**Civil Nuclear Reactors Programme**

# NNB Genco: Hinkley Point C Safety Report Assessment Report for Licensing

Assessment Report: ONR-CNRP-AR-12-053
Revision 1
19 November 2012

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| **Site:** | Hinkley Point C |
| **Project:** | Nuclear Site Licensing |
| **Title:** | NNB Genco: Hinkley Point C Safety Report Assessment Report for Licensing |
| **Licence Number:** | |
| **Licence Condition(s):** | |
| **IIS Rating:** | |

**Document Identifier**

| Identifier | Revision | TRIM Reference(s) |
|---|---|---|
| ONR-CNRP-AR-12-053 | `1 | 2012/0442463 |

**Step-based Document Review**

| Step | Description | Role | Name | Date | TRIM Revision[1] |
|---|---|---|---|---|---|
| 1 | Initial draft, including identification and mark-up of SNI/CCI | Author | [redacted] | 23 October 2012 | |
| 2 | Main editorial review | Author | [redacted] | 23 October 2012 | |
| 3 | Peer Review in accordance with AST/005 Issue 1 | Peer Reviewer | [redacted] | 19 November 2012 | |
| 4 | Assessor update / sentencing of comments and return to Peer Reviewer | Author | N/A | | |
| 5 | Final editorial / clean draft review | Author | | | |
| 6 | Acceptance review in accordance with AST/003 Issue 4 | AUH | [redacted] | 21 November 2012 | |
| 7 | Report Sign-off | Author / Peer Reviewer / AUH | [redacted] | 21 November 2012 | |

**Document Acceptance**

| Role | Name | Position | Signature | Date |
|---|---|---|---|---|
| Author | [redacted] | HM Principal Inspector | | |
| Peer Review[2] | [redacted] | HM Principal Inspector | | |
| Acceptance[3] | [redacted] | HM Superintending Inspector | [redacted] | |

[1] TRIM revision to be identified upon completion of activity and incorporation of any changes to document.

[2] Where required in accordance with ONR How2 BMS Document AST/005 Issue 1.

[3] Hard-copy of document signed-off, TRIM version updated with authors / approver / acceptor names and dates and record finalised.

### Document Acceptance

| Role | Name | Position | Signature | Date |
|---|---|---|---|---|
| Approval for publication | [redacted] | HM Superintending Inspector | [redacted] | |

### Revision History

| Revision | Date | Author(s) | Reviewed By | Accepted By | Description Of Change |
|---|---|---|---|---|---|
| 0 | | | | | First formal issue. |
| 1 | 15 November 2012 | [redacted] | | [redacted] | Updated to reflect internal review meeting comments made on 12 November 2012 |
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| | | | | | |

### Circulation (latest issue)

| Organisation | Name |
|---|---|
| ONR CNRP | [redacted] |
| | [redacted] |
| | [redacted] |
| | [redacted] |
| | [redacted] |

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## EXECUTIVE SUMMARY

### Title

NNB Genco: Hinkley Point C Safety Report Assessment Report for Licensing.

### Background

This assessment report (AR) reviews the adequacy of NNB Genco's arrangements to demonstrate whether the site is suitable for the proposed construction of a new nuclear power station at the Hinkley Point C site. It describes ONR's assessment of NNB's early batch of safety case submissions and also reviews NNB's arrangements to prepare Issue 2 of the Pre-Construction Safety Report (PCSR2) for the proposed Hinkley Point C (HPC) nuclear Power Station It has been written to support a Project Assessment Report (PAR) that addresses whether to issue a Nuclear Site Licence for the Hinkley Point C site to NNB Genco.

### Assessment and Inspection work carried out by ONR

ONR specialists in a wide range of disciplines have reviewed the HPC early safety case batches and some of the associated documentation available to date. They have also participated in discipline-specific and batch submission Level 4 meetings to review ONR comments and NNB Genco's responses.

This report reviews the adequacy of NNB Genco's work on selected site specific aspects of the safety case and succeeding safety report management and strategy. It also draws together material from individual discipline-specific assessment reports (AR). It then reviews whether the selected site is suitable against a list of key criteria identified by ONR in its Intervention Strategy for the Site Licence Application, i.e. whether

- The site is of a sufficient size.
- The site is (or can be) connected to grid supplies.
- There is adequate cooling capability for all normal and fault conditions.
- The environmental conditions would not preclude the use of the site with respect to external hazards.
- The geology of the site will provide a secure long term support to the necessary structures, systems and components.
- There is a schedule for submission of further Pre – Construction Safety Report (PCSR) updates or revisions to support subsequent construction milestones.

Finally the report gives an overall judgement on the adequacy of progress on the Station safety report and associated substantiation to support nuclear site licensing.

## Matters arising from ONR's work

No significant matters arose from the assessment and inspection work that might prevent issue of a site licence. It should be noted however that substantial further analysis work will be necessary in several technical areas to justify permissioning of first construction.

## Conclusions

Each of the discipline-specific assessment reports concludes that sampling has not revealed any reason not to grant a Licence for the proposed Hinkley Point C Power Station. The severe accident analysis assessment noted that the NNB Genco severe accident lead engineer is actively engaged with the proposed design changes arising from lessons learned from the Fukushima incident.

The review against key criteria identified by ONR found the site to be suitable. Accordingly, this report concludes that from the perspective of safety report production and site suitability, there is no impediment to Licence issue.

NNB Genco's work on the PCSR and Station Safety Report development has been found to be adequate. The review also concluded that complete design basis analysis (DBA), probabilistic safety analysis (PSA) and severe accident analysis (SAA) were not likely to be included in PCSR2 when it is delivered and that these areas required further development. However, it is judged that the progress made by NNB Genco is adequate for licensing on the basis that there will be a period before the first construction permissioning decision in which NNB Genco can improve the scope and detail of DBA, PSA and SAA.

## Recommendation

The author of the PAR addressing whether to issue a Nuclear Site Licence for the Hinkley Point C site to NNB Genco should note that that from the perspective of safety report production, there is no impediment to Licence issue.

## LIST OF ABBREVIATIONS

| | |
|---|---|
| ALARP | As low as is reasonably practicable |
| BSL | Basic Safety level (in SAPs) |
| BSO | Basic Safety Objective (in SAPs) |
| BMS | (ONR) How2 Business Management System |
| CI | Conventional Island |
| C&I | Control and Instrumentation |
| CSJ | Construction Safety Justification (NNB Genco) |
| CW | Cooling Water |
| DBA | Design Basis Analysis |
| EPR™ | The design of pressurised water reactor submitted for GDA by EDF/AREVA |
| ESWS | Essential Service Water System |
| FWP | Forward Work Plan |
| GDA | Generic Design Assessment |
| GDA PCSR | The generic version of the Pre-Construction Safety Report submitted for GDA |
| Genco | Generation Company (as in NNB Genco) |
| HF | Human Factors |
| HFIP | Human Factors Integration Plan |
| HPA | Hinkley Point A |
| HPB | Hinkley Point B |
| HPC | Hinkley Point C |
| HSE | Health and Safety Executive |
| INSA | Independent Nuclear Safety Assessment |
| IAEA | International Atomic Energy Agency |
| ILW | Intermediate Level Waste |
| ISFS | Interim Spent Fuel Store |
| IRR | Ionising Radiation Regulations |
| LC | Licence Condition |
| LUHS | Loss of Ultimate Heat Sink |
| NI | Nuclear Island |
| NNB | New Nuclear Build (as in NNB Genco) |
| NSC | Nuclear Safety Committee (NNB Genco) |
| NSDAPs | Nuclear Safety Design Assessment Principles (NNB Genco) |
| NSL | Nuclear Site Licence |

## LIST OF ABBREVIATIONS

| | |
|---|---|
| NSSS | Nuclear Steam Supply System |
| ONR | Office for Nuclear Regulation (an agency of HSE) |
| OPEX | Operational Experience |
| PAR | Project Assessment Report |
| PCER | Pre-construction Environment Report |
| PCSR | Pre-construction Safety Report |
| PCmSR | Pre-commissioning Safety Report |
| POSR | Pre-Operational Safety Report |
| PID | Project Initiation Document |
| PSA | Probabilistic Safety Assessment |
| RGP | Relevant Good Practice |
| RP | Radiation Protection |
| SAA | Severe Accident Analysis |
| SAP | Safety Assessment Principle(s) (HSE) |
| SFAIRP | So far as is reasonably practicable |
| SS | Site-Specific |
| SSC | System, Structure and Component |
| SSR | Station Safety Report |
| TAG | Technical Assessment Guide(s) (ONR) |
| TSC | Technical Support Contractor |
| UKEPR | The design of pressurised water reactor submitted for GDA by EDF/AREVA as adapted for the UK |
| WENRA | Western European Nuclear Regulators' Association |

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**Tables**

# 1 INTRODUCTION

## 1.1 Background

1 ONR's approach to licensing is informed by interventions that considered the adequacy of NNB GenCo's:

- organisation capability;
- licence condition compliance arrangements;
- safety report and associated substantiation; and
- licensing documentation and ONR's associated legal and statutory consultation due process.

