strategy is set out in this section by identifying the scope of the assessment and the standards and criteria that have been applied.

2.1 Standards and Criteria

10 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

11 This summary report reflects the outcomes from the 17 more detailed reports and therefore covers the broad range of Safety Assessment Principles.

2.2.1 Technical Assessment Guides

12 The broad range of Technical Assessment Guides used are referenced in the individual assessment reports.

2.2.2 National and International Standards and Guidance

13 National and international standards used are quoted and referenced directly in the more detailed reports (see section 4 for references)

2.3 Use of Technical Support Contractors

14 No technical support contractors were used in the production of this report.

2.4 Integration with other Assessment Topics

15 This report summarises all other technical areas covered in ONR's assessment of HPC PCSR 2012.

2.5 Out-of-scope Items

16 There are no out-of-scope items but it is noted that ONR's assessment of mechanical engineering and systems engineering aspects will be delivered by the end of June 2014. It should also be noted, the approach to safety function categorisation and safety system classification agreed during GDA is not fully reflected in HPC PCSR 2012, 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 the HPC PCSR.

2.6 Issues

17 In interventions with licensees ONR uses regulatory issues to track actions and matters requiring further work from a licensee. ONR issues are divided into 4 levels from 1 – 4 with 1 being an issue of the highest level of concern. As a result of ONR's assessment of HPC PCSR 2012 no levels 1 and 2 issues were raised. The highest level of issue raised in this work is level 3 and there are 17 of these. The remaining are level 4 issues and full

information on both level 4 and level 3 issues is given in each detailed topic report. ONR's business management system defines the meaning of each level. Level 3 is a shortfall in regulatory expectations which presents a risk (limited threat) to a positive judgement on a Hold Point. Level 4 is an action considered as routine regulatory business and in the context of this report mainly refers to updates required in documentation. This report does not describe all issues but those referred to in this report are examples taken from the level 3 issues given in the detailed topic reports.

3 LICENSEE'S SAFETY CASE

3.1 Description of HPC PCSR 2012 Materials Submitted

18 HPC PCSR 2012 was submitted to ONR under cover of a letter on 6 December 2012 (Ref. 1). The letter explained that HPC PCSR 2012 consisted of a head document and a full set of sub-chapters.

19 Appendix 1 to the letter gave the full list of documents submitted. A description of HPC PCSR 2012 Forward Work Activities sat alongside the head document.

3.2 Nature of HPC PCSR 2012 Materials Submitted

20 The head document contains an executive summary that describes the purpose and scope of HPC PCSR 2012 (referred to within the submission as PCSR2), its structure, the governance and review process used in its preparation and the standards against which it was prepared. The individual chapters of HPC PCSR 2012 were then summarised. In each chapter summary there was a description of how much of the generic information presented in GDA is applicable to Hinkley Point C, the role of any new site-specific sub-chapters or supporting documents and how the two types of documents merged together to form a complete and unambiguous description of the Hinkley Point C proposals.

21 The documents received by ONR fell into two broad categories:

- generic sub-chapters copied verbatim from the March 2011 GDA submission; and
- new sub-chapters containing information particular to Hinkley Point C.

The majority of ONR's assessment focused on the second bullet point above and the following chapter summarises its assessment in each technical area.