2 This assessment report (AR) addresses the station safety report and associated substantiation. It also draws together material from individual discipline-specific assessment reports (AR) and addresses whether the site is review against key criteria. It has been written to support a Project Assessment Report (PAR) that addresses whether to issue a Nuclear Site Licence (NSL) for the Hinkley Point C site to NNB Genco.

3 NNB made some site-specific PCSR2 sub-chapters and other supporting documentation available to ONR as 'early batches' in order to inform ONR's decision on whether to grant a Site Licence. This was done in advance of full issue of PCSR2. The batches address some of ONR's key criteria regarding site suitability (see paras 12 and 13). ONR comments on the early submission batches and NNB Genco's responses are provided in Ref. 1.

4 The Pre-Construction Safety Report is the first of a sequence of reports that cover the evolution of the Station safety case justifying construction, commissioning and operation. The 2nd issue of the Hinkley Point C PCSR (PCSR2) has not yet been published but it is known that it will comprise of a head document and 21 chapters each consisting of a number of sub-chapters. Many of the sub-chapters will be adopted verbatim for Hinkley Point C from the generic PCSR that has been the subject of the Generic Design Assessment (GDA) process (March 2011 version).

5 Batch 4 on NNB's safety case management is particularly relevant to this report (Ref. 2). Material in the other early batches has been sampled as part of the discipline-specific assessments. Site suitability is reviewed against key criteria below.

## 1.2 Scope

6 The scope of this report covers the early batches and other supporting documentation made available to ONR in the course of ONR's review work. It is important to note that the content of the generic PCSR sub-chapters likely to be adopted verbatim for HPC has not been reviewed since this task was completed in GDA.

## 1.3 Methodology

7 The methodology for the assessment is that laid down on the Office for Nuclear Regulation (ONR) How2 Business Management System (Ref. 3, nb. the methodology was formerly published as ONR BMS document AST/001, Assessment Process).

## 2 ASSESSMENT STRATEGY

8 The assessment strategy for the Hinkley Point C safety report pre-Licensing review is set out in this section. The strategy identifies the scope of the assessment and the standards and criteria that have been applied.

### 2.1 Standards and Criteria

9 The relevant standards and criteria adopted within this assessment are principally the ONR Safety Assessment Principles (SAP), Ref. 4, internal ONR Technical Assessment Guides (TAG), Ref. 5, 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.

10 An ONR guide, 'Licensing Nuclear Installations', published on the ONR website (www.hse.gov.uk/nuclear), sets the scene for site licence applications. It states (para 61) that "A licence may be granted when ONR is satisfied that the licence applicant's safety documentation provides assurance that the site will be suitable for the proposed activities if the plant is adequately designed, constructed and operated. A full pre-Construction Safety Report (PCSR) is not necessary at this stage.".

11 The test of whether the applicant's safety documentation provides adequate assurance of site suitability is the purpose of this assessment report.

12 The ONR Intervention Strategy to address NNB Genco's application to install and operate two EPR™ reactor units at Hinkley Point (Ref. 6) requires that at the point of NSL granting, NNB GenCo demonstrate its competence and provide assurance that it has the capability to develop a site-specific PCSR submission.

13 The intervention strategy also requires that the safety report and associated substantiation justify the suitability of the site in the following particular respects:-

A The site is of a sufficient size.

B The site is (or can be) connected to grid supplies.

C There is adequate cooling capability for all normal and fault conditions.

D The environmental conditions would not preclude the use of the site with respect to external hazards.

E The geology of the site will provide a secure long term support to the necessary structures, systems and components.

F The submission would also need to provide a schedule for submission of further PCSR updates or revisions to support subsequent construction milestones.

## 2.2 Safety Assessment Principles

14 The 'Licensing Nuclear Installations' guide (para 97) cites SAPs SC1 to SC8 as being relevant to assessment of safety cases (see Table 1 of this report). Some of the Fundamental Principle and Fault Analysis SAPs are also relevant as detailed in Table 1.

### *2.2.1 Technical Assessment Guides*

15 The 'Licensing Nuclear Installations' guide identifies the following Technical Assessment Guide as detailing ONR expectations that apply to a PCSR:

- T/AST/051 Guidance on the purpose, scope and content of Nuclear Safety Cases

### *2.2.2 National and International Standards and Guidance*

16 No international standards or guidance have been used as part of this assessment.

*17* Note that NNB Genco has developed its own Nuclear Safety Design Assessment Principles (NSDAPs). A review of the Hinkley Point C design against the NSDAPs is to be included in PCSR2 as a sub-chapter.

## 2.3 Use of Technical Support Contractors

18 There has been no use of Technical Support Contractors.

## 2.4 Integration with other Assessment Topics

19 This assessment draws from a wide range of discipline-specific assessment reports addressing the Licensing decision. It will be a principal reference to the PAR addressing whether a Licence should be granted.

20 The suitability of NNB Genco's arrangements for further development of the Station Safety Report beyond PCSR2 is addressed in the Licence Condition 14 compliance report for licensing (Ref. 7).

## 2.5 Out-of-scope Items

21 No items have been identified as lying outside the scope of the assessment.

# 3 APPLICANTS DOCUMENTATION

## 3.1 Pre-Construction Safety Report: Concept of Early Batches and Review within NNB Genco

22 A description of NNB's Pre-Construction Safety Report is given in Annex 1.

## 4 ONR ASSESSMENT

23 This assessment has been carried out in accordance with ONR How2 BMS policy (Ref. 3). A number of technical disciplines have been reviewed as part of ONR's assessment but comments in this report relate only to the site specific aspects of nuclear site licensing. And the early batch submissions.

### 4.1 Review of Site Suitability

24 This section reviews site suitability against the key ONR requirements set out in the Licensing Intervention Strategy (Ref. 6).

#### *4.1.1 Requirement A – Site is of Sufficient Size*

25 Specialist Civil Engineering and Fault Studies Inspectors reviewed NNB Genco's Site Plot Plan at Level 4 meetings on Batch 3.1. ONR comments and NNB Genco's responses are given in Ref. 1.

26 The Civil Engineering assessment (Ref. 20) noted that the Site Plot Plan was intended to help demonstrate that

- the site plot is of sufficient size to accommodate a twin UK EPR nuclear power station and
- that the layout of the buildings has been optimised to ensure that any risks which could be initiated through the layout of the site have been reduced so far as is reasonably practicable.

27 Ref 19 found that the site plot plan summary document provides confirmation that the site is physically large enough to accommodate all the buildings and services required for the twin UK-EPR. Furthermore, the Civil Engineering Specialist Inspector was satisfied that the investigations based on the assumed construction sequence confirm that the site is of a sufficient size to allow construction.

28 The Specialist Fault Studies Inspector queried whether risks originating from the nearby Hinkley Point A and Hinkley Point B sites were significant enough to have an impact on the plot plan. NNB Genco responded (Ref. 1) that it did not consider the risks from explosions, chemical releases and radiological releases from the A and B sites to have a material impact on the plot plan for the C site and that evidence to this effect would be presented in PCSR2. This position was judged to be adequate to support licensing.

29 The Specialist Fault Studies Inspector also queried some items of further work that were identified by NNB Genco as necessary regarding chemical storage, the mechanical gallery and the nuclear island (NI) water storage tank. The NI water storage tank was listed as a shared treated water system with 'safety functions such as provision of additional cooling water or fire-fighting' suggesting clear implications to the plot plan if the shared tank had to be replaced with unit-specific NI tanks. NNB Genco's response (Ref. 1) makes it clear that analysis of these areas is currently underway. It is explained that the need for NI storage tank capability arose out of lessons learned from the Fukushima incident. The NI storage tank facilities will be incorporated within the raw water supply and storage building (coded HOR). Furthermore, the Architect Engineers have confirmed that there will be separate dedicated tanks and pumps for each unit so that draining of the

NI tank on one unit cannot affect the other unit. The Specialist Inspector judged this response to be adequate for the purposes of licensing, noting that there would be further opportunities to confirm that these areas of further work had been fully closed out prior to first construction.

*4.1.2 Requirement B - The site is (or can be) connected to grid supplies*

30 The Specialist Electrical Engineering Inspector was content with the Batch 6 submission on Hinkley Point C Grid Connection Justification (see Ref. 24). In particular the Inspector was satisfied that a process has been developed, and is in the process of implementation, to provide a sufficient level of confidence that a Grid connection can be established to Hinkley Point C.

*4.1.3 Requirement C - There is adequate cooling capability for all normal and fault conditions*

31 The cooling capability of the heat sink design (Ref. 15) was reviewed by specialist civil engineering Inspectors with support from fault studies, chemistry, external hazards, internal hazards and PSA Inspectors. The outline design is an open circuit system with two intake tunnels and two link tunnels between the forebays that takes due account of site-specific data and environmental considerations including the very large tidal range in the Severn estuary. Detailed design work is ongoing to refine and substantiate the design of the intake heads, forebay, pumping station and discharge pond through physical modelling and further numerical modelling of hydraulic conditions and silting effects.

32 The civil engineering assessment (Ref.19,) addressed cooling capability. NNB have defined the heat sink performance requirements as:

- Provision of the necessary cooling water flow rates to the required services
- Cooling water availability (over time)
- Inlet water temperature within set limits (for safety systems)
- Cooling water quality with respect to debris and marine organisms

33 The Civil Engineering Specialist Inspector noted a number of key justifications for the adequacy of NNB Genco's design:

- The design of the system and pumps ensure a sufficient flow rate is maintained for each unit.
- High availability of the cooling is achieved by positioning the intake heads below water level taking into account the tidal range and the predicted effect of climate change and by introducing redundancy and diversity in many aspects of the design.
- The cleanliness of the water is ensured by both reducing the likelihood of drawing foreign material into the heat sink circuit and by using a series of filtration systems

34 The assessment identified the main threat to provision of adequate flow rates, availability and quality to be the potential for silting of the civil engineering structures and noted that good inspection and maintenance of the structures will be essential.

35 In order to mitigate against silting up of the intake structures, NNB intend to analyse the hydraulics of the system in further detail in mock-up studies that will inform the detailed design process.

36 The Civil Engineering Specialist Inspector was satisified that the concept, layout and design of the civil structures is such that adequate cooling capability will be available for all normal and fault conditions, subject to satisfactory completion of the mock-up studies and the detailed design.

37 The Fault Studies Specialist Inspector noted that the batch document was a design description rather than a systematic demonstration of adequate cooling capability showing tolerance to faults from all possible operational plant states. He also questioned whether faults occurring beyond the nuclear island had been fully addressed.

38 NNB Genco responded (Ref. 1) that the list of design basis faults to be addressed in PCSR2 would be identical to that in consolidated 2011 GDA PCSR and hence would include a range of conventional island (CI) as well as nuclear island faults (examples given of CI faults included turbine trip and loss of condenser vacuum. Loss of ultimate heat sink (LUHS) faults would be addressed as beyond design basis in PCSR2. NNB Genco stated that faults with CI initiators are addressed generically so far as possible in the GDA PCSR because the CI systems are site-specific. To further clarify the position with respect to CI faults, NNB Genco accepted an action for completion by March 2013 to provide a programme on how it will show that the list of Hinkley Point C design basis faults is complete and that the associated fault frequencies are appropriate.

39 In response to a query from the Fault Studies Specialist Inspector, NNB Genco also confirmed that they had considered the heat sink as an integrated system and had addressed all the potential interactions between the constituent parts. The response states that the design takes into account all possible water transients in the forebay and discharge pond that could be caused by the main cooling water pumps (transients caused by these large pumps are stated to bound those from all other pumps in the heat sink) and gives details of how a number of critical cases are addressed.

40 The Fault Studies Inspector also queried why Hinkley Point C did not require a diverse Reserve Ultimate Heat Sink (RUHS) as provided at Sizewell B. NNB Genco's response (Ref. 1) explained that the Sizewell B RUHS was provided to address a large break loss of coolant accident or main steam line break following a $10^{-4}$ seismic event that also might disable the Essential Service Water System (ESWS) and intake structures. For Hinkley Point C the ESWS system including forebays and intake structures are to be qualified against a $10^{-4}$ seismic event. The availability of the heat sink is further assured by the provision of the forebay link tunnels and ESWS diversification pipeline from the discharge pond.

41 The Fault Studies Inspector concluded that these responses were adequate for the purposes of Licensing.

42 The internal hazards assessment report (Ref. 18) states that none of the ONR internal hazards comments on the heat sink summary document form major challenges to the proposed design of the heat sink arrangement or to the suitability of the Hinkley Point C site

43 The Reactor Chemistry Specialist Inspector raised a query on impairment of cooling due to biofouling and was satisfied with NNB Genco's response. Queries raised by the External Hazards Specialist Inspector cover issues that were fully addressed in his report (Ref. 20). The PSA Specialist Inspector considered NNB Genco's responses to the queries he had raised to be adequate for nuclear site licensing (Ref. 21,)

*4.1.4 Requirement D - The environmental conditions would not preclude the use of the site with respect to external hazards*

44 This requirement is addressed in the external hazards assessment (Ref. 20). The Specialist External Hazards Inspectors conclusion, that there was a satisfactory position for Licensing with respect to each external hazard, shows that Requirement D has been met.

*4.1.5 Requirement E – The geology of the site will provide a secure long term support to the necessary structures, systems and components*

45 Early batch 2.2 (Ref. 17) addressed site geology. As describedabove, the Civil Engineering assessment (Ref.19,) noted that the site geology presents a number of challenges. The Specialist Inspector concluded that he was satisfied that NNB Genco have demonstrated that the geology of the site will not lead to the structures being vulnerable to seismic action. Also, having quantified the seismic hazard and the geology, there is evidence to show that the structures can be designed to accommodate the envisaged forces (by analysis) and movements (by analysis and detailing).

46 Site geology was also addressed in the external hazards assessment (Ref. 20, ) which identifies two issues as having the potential to affect the suitability of the site, i.e. capable faulting and control of the water table, both of which were also considered in the civil engineering assessment.

47 The external hazards assessment judged the capable faulting hazard to be very unlikely to be significant at Hinkley Point C based on an interim confidence statement from NNB.

48 The assessment also stated that for licensing the threat to the foundations of safety related civil structures from a rise in the water table, perhaps leading to them being lifted by buoyancy, has to be addressed by showing that an engineered solution for water level control is available. The assessment noted that two external hazards factors would be relevant, i.e. rainfall intensity and the geological features of the site that control groundwater flow. As the Specialist Civil Engineering Inspector judged that an acceptable engineering solution was possible, the External Hazards Inspector concluded that the site would be suitable in terms of water table control.

*4.1.6 Requirement F – The submission would also need to provide a schedule for submission of further PCSR updates or revisions to support subsequent construction milestones.*

49 Ref. 8 reports that NNB Genco intend to produce a further update to the PCSR, named PCSR3, following completion of the GDA process, to enable the final outcomes of that process to be incorporated into the Hinkley Point C safety case and to incorporate new information. Ref. 8 adds that an option is left open to have additional updates after

PCSR3 should the need arise due to major changes, or for manageability of multiple changes.

50 An NNB Genco presentation (Ref. 8) describes the strategy for the development of the safety report to support operation of UK EPR stations including Hinkley Point C. This report sets out proposals to prepare a Pre-Commissioning Safety Report (PCmSR) to justify bringing fuel to site and carrying out commissioning. Initial start-up and operation will be justified by a Pre-Operation Safety Report (POSR) and once operation at power has become well established the Station Safety Report (SSR) will be prepared.

51 Although no target dates have been provided for the issue of PCSR3 and subsequent updates of the station safety report, the strategy is judged adequate to comply with Requirement F on further safety report development.

## 4.2 Discipline-Specific Assessments

### *4.2.1 Internal Hazards*

52 An internal hazards assessment is presented in Ref. 9. The assessment was based principally on evidence gathered from attendance at meetings with NNB and on briefing material and presentations at those meetings.