4 ONR ASSESSMENT

4.1 Civil Engineering

- 22 The civil engineering assessment (Ref. 7) reviews the adequacy of HPC PCSR 2012 and builds upon the ONR civil engineering assessment from the earlier site licensing and GDA phases. The intent of HPC PCSR 2012 is to satisfy regulatory expectations that NNB GenCo has adequate arrangements for producing a competent construction stage PCSR. Much of the detailed design has yet to be carried out, which is normal for this stage in the design of a nuclear power plant. The assessment therefore considered concept and basic designs for the topics sampled. However, there are certain structures for which construction activities are planned prior to the issue of the next revision of HPC PCSR, and hence this work is intended to proceed under a Construction Safety Justification (CSJ). The purpose of the CSJ is to provide confidence that the as-built system, structure or component (SSC) will meet the requirements laid down in the safety case. The early structures addressed by CSJ were therefore sampled in more detail.
- 23 The inspector sampled the current status of the following:
- geological and geotechnical information;
 - technical galleries;
 - heat sink structures;
 - buildings and structures classification;
 - other material of relevance to civil engineering within HPC PCSR 2012; and
 - progress of design and resolution of GDA Assessment Findings.
- 24 The civil engineering inspector identified a number of areas where additional substantiation is required in support of the Construction Safety Justifications. The assessor considered it to be an important matter that the CSJ are submissions that clearly and comprehensively set out and substantiate the safety arguments.
- 25 The civil engineering inspector was satisfied that the site-specific environmental and external hazards envelope is bounded by the generic environmental and external hazards envelope assumed during GDA, although the inspector noted that further substantiation is necessary to confirm that the geological and geotechnical properties are bounded by the GDA envelope.
- 26 The inspector identified 6 level 3 regulatory issues and 14 level 4 regulatory issues all of which must be addressed prior to pouring of the first safety-related concrete. The level 3 issues have higher safety significance than the level 4 ones. The level 3 issues cover:
- Justification of the structures, systems and components required to lower and maintain site ground water levels within operating limits.
 - Justification for the location of the intake heads and substantiation for the modelling of sediment transport and deposition.
 - Justification that the planned inspection and maintenance operations for marine structures comply with the Construction (Design and Management) Regulations, 2007.
 - Adequacy of documentation for the safety-functional and design performance requirements for the safety-classified buildings.
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- Confirmation of the scope and methodology for the verification and validation of the proposed analysis and design software.
- Confirmation of the safety functional requirements for the pre-stressing gallery and justification for early construction..

The Licensee's progress in addressing these findings will be monitored via appropriate entries in the ONR Issues database.

- 27 The civil engineering inspector was satisfied with the claims, arguments and evidence laid down within the Licensee's safety case in relation to the items within the scope of his assessment. The inspector's conclusions were made in recognition that no construction permissions will be given on the basis of this safety case, and that any construction permission required prior to the next revision of the HPC PCSR will be covered by appropriate construction safety justifications.

4.2 Internal Hazards

- 28 No issues were raised in the internal hazards assessment (Ref. 8), though the inspector had some technical observations on each of the major supporting references relating to internal hazards. Nonetheless the inspector was satisfied with the claims, arguments and evidence laid down within the licensee's safety case at this stage of development, i.e. after having granted a licence but not having started construction.

- 29 The inspector noted that there is outstanding work to perform in the detailed design phase of the project related to the internal hazards safety case. This is particularly the case in the areas of hazards from balance of plant systems and structures, in incorporating necessary changes from ONR's GDA process, and in demonstrating that risks have been reduced so far as is reasonably practicable. The inspector added that a work plan described within the HPC PCSR 2012 was a useful starting point, but is now out of date.

4.3 External Hazards

- 30 The external hazards assessment (Ref. 9) noted that the external hazards discipline is primarily concerned with the site-specific challenges to structures and systems. The main input from the GDA process is the specification of external hazards design bases (e.g. seismic vibration, rainfall), or conditions that the site must satisfy to meet the intent of the generic design (e.g. the assumption of a dry site in respect of coastal flooding). The external hazards technical work by the licensee is aimed primarily at supporting the GDA design bases and siting assumptions by site-specific technical work, or justifying changes if necessary.

- 31 The inspector described that the external hazards assessment was at a preliminary stage, with the objective of identifying any issues of substantive nuclear safety significance. Additional work is now underway to provide a more complete assessment towards the end of the year 2014, and the results of this work will be integrated into the external hazards assessment of the next revision of the HPC PCSR and the safety case submission supporting first nuclear safety concrete.

- 32 The inspector was content with the work presented in HPC PCSR 2012 at this stage provided that a programme of forward work to address a number of issues is undertaken:-
- Complete the seismic hazard forward work programme to confirm the seismic design basis to be used for plant design before end December 2014.
 - Complete the HPC frazil ice hazard analysis in order to meet the timescales for permissioning first nuclear safety concrete.

- Develop a philosophy for its treatment of beyond design basis external hazards and identify a forward work programme for its implementation consistent with the requirements of the overall design process.

33 From the above points the inspector raised one Level 3 Issue on the absence of a completed seismic hazard analysis when detailed design work using seismic hazard information is about to start. The inspector also raised two Level 4 issues on completion of the Frazil ice hazard analysis and development of an approach to beyond design basis analysis.