53 ONR reviewed the 1st issue of the site specific Pre-construction Safety Report (PCSR1), early submissions of site specific PCSR2 sections relevant to the site suitability, and supplementary documents. ONR raised comments from this limited internal hazards assessment, but they were not viewed as critical to the judgements made for licence granting.

54 Although the internal hazards principles and some of the claims and arguments being made with respect to the resistance of the design to internal hazards are apparent in the early site-specific documentation, the arguments are limited in detail. This is not unexpected as the design is still being developed for many of the buildings (other than the nuclear island, covered by the GDA).

55 The assessment concluded that the internal hazards safety claims and arguments made so far by NNB for constructing and operating a UKEPR twin unit facility at Hinkley Point C are sufficient at this stage for nuclear site licence granting. The assessment recommended from an internal hazards perspective that a site licence be granted. It noted that NNB Genco recognises that it will need to develop the design and the safety case in many areas relating to internal hazards as the project progresses.

### *4.2.2 Civil Engineering ( including seismic )*

56 The civil engineering assessment (Ref. 10) covered whether the HPC site is suitable for the construction and operation of a twin arrangement of UKEPR. It was noted that the geology at the site presents a number of challenges The Specialist Civil Engineering Inspector found that the site investigation and interpretive site investigation reports were adequate and fit for purpose. He recommended that NNB Genco should continue to

assess site geological and hydrogeological characteristics during early earthworks and temporary dewatering activities in order to enhance the substantial body of knowledge already gathered during the site investigations.

57 The assessment covered:

- the implications of the twin reactor design in terms of adequacy of the site investigation, suitable assessment of the variation of geological and hydro-geological characteristics and the consequences on the preliminary design.
- the rock quality and characteristics at and below the foundation interface for safety related plant are capable of being prepared and demonstrated to be adequate to receive blinding concrete.
- potential degradation mechanisms and suitable protection measures
- understanding of the hydrogeology demonstrated by suitable investigation, assessment, modelling and analysis
- whether there are credible means of accommodating the hydro-geological characteristics in the overall design of the safety related plant.
- whether the site geology will lead to the structures being vulnerable to seismic action (capable faulting, liquefaction and seismic movements) and that the structures can be designed to accommodate the envisaged forces (by analysis) and movements (by analysis and detailing). Note that 'capable faulting' is a seismic hazard in which fault ruptures under the site can damage safety related structures by displacement across the fault that directly impinges on the building foundations (as distinct from damage due to seismic vibrational motion).

58 The Specialist Inspector judged that the civil engineering documentary evidence assessed was adequate in terms of scope and content for nuclear site licensing purposes and that any outstanding issues could be dealt with in the lead up to permissioning first construction. He concluded that NNB GenCo has demonstrated that it is capable of producing a site specific safety report and relevant design substantiation to support the construction and installation of two EPR units at Hinkley Point C. On that basis, the Specialist Inspector recommended from the civil engineering perspective that ONR should grant a Nuclear Site Licence to NNB GenCo to install and operate two EPR units at Hinkley Point C.

*4.2.3 External Hazards*

59 The external hazards assessment (Ref. 11) addressed whether:

- there would be adequate cooling capability for all normal and fault conditions.
- the environmental conditions could preclude the use of the site with respect to external hazards.
- the geology of the site will provide secure long term support to the safety related structures, systems and components.
- emergency arrangements relevant to external hazards would be adequate

- PCSR development was satisfactory.

The implications of the Fukushima incident in Japan were taken into account.

60 The assessment found that

- for many external hazards the site challenge is bounded comfortably by the GDA envelope and for the others (e.g. high air temperature and low seawater temperature) it is likely that refined hazards analysis, plant modifications and restrictions to operating procedures will allow NNB Genco to demonstrate that the risks from these hazards are ALARP
- previous work on the seismic vibratory hazard for the Hinkley Point B site is indicative for the C site challenge and adequate for licensing (but substantially more work is needed for permissioning)
- an interim statement that gives confidence that capable faulting will not be a significant hazard at Hinkley Point C was acceptable for licensing
- for external flooding, the technical work to show the preferred platform level of 14m is adequate, and the intention to make flood defences that can be adapted through the life of the site, are acceptable for licensing
- for water table level control, NNB Genco's advice that a technical solution is feasible is acceptable for licensing

61 The assessment concluded that from the perspective of external hazards, ONR should grant a Nuclear Site Licence to NNB GenCo to install and operate two EPR units at the Hinkley Point C site. A recommendation was made that where the GDA envelope is breached or approached with little margin for certain external hazards, mitigating actions should be captured by operating procedures.

*4.2.4 Probabilistic Safety Analysis (PSA)*

62 A PSA Specialist Inspector has assessed NNB Genco's PSA work to date (Ref. 12). The assessment drew on engagement since March 2011 in regular Level 4 meetings, assessment of available relevant documentation and an inspection of PSA arrangements carried out in May 2012. The Specialist Inspector also reviewed a number of documents relevant to the PSA work stream submitted to ONR as part of the early batches and carried out a preliminary assessment of a small sample of PCSR2 PSA supporting references.

63 With regard to safety report, the Specialist Inspector's objective was to judge:

- whether NNB GenCo has demonstrated that there is a high level of confidence that the Hinkley Point C site can support the licensable activity; and
- whether NNB GenCo has demonstrated that it is capable of producing a site specific safety report and relevant design substantiation to support the construction and installation of two EPR units at Hinkley Point C.

64 The Specialist Inspector sampled a number of early batch submissions, where they were relevant to PSA, and also some PCSR2 PSA supporting references. Based on this assessment he considered that these documents were adequate in terms of their scope

and content for nuclear site licensing purposes. In particular, NNB Genco's responses to PSA comments on the early batch documents were judged adequate for licensing. The Inspector noted that a detailed PSA assessment will not be carried out until after PCSR2 is published in late 2012.

65 The Specialist Inspector judged the PSA content of the batch documents and the sampled PSA supporting references to be adequate in terms of their scope and content for nuclear site licensing purposes. A number of queries raised with NNB GenCo during the assessment were addressed adequately for licensing. It was therefore concluded, from the perspective of the PSA work stream, that:

- NNB GenCo has demonstrated that there is a high level of confidence that the Hinkley Point C site can support the licensable activity; and
- NNB GenCo has demonstrated that it is capable of producing a site specific safety report and relevant design substantiation to support the construction and installation of two EPR units at Hinkley Point C.

*4.2.5 Fault Studies and Severe Accident Analysis (SAA)*

66 The fault studies and severe accident analysis assessment (Ref. 13) states that as PCSR2 has not been published yet, documentation assessment has been limited to gauging whether the available documentation shows that fault studies of adequate scope including site specific aspects are to be included in PCSR2.

67 Examination of the Masterlist of PCSR2 sub-chapters (Ref. 10) indicated that no additional site-specific sub-chapters are planned in Chapter 14 'Design Basis Analysis', instead only the generic sub-chapters prepared as part of the generic PCSR are to be included, verbatim. Noting that the generic PCSR addressed only risks to the nuclear island of a nominal single reactor site, the Specialist Fault Studies Inspector therefore queried whether PCSR2 would

- cover the effect of the neighbouring reactor on reactor safety
- fully address initiating events occurring beyond the nuclear island (NI), i.e. on the conventional island (CI)
- address ex-reactor nuclear risks (such as those from on-site fuel handling, transport and storage)
- examine risks originating from the nearby Hinkley Point A and Hinkley Point B sites.

68 In response to the query on the effect of the neighbouring reactor, NNB Genco provided a report (Ref. 14) that concluded that based on the level of design then available, it was expected that there would be no significant increase in level of risk per reactor unit, compared with the GDA baseline.

69 On initiating events occurring on the conventional island, NNB Genco responded that the list of design basis faults to be addressed in PCSR2 would be identical to that in consolidated 2011 GDA PCSR and hence would include a range of conventional island (CI) as well as nuclear island faults. Furthermore, faults with CI initiators are addressed generically so far as possible in the GDA PCSR because the CI systems are site-specific. Examples given of these generic CI faults included turbine trip and loss of condenser

vacuum. This left open the question of whether the site-specific features selected for Hinkley Point C introduce CI initiating events that were not covered in the generic PCSR. To clarify the position with respect to CI faults, NNB Genco accepted an action for completion by March 2013 to provide a programme on how it will show that the list of Hinkley Point C design basis faults is complete and that the associated fault frequencies are appropriate.