34 Additional significant items to be considered through routine engagement with the licensee and/or interfacing with other ONR workstreams are:

- Completion of the external hazards PSA and the availability of PSA results to inform the design process in a timely manner and to ensure the overall plant risk is as low as reasonably practicable (ALARP). This issue is being taken forwards primarily by the PSA inspector.
- Resolution of the groundwater control issue so that deeply founded structures are able to deliver all their safety functions through the life of the facility. This issue is being taken forwards primarily by the civil engineering inspector.
- Re-examine the GDA Assessment Finding milestone dates to gain confidence that the work identified in each finding is undertaken in time to benefit all relevant structures, systems and components.

4.4 Equipment Qualification

35 The equipment qualification assessment (Ref. 10) did not fully address the detailed environmental conditions as these conditions are still to be finalised as part of the HPC PCSR forward work programme. The inspector was satisfied with the overall approach described within sub-Chapter 3.6 and considered that the ongoing work within the equipment qualification area demonstrates suitable progress towards meeting ONR's expectation for an adequate PCSR to be available to support nuclear island construction.

4.5 Structural Integrity

36 The structural integrity assessment (Ref. 11) reports a high level review of the new site-specific information presented in HPC PCSR 2012. The additional information is at a preliminary stage of design and the component safety classification system agreed during final stages of the close-out of GDA issues has yet to be fully implemented. The HPC PCSR 2012 presents no new substantive claims relating to structural integrity.

37 The inspector reported that a design change to provide watertight compartments for the fuel transfer tube, agreed within GDA, is now considered impracticable to implement and that instead NNB GenCo will present a justification based on demonstration of the integrity of the fuel transfer tube as a high integrity component (HIC). Accordingly an ONR Issue was raised seeking that the Licensee demonstrates that the high integrity approach for the fuel transfer tube is an ALARP solution and submits a formal safety case for assessment by ONR.

38 Due to the importance of the overall quality framework for ultrasonic testing of forgings for high integrity components during manufacturing, the inspector raised a new Level 3 issue "The Licensee shall demonstrate an adequate level of redundancy, diversity and independence for ultrasonic inspections of forgings for HIC pressure boundaries, and shall ensure that the results of these inspections form part of the lifetime records."

39 The inspector also raised a Level 3 issue for the Licensee to address uncertainties in the adequacy of the procedure for determining fracture toughness in the French design code. The issue relates to the transition temperature region and for providing an appropriate definition for the onset of upper-shelf transition.

4.6 Fuel and Core (including Criticality Safety)

40 The fuel and core assessment (Ref. 12) notes that those sub-chapters relevant to fuel and core safety including criticality safety are unchanged from those presented in the March 2011 GDA PCSR (sub-chapters 4.1 to 4.5 and 9.1). In accordance with the principle of not revisiting previously assessed material unless there have been developments which would warrant it, the inspector decided not to carry out a re-assessment but did confirm the adequacy of the integration of the GDA information. More generally the inspector did comment that NNB GenCo had made good progress on this topic since December 2012 giving confidence that the next revision of the HPC PCSR should adequately address this topic.

4.7 Fault Studies

41 The fault studies assessment (Ref. 13) addressed whether the design basis analysis (DBA) for the generic UK EPR™ is applicable to the HPC site, including the particular equipment provided for power generation and for the ultimate heat sink. NNB GenCo has provided claims and arguments within the head document of HPC PCSR 2012 that the DBA provided is applicable. However the Fault Studies Assessor concluded that at the current time, NNB GenCo has provided insufficient evidence to support these arguments in the system description documentation. In particular, the description of the support systems provides details of the configuration of these systems and the measures taken to ensure suitable resilience, but there is not sufficient information at present on the safety features of the systems to provide the required safety functions; their failure modes and the effects of loss of system availability. This information is needed to justify the level of safety classification given to the system and the measures required to ensure adequate reliability.

42 The information on the turbine and steam dump systems is currently at a preliminary design level and ONR will need additional information when the design becomes more mature.

43 The inspector judged that HPC PCSR 2012 does not provide a sufficient safety justification for the HPC site outside of the scope of GDA. Rather, it provides a description of the proposed plant and details the outcome of site-specific design decisions. Evidence of a systematic design process will need to be provided in the next revision of the HPC PCSR. The rationale behind the selection of design options is sometimes missing or insufficiently detailed to substantiate the decision. This is particularly true in the area of support systems and heat sink. The inspector noted however that NNB GenCo is currently undertaking a major review of these systems, partly in the context of GDA findings relating to their adequacy and partly in the context of findings relating to safety system classification.

44 The inspector was satisfied with the licensee's claims and arguments that the GDA DBA can be applicable to the HPC site. However, insufficient evidence has been presented on the basis of the design decision making. Ultimately, NNB GenCo will be expected to provide ONR with the evidence that DBA claimed in the PCSR is still valid for the HPC site or to provide a HPC-specific DBA safety justification. NNB GenCo should ensure that this information is available within the next issue of the HPC PCSR.

4.8 Probabilistic Safety Analysis (PSA) and Radiological Protection/Consequences

- 45 The inspector, based on an assessment of the new material in HPC PCSR 2012, concluded (Ref. 14) that adequate progress has been made for the point in time of this PCSR. For PSA, the March 2011 GDA PCSR has been adequately updated to reflect the site-specific features, with those aspects identified as outside the generic site environmental and external hazards envelope, where relevant, being updated with site-specific information.
- 46 The inspector stated that a significant amount of work needs to be completed on the PSA for the next revision of the HPC PCSR. The inspector considered that NNB GenCo had undertaken a comprehensive identification of required further work and had qualitatively assessed the impact of the PSA limitations as part of HPC PCSR 2012. However, given the importance of having as comprehensive as possible PSA for the nuclear island safety related concrete milestone, the inspector judged that NNB GenCo needs to develop the PSA model and supporting documentation to address those aspects identified in its HPC PCSR 2012 PSA forward work plan and PSA limitations report. This work should focus on those aspects that are relevant for risk informing the design to support a future ONR decision on whether to permission the Nuclear Island construction of Hinkley Point C.
- 47 The inspector identified a number of additional PSA limitations beyond those already identified in ONR's GDA step 4 PSA assessment report and those identified by NNB GenCo in HPC PCSR 2012. Formal ONR Issues have been raised to address the following:
- The PSA model (and documentation), PCSR and reference design are not aligned.
 - It is important for NNB GenCo to develop sufficient seismic PSA at an early stage so that it can risk inform the design of Hinkley Point C effectively. Further information is required on how its seismic PSA strategy will be implemented to ensure it meets this expectation.
 - The current ALARP demonstration is not fully developed. A Hinkley Point C specific overall ALARP assessment is required that includes, but is not limited to, the following: a summary of NNB GenCo's arrangements for ensuring risk is managed ALARP as the Hinkley Point C design and construction progresses; consideration of the insights from PSA; a comprehensive summary of the site-specific ALARP studies; and a summary of the GDA ALARP position.
- 48 The inspector stated that design basis analysis of individual radiological risks off-site has not been changed from the generic analysis supplied in the GDA PCSR. Hence radiological protection and radiological consequences assessment has been limited to an assessment of the Level 3 PSA presented in HPC PCSR 2012 sub-chapter 15.5, noting that there is already a GDA finding relating to radiological consequences analysis of design basis events.
- 49 The inspector noted that some of the Level 3 analysis in HPC PCSR 2012 used a UK Health Protection Agency code called PC COSYMA with appropriate site-specific population and other data. As the input dataset was incomplete, the inspector judged that it would be premature to carry out an in depth assessment, though he noted that the analyses appeared robust. The inspector found that the treatment of societal risk in HPC PCSR 2012 was a substantial improvement on the coverage in the final GDA PCSR report. It was also noted that the existing GDA AF relating to level 3 PSA (AF-UK EPR-PSA-044), required to be complete before fuel load, was adequate and that it was not necessary to raise any new Issues on the ONR Issues database.
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4.9 Severe Accident Analysis (SAA)

50 The inspector reported (Ref. 15) that the SAA information presented in HPC PCSR 2012 is essentially unchanged from that presented in the Consolidated GDA PCSR in March 2011. Consequently, the assessment of the severe accident analysis aspects is unchanged from the position reported in the GDA step 4 report for this topic.