70 Examination of the Masterlist (Ref. 10) confirmed that fuel handling and storage would be addressed in sub-chapter 9.1 and discharges and waste/spent fuel would be the subject of Chapter 11, giving assurance that ex-reactor risks would be addressed in PCSR2.

71 Ref 1 gave confirmation that evidence would be presented in PCSR2 that risks from explosions, chemical releases and radiological releases originating from the nearby Hinkley Point A and Hinkley Point B sites would not have a significant impact on the Hinkley Point C site.

72 The Specialist Fault Studies Inspector judged the above responses to his queries on the scope of fault studies in PCSR2 to be adequate for licensing.

73 NNB GenCo was found to have demonstrated that it has adequate intelligent customer capability in the severe accident analysis area and that adequate specialist support is available from the Architect Engineer and contractors. NNB GenCo was also judged to have demonstrated an appropriate commitment to, and reasonable progress towards, developing adequate GDAF resolution plans. It was noted that the severe accident lead engineer is actively engaged with the proposed design changes arising from lessons learned from the Fukushima incident. Overall, NNB GenCo was considered to have developed satisfactory arrangements for the severe accident topic area that are sufficient to enable ONR to grant a Nuclear Site Licence to install and operate two EPR units at Hinkley Point C.

*4.2.6 Electrical Engineering*

74 The Electrical Engineering Specialist Assessment (Ref. 14) covered:

- Assessment of NNB Genco's documentation that provides justification that the site can be connected to grid supplies.
- Sampling of NNB Genco's progress in developing the safety case within the PCSR covering the electrical systems.

75 The Electrical Engineering Specialist Inspector was satisfied that a process has been developed, and is in the process of implementation, to provide a sufficient level of confidence that a Grid connection can be established to Hinkley Point C. He was also satisfied that the requirements for Grid Code compliance have been addressed so that the design of Hinkley Point C power plant and connections will be in full compliance with the Grid Code.

76 The Specialist Inspector was content with the Batch 6 submission Hinkley Point C Grid Connection Justification which is based on the PCSR Chapter 8.1. Based on sampling of the development of NNB Genco's organisation and systems, he was satisfied that a robust organisation and systems to support nuclear safety are being developed.

77 From his assessment of the connectability of the proposed station to the national grid, and sampling of the capability of the NNB Genco electrical engineering organisation, the Specialist Inspector recommended that a Nuclear Site Licence be granted.

*4.2.7 Fuel and Core and Spent Fuel Storage*

78 With regard to the station safety report, the aims of the fuel and core and spent fuel storage assessment (Ref. 15) were

- to gain reassurance that NNB GenCo was responding to Generic Design Assessment (GDA) assessment findings in an appropriate manner,
- to understand its plans for developing safety cases and facilities for fuel & core and spent fuel

79 Note that few site-specific fuel and core or spent fuel storage reports have been issued yet and there was no information relating to these topics in the early batches. NNB GenCo has produced a strategy justification document to present the optioneering and technical factors that drove its choice of wet spent fuel interim storage technology, and also to present a high level case for the Interim Spent Fuel Store (ISFS). The Specialist Inspector reviewed the strategy justification document and was content with NNB GenCo's choice of a wet interim spent fuel storage facility for the HPC site.

80 It was concluded that no issues had been identified in the course of the assessment of the fuel and core and spent fuel areas that would preclude a nuclear site licence being granted for the Hinkley Point C site.

*4.2.8 Reactor Chemistry*

81 An ONR Reactor Chemistry Specialist Inspector considered the Batch submissions supplied (Ref. 16) and identified only part of Batch 5 (Heat Sink Summary Document) as having any reactor chemistry significance.

82 NNB Genco's intention not to chemically dose abstracted seawater to control biofouling was challenged given that the satisfactory experience of not dosing at Hinkley Point B (HPB) might not be a reliable guide for the proposed C station that will have sea water intakes some 3km farther off-shore. Analysis provided showed that the estuarine tidal dynamics and high turbidity experienced at the HPB inlet are essentially identical to those found throughout that region of the estuary. NNB stated further that a number of geomorphologic scenarios had been considered that might impact this position and the only one with any significance was the construction of a tidal barrage as this would impact local bathymetry and tidal velocity. NNB also confirmed that as retrospective installation of dosing points would be challenging, the possibility of a future emergent requirement for biofouling control would be addressed by including dosing infrastructure in the station design, and undertaking monitoring to ensure the estuarine conditions were not changing.

83 The Specialist Inspector was satisfied with this response. No other significant matters arose and hence the Specialist Inspector concluded that from the perspective of Reactor Chemistry, a licence should be granted to NNB Genco in respect of Hinkley Point C.

*4.2.9 Mechanical Engineering*

84 The mechanical engineering assessment (Ref. 17) notes that a significant quantity of mechanical engineering evidence to substantiate the safety case claims will come from the detailed design and testing stage. This information was generally not available for Generic Design Assessment, nor is it available now to substantiate the Licence application.

85 The mechanical engineering intervention included a number of level 4 progress meetings and inspections that addressed the development of the Site Specific HPC Pre-Construction Safety Report (SS HPC PCSR) *inter alia*. ONR learned that NNB Genco had prioritised 23 of the 35 mechanical engineering GDA assessment findings for completion prior to first nuclear island concrete.

86 The assessment (Ref. 29) reported that only early batch 5 on the adequacy of the cooling capability for all normal and fault conditions was relevant to mechanical engineering. The Batch 5 document only presents the design at a high level with the detailed design and substantiation to be added post PCSR2 as the project proceeds.

87 The design includes 27m drum screens for filtering cooling water (CW) intake due to the large tidal range at the site. Such drum screens fitted to two of the four trains would be the largest in the world but the Inspector judged the proposals acceptable due to the presence of band screens in the other two trains and because the safety related CW systems will not rely on operation of the drum screens.

88 The Inspector also noted that appropriate mitigation was being put in place to address the technical risks arising from the remaining uncertainty as to the classification of systems, structures and components (SSC) and equipment qualification.

89 The Inspector reported that the Batch 5 report contains a presentation of the option studies on

- open versus closed circuits,
- the use of international operational experience (OPEX, including lessons from cooling water intake blockage events reported by the World Association of Nuclear Operators),
- adoption of UK practices and
- the use of technical design reviews to assess the robustness of the concept design.

90 The Inspector concluded that from a mechanical engineering perspective ONR should grant a licence to NNB Genco for Hinkley Point C.

*4.2.10 Safety Categorisation and Classification*

91 ONR has engaged with NNB GenCo since early 2012 on the safety categorisation and classification workstream, via level 4 meetings, assessment of relevant documentation where available and a licensing safety categorisation and classification intervention in July 2012 (Ref. 18). The engagement had the objective of verifying *inter alia*

- NNB GenCo's approach to safety categorisation and classification is consistent with that agreed in the Generic Design Assessment (GDA).
- Adequate safety categorisation and classification has been carried out given the point in time of the build programme.
- Robust arrangements have been or are being developed, to apply safety categorisation and classification to support the design development and analysis.

92 The Inspector noted that due to the safety categorisation and classification approach being still under development to address a GDA issue, NNB GenCo has been unable to make significant progress in this area. However, NNB GenCo appeared to be aware of the risks involved in inappropriately classifying systems, structures and components, particularly for the long lead items in advance of the categorisation and classification methodology being finalised. To address them, a number of de-risking activities have been carried out to identify the likely class conservatively. The Inspector judged the de-risking activities to be adequate to support licensing based on sampling of work on the turbine hall and power transmission contracts.

93 The Inspector sampled Batch 5 on adequate cooling in normal operations and post fault. The Batch 5 documents do not take account of the revised safety categorisation and classification methodology under development to support resolution of GDA issue GI-UKEPR-CC01, and the classification presented follows the French approach, which was noted in GDA to not meet UK expectations. The documents confirm that a new safety classification system based on UK nuclear practice is to be adopted for Hinkley Point C. The safety categorisation and classification will not be fully implemented using the revised agreed methodology until post PCSR2, at the end of 2013.

94 The assessment concluded that from the perspective of the safety categorisation and classification workstream no issues have been identified that preclude ONR granting a nuclear site licence for NNB GenCo to install and operate two EPR units at Hinkley Point C.