51 The inspector judged that the forward SAA activities included within HPC PCSR 2012 appear reasonable but, as they are at a relatively high level, further detail will be required in due course.

52 The inspector reported that progress has been made in developing appropriate resolution plans for GDA assessment findings with one exception. The exception regards the draft resolution plan addressing measures to limit containment pressure in the case of an extended loss of all alternating current electrical power. In this case the inspector judges that the draft resolution plan does not give appropriate consideration to the installation of filtered containment ventilation at Hinkley Point C.

53 The main conclusion was that the inspector was content that an adequate level of progress is being made in developing the safety case and responding to GDA findings, with the sole exception of the position on filtered containment venting.

4.10 Essential Electrical

54 The Essential Electrical assessment (Ref. 16) noted that the electrical systems safety case resulting from resolution of GDA issue GI-UKEPR-EE-01 is not incorporated in HPC PCSR 2012. This is an outstanding matter that will ONR expects NNB GenCo to resolve in the next revision of HPC PCSR 2012.

4.11 Control and Instrumentation

55 The control and instrumentation (C&I) assessment (Ref. 17) reviewed the C&I aspects of sub-chapters 7.1 to 7.7, 10.2, 10.3 and 12.3, respectively, to determine how HPC PCSR 2012 has dealt with systems outside the scope of ONR's Generic Design Assessment (GDA).

56 The inspector reported that he was not yet satisfied that the claims, arguments and evidence laid down within HPC PCSR 2012 are sufficient to support permissioning of the C&I safety systems and equipment intended for use at HPC. This is due to the the design and development of a number of C&I safety systems and equipment requiring further work in terms of fully fulfilling the GDA outcomes and providing adequate information on those systems and equipment important to safety that are associated with the balance of plant outside the scope of GDA.

57 Several shortfalls identified in the assessment report have already been raised with NNB GenCo Ltd so that they can be addressed as part of the design and development of the C&I safety systems. An ONR Issue was made regarding those shortfalls that have not been specifically addressed by actions assigned to NNB GenCo to date. The areas NNB GenCo should address primarily cover improving on the limited information in HPC PCSR 2012 on standards compliance, equipment qualification procedures, protective measures for adverse electromagnetic phenomena and design for reliability of C&I safety systems and equipment important to safety at HPC for those systems which were outside the scope of GDA.

4.12 Reactor Chemistry

- 58 The chemistry assessment (Ref. 18) noted the proactive approach taken by NNB GenCo in developing the chemistry aspects of HPC PCSR 2012. This differed significantly from that taken during GDA, involving a more systematic review and definition of the chemistry requirements for the various plant systems. However the inspector found some inconsistencies between the various chemistry sub-chapters, both in terms of quality and approach. Those which are based closely on the March 2011 GDA PCSR (namely sub-chapters 5.5 and 10.7) are much better than those which are new for HPC PCSR 2012 (sub-chapters 6.9 and 9.6), although all sub-chapters are in need of improvement to some degree. He concluded that sub-chapter 9.6 is inadequate and that sub-chapter 6.9 also needs significant development. An ONR Issue was raised requiring NNB GenCo to address these deficiencies to ensure that the consistency, visibility and clarity of chemistry related claims, arguments and evidence are adequate. This finding must be addressed before plant operations using the intended operating chemistry during cold operations start.
- 59 The inspector raised a second ONR Issue to review the safety claims made on the demineralised water treatment and distribution systems at HPC prior to installation of such systems at site.
- 60 The inspector judged that the basis of an adequate safety case is present in the documents. Although the presentation of it is not sufficiently clear at this time, he was content that there are no fundamental safety issues or concerns which are not covered by existing Assessment Findings from GDA of UK EPR™. In terms of development of the safety case for HPC, aside from the developments expected as part of normal business by NNB GenCo the key areas for improvement that the Reactor Chemistry assessment has highlighted are related to limits and conditions, chemistry control during transient periods, the development of secondary circuit chemistry and controls for boron. A number of GDA Assessment Findings refer to these aspects already.
- 61 The inspector concluded that he was satisfied with the claims, arguments and evidence described within the Licensee's safety case at this stage in the development of the design and safety case for HPC. The inspector expects improvements to be made to the safety case at the next revision of the HPC PCSR. In the longer term the report describes further refinements as the safety case moves towards commissioning and operations, where operational chemistry becomes more significant. The inspector was satisfied that the progress made by NNB GenCo in the reactor chemistry area supports the conclusion that these improvements should be realised.