### 4.3 Batch 4 – NNB Safety Case management

95 Batch 4, comprising the covering letter, the PCSR2 Specification and the PCSR2 Work Instruction (Refs. 8 and 9), was sent to address the ONR requirement that NNB Genco show their capability to develop a site-specific PCSR to support construction and installation activities.

96 The PCSR2 Specification is judged to provide an adequate basis for the preparation of a satisfactory PCSR2. This judgement is made on the grounds that the proposed documentation structure incorporating both generically-prepared material and HPC-specific sub-chapters into one report for the first time is an important step in the evolution of the Station Safety Report.

97 I judge that the HPC PCSR2 Master List (Ref. 10) of named sub-chapters is also adequate on the grounds that:-

- the decision making on whether a generic sub-chapter is valid for HPC is in my judgement sound. For example sub-chapters to Ch 4 Fuel and Core that intuitively are unlikely to have any site-specific content are to be adopted verbatim from the

generic PCSR whereas Ch 2 Site Data and Bounding Character of the GDA Site Envelope contains only site-specific sub-chapters.

- the provision of additional site-specific sub-chapters over those in the generic PCSR is to be logical and comprehensive, e.g. the sub-chapter on the safety implications of the site accommodating two EPR units was provided because the generic PCSR addresses a site with a single EPR unit only. Similarly sub-chapters on areas of plant beyond the nuclear island have been provided because the generic PCSR only addressed nuclear island plant.

98 I identified the difficulty of writing a head document that draws together the material presented in 116 separate sub-chapter documents as a significant impediment to the production of an adequate HPC PCSR. However, I judge that it is probable that NNB Genco have addressed this potential problem satisfactorily by having a range of authors prepare individual chapter summaries for inclusion in the head document as set out in the Master List. The head document author's task is thus reduced to the more manageable one of linking the prepared summaries together and ensuring that the head document does not contain contradictions or gaps between chapter summaries.

99 ONR comments on Batch 4 and NNB Genco's responses are given in Ref. 1. ONR queried how PCSR2 would justify the safety of the whole site given that ONR had learned that site-specific Design Basis Analysis (DBA) for conventional plant faults would not be available in time for inclusion in PCSR2 and the conventional plant initiating fault list was not yet comprehensive. NNB replied (Ref. 1, ) that this point would be addressed directly by a supporting reference to Ch 1 of PCSR2 titled 'PCSR Compliance with Objectives' and that the PCSR2 head document would clarify any exclusions. Furthermore, details of tasks that are not expected to be completed within the timescales of PCSR2 would be provided in Forward Work Plans (FWP) prepared for each chapter. NNB Genco argued that this approach gives evidence that they have good visibility and control on additional work needed to develop the safety case.

100 The comments also make it clear that a complete Probabilistic Safety Analysis (PSA) will also not be available by the time PCSR2 is published and I judge that this limitation is likely to apply to severe accident analysis (SAA). Confirmation that PCSR2 will not contain complete DBA, PSA and SAA for the whole site is an important finding as it indicates that PCSR2 alone will not be sufficient to meet the requirements of several ONR SAPs. The relevant SAPs are FA1 to FA10 inclusive and FA15 (see Table 1 for details).

101 This feature is mentioned briefly in the PCSR2 Specification (Ref. 8,) where it is stated that "For all site-specific or operator-specific differences from the GDA, site-specific design and safety analysis is to be produced which collectively amends, replaces or fill gaps in, the GDA, as necessary to give a complete case addressing the HPC site. This is to be completed so far as possible in PCSR2, given the level of design information.". However, it is not given the prominence its significance deserves and to a certain extent contradicts the main purpose of PCSR2 "to provide the safety justification, for NNB's own assurance, for moving into the construction phase of the plant."

102 Further information on the likely state of completeness of SSC safety justification was obtained at Level 4 meeting in July 2012 (Ref. 12) where the concept of Construction Safety Justification documents was introduced to set out the justification for releasing

major project hold points. ONR has not yet formed a clear understanding of how much safety case detail will be available to support each Construction Safety Justification and its location within the project safety documentation. However I judge that the progress made by NNB Genco is adequate for licensing on the basis that there will be a period before the first construction permissioning decision in which to resolve the outstanding uncertainty.

103 More generally I judge that the progress made by NNB Genco is adequate for licensing on the basis that there will be a period before the first construction permissioning decision in which NNB Genco can improve the scope and detail of DBA, PSA and SAA.

## 5 CONCLUSIONS

104 This assessment report reviews the adequacy of NNB Genco's work to prepare Issue 2 of the Pre-Construction Safety Report (PCSR2) for the proposed Hinkley Point C (HPC) nuclear Power Station. It also addresses whether NNB Genco have met key ONR requirements regarding whether the site has been shown to be suitable for construction and operation of a UK EPR as set down in the Intervention Strategy for Licensing for Hinkley Point C.

### 5.1 Key Findings from the Assessment

105 The review of NNB Genco's safety management arrangements covered by early batch 4 judged that the PCSR2 Specification would provide an adequate basis for the preparation of a satisfactory PCSR2 and the that the HPC PCSR2 Master List of named sub-chapters is also adequate. The review also concluded that complete design basis analysis, probabilistic safety analysis and severe accident analysis were not likely to be included in PCSR2 when it is delivered and that these areas required further development. However, it was judged that the progress made by NNB Genco is adequate for licensing on the basis that there will be a period before the first construction permissioning decision in which NNB Genco can improve the scope and detail of DBA, PSA and SAA.

106 Each of the discipline-specific assessment reports concludes that sampling has not revealed any reason not to grant a Licence for the proposed Hinkley Point C Power Station. Specific points made were:-

- The external hazards assessment made a recommendation that where the GDA envelope is breached or approached with little margin for certain hazards, mitigating actions should be captured by operating procedures.
- The fault studies assessment found that risks from the neighbouring reactor, initiating events occurring on the conventional plant island (site-specific design), ex-reactor activities (e.g. on-site fuel handling, transport and storage) and nearby Hinkley Point A and B nuclear sites, were all being addressed adequately for licensing purposes

- The severe accident analysis assessment noted that the NNB Genco severe accident lead engineer is actively engaged with the proposed design changes arising from lessons learned from the Fukushima incident.
- The specialist fuel performance Inspector was content with NNB GenCo's choice of a wet interim spent fuel storage facility for the HPC site
- The Reactor Chemistry Specialist Inspector was content with NNB Genco's proposals to address any significant future biofouling threat by undertaking monitoring to ensure the estuarine conditions were not changing and by including infrastructure in the station design to allow chemical dosing of abstracted seawater.
- The assessment of NNB Genco's work on radiological waste and decommissioning found that the overall strategies for decommissioning and management of both Intermediate Level Waste (ILW) and spent fuel at HPC are feasible and are in accordance with national and regulatory policy and strategy. The selected decommissioning strategy for Hinkley Point C is Early Site Clearance (i.e. prompt dismantling with no period of Care and Maintenance), in line with international practice for decommissioning similar reactors, and the declared decommissioning strategy for Sizewell B.
- The safety categorisation and classification assessment found that a new safety classification system based on UK nuclear practice is to be adopted for Hinkley Point C at the end of 2013.

107 The review against key criteria identified by ONR found the site to be suitable. More specifically it was found that:-

- the site plot plan summary document provides confirmation that the site is physically large enough to accommodate all the buildings and services required for the twin UK-EPR and that the site is of a sufficient size to allow construction based on the assumed construction sequence
- a process has been developed, and is in the process of implementation, to provide a sufficient level of confidence that a Grid connection can be established to Hinkley Point C
- the concept, layout and design of the civil structures is such that adequate cooling capability will be available for all normal and fault conditions, subject to satisfactory completion of the mock-up studies and the detailed design. Fault studies queries on whether conventional island faults would be addressed fully, if the design had considered the system as a whole and the lack of a reserve ultimate heat sink were addressed satisfactorily.
- there was a satisfactory position for Licensing with respect to each external hazard,
- the geology of the site will not lead to the structures being vulnerable to seismic action and that the structures can be designed to accommodate the envisaged forces (by analysis) and movements (by analysis and detailing). The capable faulting hazard was judged to be very unlikely to be significant at Hinkley Point C based on an interim confidence statement from NNB Genco. The threat to the foundations of safety related civil structures from a rise in the water table was found to be acceptable for the

purposes of licensing as an acceptable engineering solution for water table control was judged to be possible.