4.13 Human Factors

- 62 The human factors (HF) assessment (Ref. 19) noted that the HF topic sub-chapters 18.1 and 18.3 (copied from the March 2011 GDA PCSR) were extensively re-written for the final November 2012 GDA PCSR in order to incorporate the very extensive HF safety case that was developed in response to a GDA Issue on Human Factors. Consequently the human factors assessment of HPC PCSR 2012 has focussed on either new material that may alter any of the final GDA HF safety case, or new site specific aspects that are additional to the final GDA HF safety case.
- 63 The main conclusions from the assessment were
- Chapter 15 presents some minor changes to the HF aspects of the PSA but nothing that significantly alters the final GDA HF safety case. The PSA and supporting HRA will need to be updated for PCSR3 to reflect the reference design prior to construction.

- None of the other chapters in the HPC PCSR 2012 contain new material that impacts the HF safety case at this point. There are aspects related to maintenance, inspection and operational practices that will need to be considered in the future post-PCSR.

64 The HF inspector did not raise any ONR Issues relating to his assessment.

4.14 Radioactive Discharges, Waste and Decommissioning

65 The radioactive discharges, waste and decommissioning assessment (Ref. 20) addressed new information provided in HPC PCSR 2012. This work primarily related 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.

66 The inspector found the presentation of NNB GenCo's HPC PCSR 2012 and supporting documents was logical and clear and concluded that given the current stage of design development, NNB GenCo had in general produced adequate proposals for:

- producing and implementing radioactive waste and decommissioning strategies;
- achieving waste minimisation, characterisation, segregation, processing and passively safe storage;
- design and operation of facilities to promote their safe decommissioning; and
- Record keeping and knowledge management for radioactive waste management.

67 However there were four areas where the inspector considered that the optioneering studies presented in HPC PCSR 2012 did not substantiate NNB GenCo's proposals adequately:

- 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; and
- campaign processing and decay storage.

68 The inspector found that NNB GenCo needed to carry out a more rigorous and systematic optioneering studies in those four areas including objective comparisons of the advantages and disadvantages of appropriate options 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 and ONR's expectations as set out in regulatory guidance.

69 The inspector also judged that NNB GenCo needs to progress design and assessment work on its proposed Interim Storage Facility (ISF) for ILW and Interim Spent Fuel Store (ISFS). This work is sought to ensure that all the interdependencies within its proposals for radioactive waste management and decommissioning reach the required level of maturity to allow a demonstration of adequacy appropriate for the pre-construction phase to be made by the time the next revision to the HPC PCSR is issued.

70 The inspector also made a number of other observations and noted apparent inconsistencies in HPC PCSR 2012, relating to areas including:

- safety and regulatory requirements;
- temporary biological plugs;

- temporary storage of high-dose-rate activated components;
- irradiated control rods;
- chemistry control;
- resin transfer assessments; and
- generation of high level radioactive waste (HLW).

71 Action in response to the inspector's observations will be traced via 11 Level 4 Issues relating to radiological waste and 3 Level 4 Issues on decommissioning.

4.15 Pre-Operations

72 Pre-Operations is the term given to a work stream that addresses assesses the progress of NNB GenCo in developing suitable arrangements for compliance with a range of identified licence conditions (LCs) and hence is primarily a licence compliance work stream. However HPC PCSR 2012 contains information relevant to LC compliance and hence it has been assessed from a Pre-Operations perspective (Ref. 21) in order to ensure that any necessary improvements to the HPC PCSR can be identified. The Pre-Operations assessment focused on the adequacy of PCSR 2012 to support:

- The development of future operational emergency arrangements particularly those activities which are required before the start of construction.
- The extent to which the maintenance requirements and arrangements have been developed to support compliance with LC28 and inform procurement and design.
- The development of operational standards/processes, requirements and documentation including the extent to which these are integrated in the design and procurement process where applicable.

73 The inspector concluded that HPC PCSR 2012 was not adequate at this stage in that there was insufficient information in to allow an assessment of the site specific emergency arrangements. The inspector commented that it is essential that the requirements for the emergency arrangements in terms of facilities etc and their required protection measures are developed to the point where these requirements can be included in the design. This should be done prior to the start of construction and included in the next revision of HPC PCSR.

74 The inspector found that HPC PCSR 2012 contained no new information covering maintenance and operations beyond that included in the GDA PCSR and concluded that further development is necessary. This development should cover the maintenance and operations arrangements, such as isolation standards, component locking requirements, plant preservation and maintenance requirements during construction. This development is required in order to inform the design and procurement processes. No ONR Issues were raised as part of this assessment.

4.16 Commissioning

75 The commissioning assessment (Ref. 22) noted that commissioning was not formally assessed by ONR during GDA and hence all the material presented in Chapter 19 of HPC PCSR 2012 was considered. The inspector commented that there was limited detail in Chapter 19 but that he was satisfied with the material presented. Two ONR Issues will be raised relating to

- the need to categorise commissioning activities in accordance with their nuclear safety significance; and

- clarification of the safety claims to be made for Hinkley Point C from 'first plant only' tests to be undertaken on other EPR™s.

4.17 Integrated Management Systems

76 The inspector was satisfied that NNB GenCo has a good understanding of the requirements of the GDA Integrated Management System assessment findings (Ref. 23). The inspector found the NNB GenCo management systems arrangements to be adequate for this stage of the project and was also satisfied that NNB GenCo's compliance arrangements for LC17 Management systems have adequately addressed the expectations of relevant international standards.

4.18 Interim Spent Fuel Storage Facility (ISFS)

77 Although the ISFS was briefly described in section 4.14 on waste and decommissioning this topic was assessed separately due to the fact that it was out of scope for the GDA. The inspector has reported good progress in HPC PCSR 2012 with the preliminary information in the safety case describing an initial proposal for a wet storage scheme based on one in operation in Switzerland. The inspector has also reported continuing progress from NNB GenCo since HPC PCSR 2012 was issued on developing the conceptual wet storage scheme and its intentions to continue to review other technology options.

5 CONCLUSIONS

- 78 This report summarises the findings of ONR's assessment of the Hinkley Point C Pre-Construction Safety Report 2012 (HPC PCSR 2012). It summarises 18 more detailed assessment reports all of which have been published on ONR's website. A report on the mechanical engineering aspects of the balance of plant for the nuclear island could not be completed in time for this report. This report will be published by the end of June 2014 and an update of this summary report will be produced at the same time.
- 79 This Summary Assessment Report addresses whether HPC PCSR 2012 demonstrates suitable progress towards meeting ONR's expectations for an adequate Pre-Construction Safety Report. The high level overview of the more detailed ARs presented in Section 4 above reveals a consistent picture of inspectors raising regulatory concerns and documenting these as ONR Issues. However each inspector was satisfied with HPC PCSR 2012 given the current early stage of its development and the stated intention to produce a further PCSR issue before seeking consent for the start of pouring of safety related concrete for the nuclear island. On this basis it is concluded that HPC PCSR 2012 demonstrates suitable progress towards meeting ONR's expectations for an adequate Pre-Construction Safety Report. An IIS rating of 3 (Adequate) is judged to be appropriate.

6 REFERENCE

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- 3 *Safety Assessment Principles for Nuclear Facilities*. 2006 Edition Revision 1. HSE. January 2008. www.hse.gov.uk/nuclear/SAP/SAP2006.pdf
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- 13 NNB Genco: Hinkley Point C Pre-Construction Safety Report 2012 – Assessment Report for Work Stream Fault Studies, ONR-CNRP-AR-13-053, Rev 0, 19 March 2014, TRIM 2013/430795
- 14 NNB Genco: Hinkley Point C Pre-Construction Safety Report 2012 – Assessment Report for Topic Stream B8, Probabilistic Safety Analysis (PSA), ONR-CNRP-AR-13-084, Rev 0, 19 March 2014, TRIM 2013/459661
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- 16 NNB Genco: Hinkley Point C Pre-Construction Safety Report 2012 – Assessment Report for Electrical Systems Work Stream, ONR-CNRP-AR-13-093, Rev 0 17 Mar 2014, TRIM 2014/16641
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