- Although no target dates have been provided for the issue of PCSR3 and subsequent updates of the station safety report, the strategy is judged adequate to comply with the ONR requirement to provide a schedule for submission of further PCSR updates or revisions to support subsequent construction milestones.

### 5.2 Overall Conclusions

108 Following my sampling of the applicant's documentation, my review of discipline-specific supporting assessment reports and my review of site suitability against ONR's identified requirements, I have no outstanding concerns that would preclude issue of a Nuclear Site Licence.

109 Hence, with regard to the station safety report and associated substantiation, NNB Genco's progress is judged to be adequate to justify issue of a Nuclear Site Licence.

## 6 RECOMMENDATION

110 The author of the PAR addressing whether to issue a Nuclear Site Licence for the Hinkley Point C site to NNB Genco should note that that from the perspective of safety report production, there is no impediment to Licence issue.

## 7 REFERENCES

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3 *ONR How2 Business Management System. Assessment Process* (formerly AST/001 Issue 4 HSE. April 2010.) www.hse.gov.uk/nuclear/operational/assessment/index.htm.

4 *Safety Assessment Principles for Nuclear Facilities.* 2006 Edition Revision 1. HSE. January 2008. www.hse.gov.uk/nuclear/SAP/SAP2006.pdf

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

6 NNB Genco Ltd's Application for a Nuclear Site Licence to Install and Operate Two EPR Reactor Units at Hinkley Point: ONR Intervention Strategy, TRIM 2012/61973.

7 NNB Genco: Hinkley Point C Licence Condition 14 Report for Licensing, ONR-CNRP-AR-12-083, Rev 0, October 2012, TRIM 2012/412511

8 Overview on Development of HPC Safety Case beyond PCSR, P Edwards, 20 May 2011, TRIM 2011/326112

9 NNB Hinkley Point C: Internal Hazards Workstream Assessment to inform the nuclear site licensing of two EPR Reactor Units at Hinkley Point C, ONR-CNRP-AR-12-082, Rev 0, 22 August 2012, TRIM 2012/324747

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11 External Hazards Assessment to Inform Nuclear Site Licensing of Hinkley Point C, ONR-CNRP-AR-12-107, Revision 0, 15 September 2012, TRIM 2012/373106

12 Probabilistic Safety Analysis (PSA) workstream assessment to inform nuclear site licensing of Hinkley Point C, ONR-CNRP-AR-056 Rev 0**,** 10 August 2012, TRIM 2012/310485

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14 Electrical Engineering Assessment NNB Genco Hinkley Point C Licensing, ONR-CNRP-AR-12-085, Rev 0, 17 August 2012, TRIM 2012/334580

15 Fuel & Core and Spent Fuel Storage Work Streams – NNB GenCo Hinkley Point C Licensing, ONR-CNRP-AR-12-84, Rev 0, 16 August 2012, TRIM 2012/344488

16 Reactor Chemistry Assessment Report to inform Nuclear Site Licence of NNB Genco Hinkley Point C, ONR-CNRP-AR-12-108, Rev 0, 4 September 2012, TRIM 2012/351327

17 Hinkley Point C Nuclear Site Licensing – Mechanical Engineering Topic Report, ONR-CNRP-AR-12-075, Rev 0, 14 August 2012, TRIM 2012/339862

18 Safety Categorisation and classification workstream assessment to inform nuclear site licensing of Hinkley Point C, ONR-CNRP-AR-12-081, Rev 0, 3 September 2012, TRIM 2012/324266

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20 External Hazards Assessment to Inform Nuclear Site Licensing of Hinkley Point C, ONR-CNRP-AR-12-107, Revision 0, 15 September 2012, TRIM 2012/373106

21 Probabilistic Safety Analysis (PSA) workstream assessment to inform nuclear site licensing of Hinkley Point C, ONR-CNRP-AR-056 Rev 0**,** 10 August 2012, TRIM 2012/310485

22 NNB Genco Hinkley Point C Fault Studies and Severe Accident Analysis Topic Report for Licensing, ONR-CNRP-AR-127, October 2012, TRIM 2012/387223

23 Control and Instrumentation (C&I) workstream assessment to inform nuclear site licensing of NNB Genco Hinkley Point C, ONR-CNRP-AR-12-092, Rev 0, 31 August 2012, TRIM 2012/346436

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30 Hinkley Point C Human Factors Topic Report to Inform Nuclear Site Licensing, ONR-CNRP-AR-12-086 Rev 0, 23 August 2012, TRIM 2012/334496

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35 Work Instruction HPC PCSR2 Safety Case Production and Management, Version 2, 12 Jan 2012, HPC-NNBOSL-XX-000-WIN-000001, TRIM 2012/118830

36 HPC PCSR2 Master List update for information as at 12 March 2012, TRIM 2012/120160

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39 Hinkley Point C Pre-Construction Safety Report – Sub Chapter 2.3 Site Plot Plan Summary HPC-NNBOSL-U0-ALL-RET-000001 NNB Genco 11 May 2012 TRIM 2012/213435

40 UK EPR Hinkley Point Project:Identification and Review of the Safety Implications of a Twin Reactor Design for Hinkley Point C CN376-700-00002 Issue 6 Rolls Royce 7 May 2012 TRIM 2012/213435

41 Hinkley Point C Pre-Construction Safety Report – HPC PCSR2 – Heat Sink Summary Document HPC-NNBOSL-U0-000-RET-000011 31 January 2012 TRIM 2012/61317

42 Pre Construction Safety Report: Submission of Batch 5: Hinkley Point C (HPC) Cooling Capability Letter ONR-HPC-20185N NNB Genco 2 February 2012

43 HPC PCSR2 SITE GEOLOGY SUMMARY DOCUMENT – NNB Letter Ref: HPC20274N - Updated Reference for Pre Construction Safety Report 2 (PCSR2) Batch 2.2 Submission; Hinkley Point C (HPC) Site Geology August 2012 TRIM 2012/330687

**Annex 1 - NNB Pre-Construction Safety Report**

**Pre-Construction Safety Report: Concept of Early Batches and Review within NNB Genco**

111 The content of the Early Batches is shown in Table 3. The batches were intended to address the ONR requirements as set out above.

112 It is important to note that the early batch documents were sent to ONR as fully issued documents that had met the company internal quality assurance controls. However, no details of the outcome of their consideration by the NNB Genco Nuclear Safety Committee (NSC) were provided, in some cases because NSC consideration post-dated sending the batch to ONR. Furthermore, the batch documents were not subject to Independent Nuclear Safety Assessment (INSA) within NNB Genco as an INSA capability had not yet been established.

**Pre-Construction Safety Report: Batch 4 – Safety Case Management**

113 Batch 4 addresses the requirement to demonstrate the capability to develop a site-specific PCSR submission and consists of a covering letter with two attachments:

Attachment 1: Specification for the Pre-Construction Safety Report PCSR2 for Hinkley Point C (Ref. 19).

Attachment 2: Work Instruction – HPC PCSR2 Safety Case Production and Management (Ref. 20).

114 Ref. 8, the PCSR2 Specification, states the purpose and objectives of the HPC PCSR and details the structure of the report, i.e. a head document that is the top level summary of the safety case and 116 sub-chapters (each a separate approved document), grouped into 21 chapter subject areas (chapters are not separate approved documents).

115 The titles of the chapters and sub-chapters are set down in the 'HPC PCSR2 Master List' (a living document, snapshot at March 2012 is Ref. 21). The Master List shows which sub-chapters have been adopted verbatim from the generic PCSR and those site-specific documents that are necessary. For clarity the chapter and sub-chapter numbering scheme follows that in the generic PCSR, e.g. Chapter 4 is on Reactor and Core Design and sub-chapter 4.2 is on Fuel system design in both reports. Site-specific sub-chapters that simply replace a generic sub-chapter that was not adopted for HPC are allocated the number of the replaced generic sub-chapter. Other site-specific sub-chapters are given a letter, e.g. 2U, addressing the implications of the twin-reactor design in Chapter 2 on "Site Data and Bounding Character of the GDA Site Envelope". Full issue of PCSR2 is anticipated at the end of 2012.

116 The HPC PCSR2 Master List also shows that a chapter summary document is to be prepared for each Chapter (designated document A, so that for example the summary for Ch 4 is document 4A).

117 Although PCSR2 will not be issued in time to inform the NSL application process, the PCSR2 Specification (Ref. 8) also details the measures taken by NNB Genco to facilitate licensing by addressing the questions posed in the ONR Intervention Strategy (Ref. 6, see paras 12 and 13 above). Those parts of the HPC PCSR safety case that are relevant to the questions were sent to ONR as 'early batches'. Batch 4 addressed the ONR requirement that NNB Genco show the capability to develop a site-specific PCSR submission to support the construction and installation activities.

118 The PCSR2 specification (Ref. 8) explains that those details of the station design and safety substantiation that are not available in time for inclusion in PCSR2 will be added later by Addenda as they become available. It is stated that "Each addendum will cover a particular section of the plant, generally a group (or subdivision) of SSCs (structures, systems and components) and will present, as a minimum, the detailed design suitable for construction, and the design substantiation, for that equipment, and will be linked to a particular construction activity for that plant."

119 The PCSR2 Specification (Ref. 8) goes on to say that more detail on the process of using addenda to update and expand the safety case will be provided in Chapter 21 of PCSR2. The link between addenda and NNB hold point release will also be provided in PCSR2 Ch 21.

120 The NNB Genco Nuclear Safety Committee (NSC) discussed the PCSR2 addenda process at its June 2012 meeting (Ref. 22). The NSC expressed concern that the project design process appeared not to be well co-ordinated with the safety case process. The NSC were informed that the addenda were to be created to allow release of construction hold points and were for "internal purposes, other than those associated with regulatory milestones, where they would help provide assurance to ONR that the design and safety case are adequate for construction release." The addenda would be categorised and the NSC would receive only the most safety significant ones. The NSC concluded that the proposed addenda process needed clarification.

121 ONR learned at a Level 4 Meeting (Ref. 23) in July 2012 that the addenda would instead be known as Construction Safety Justifications (CSJ). NNB further clarified that for each structure, system, or component (SSC), a Construction Safety Justification (CSJ) would be provided prior to the start of construction of that SSC. Importantly, the CSJ might not be based on a completed design basis analysis (or equally PSA or SAA), as some aspects might rely on engineering judgement with remaining analysis to be provided after construction had commenced. Construction could thus be started on the basis of a judgement that sufficient safety justification was available at that date.

122 Ref. 9, the PCSR2 Work Instruction, defines the activities necessary to achieve delivery of PCSR2 including the interactions with the Architect Engineer and other contractors.

**Pre-Construction Safety Report: Other Early Batches**

123 Requirement A to show that the site was of sufficient size prompted Batch 3.1. Batch 3.1 consists of two documents, the Site Plot Plan Summary (Ref. 24) and a report on the implications for safety of their being two reactors on the site (Ref. 25) rather than the single unit addressed under GDA.

124 Batch 6 was sent to respond to Requirement B to demonstrate that the site is, or could be, connected to grid supplies.

125 Requirement C to show that adequate cooling capability for all normal and fault conditions could be provided was addressed by Batch 5 on the heat sink (Refs. 26 and 27).

126 Requirement D to show that the environmental conditions would not preclude use of the site with respect to external hazards is addressed by several early batch submissions, i.e. Batch Numbers 1.1, 1.2, 1.3 and 2.1.

127 Batch 2.2 on site geology (Ref. 28) addressed Requirement E that the site provide a secure long term support to the necessary structures, systems and components.

128 No early batch information was sent to address Requirement F.

**Table 1**

Relevant Safety Assessment Principles Considered During the Assessment

| SAP No. | SAP Title | Description |
|---|---|---|
| FP1 | Responsibility for Safety | The prime responsibility for safety must rest with the person or organisation responsible for the facilities and activities that give rise to radiation risks. |
| FP3 | Optimisation of Protection | Protection must be optimized to provide the highest level of safety that is reasonably practicable |
| FP6 | Prevention of accidents | All reasonably practicable steps must be taken to prevent and mitigate nuclear or radiation accidents |
| SC1 | Safety Case Process | The process for producing safety cases should be designed and operated commensurate with the hazard, using concepts applied to high reliability engineered systems. |
| SC2 | Safety Case Process | The safety case process should produce safety cases that facilitate safe operation |
| SC3 | Safety Case Process | For each life-cycle stage, control of radiological hazards should be demonstrated by a valid safety case that takes into account the implications from previous stages and for future stages. |
| SC4 | Safety Case Characteristics | A safety case should be accurate, objective and demonstrably complete for its intended purpose |
| SC5 | Safety Case Characteristics | Safety cases should identify areas of optimism and uncertainty, together with their significance, in addition to strengths and any claimed conservatism. |
| SC6 | Safety Case Characteristics | The safety case for a facility or site should identify the important aspects of operation and management required for maintaining safety |
| SC7 | Safety Case Maintenance | A safety case should be actively maintained throughout each of the life-cycle stages. |
| SC8 | Safety Case Ownership | Ownership of the safety case should reside within the dutyholder's organisation with those who have direct responsibility for safety. |

**Table 1**

Relevant Safety Assessment Principles Considered During the Assessment

| SAP No. | SAP Title | Description |
|---|---|---|
| FA1 | Design basis analysis, PSA and severe accident analysis | Fault analysis should be carried out comprising design basis analysis, suitable and sufficient PSA, and suitable and sufficient severe accident analysis. |
| FA2 | Identification of initiation faults | Fault analysis should identify all initiating faults having the potential to lead to any person receiving a significant dose of radiation, or to a significant quantity of radioactive material escaping from its designated place of residence or confinement. |
| FA3 | Fault sequences | Fault sequences should be developed from the initiating faults and their potential consequences analysed |
| FA4 | Fault tolerance | DBA should be carried out to provide a robust demonstration of the fault tolerance of the engineering design and the effectiveness of the safety measures. |
| FA5 | Initiating faults | The safety case should list all initiating faults that are included within the design basis analysis of the facility. |
| FA6 | Fault sequences | For each initiating fault in the design basis, the relevant design basis fault sequences should be identified. |
| FA7 | Consequences | Analysis of design basis fault sequences should use appropriate tools and techniques, and be performed on a conservative basis to demonstrate that consequences are ALARP |
| FA8 | Linking of initiating faults, fault sequences and safety measures | DBA should provide a clear and auditable linking of initiating faults, fault sequences and safety measures |
| FA9 | Further use of DBA | DBA should provide an input into the safety classification and engineering requirements for systems, structures and components performing a safety function; the limits and conditions for safe operation; and identification of requirements for operator actions. |

**Table 1**

Relevant Safety Assessment Principles Considered During the Assessment

| SAP No. | SAP Title | Description |
|---|---|---|
| FA10 | Need for PSA | Suitable and sufficient PSA should be performed as part of the fault analysis and design development and analysis. |
| FA15 | Fault Sequences | Fault sequences beyond the design basis that have the potential to lead to a severe accident should be analysed. |

**Table 2**

Interventions carried out related to Safety Report and Associated Substantiation

| Date | Topic | Contact or Intervention report number and TRIM reference |
|---|---|---|
| 23 Aug 2010 | Level 4 Hinkley Point C Pre-Construction Safety Report (PCSR) Progress Meeting | CR10078 2010/374856 |
| 20 May 2011 | Level 4 PCSR Meeting | CR 11100 2011/325044 |
| 11 Jul 2011 | Level 4 PCSR Meeting | CR11131 2011/584674 |
| 19 Aug 2011 | Level 4 PCSR Meeting | CR 11194 2011/527928 |
| 27 Oct 2011 | Level 4 PCSR Strategy and Management | IR-11-203 2012/81352 |
| 10 Feb 2012 | PCSR2 Early Submissions to Support NSL Granting | CR-12-005 2012/83075 |
| 26 Jun 2012 | Site Specific PCSR Mangement | IR-12-133 2012/289510 |
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**Table 3**

Early Batches of PCSR2 Documentation sent to ONR to aid Licensing Decision Making

| Batch No. | Topic |
|---|---|
| 1 | Site Data relevant to Boundary Conditions of Generic Design Assessment plus Seismic Hazard data |
| 2 | Site data relevant to heat sink and sea conditions plus site geology |
| 3 | Justification that the site is of sufficient size |
| 4 | NNB Genco Safety Case Management |
| 5 | Heat Sink/Cooling |
| 6 | Grid Connection |