Office for Nuclear Regulation

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Civil Nuclear Reactor Programme

Probabilistic Safety Analysis (PSA) workstream assessment to inform nuclear site licensing of Hinkley Point C

Assessment Report: ONR-CNRP-AR-12-056
Revision 1
15 January 2013

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ASSESSMENT REPORT

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EXECUTIVE SUMMARY

Background

This report presents the findings of the Office for Nuclear Regulation (ONR) Probabilistic Safety Analysis (PSA) workstream assessment of New Nuclear Build Generation Company Ltd's (NNB GenCo) application, including supporting information and arrangements, for a nuclear site licence at Hinkley Point C. This assessment supports ONR's decision whether to grant a nuclear site licence or not for NNB GenCo to install and operate two EPR™ units at Hinkley Point C.

This report has been produced in line with ONR's overall licensing strategy and the underpinning PSA intervention strategy. It informs both ONR's organisational capability intervention, and safety report and the associated substantiation intervention from ONR's licensing strategy.

Assessment and inspection work carried out by ONR

ONR has engaged with NNB GenCo since March 2011 on the PSA workstream, via regular level 4 meetings, assessment of relevant documentation where available and inspection of PSA arrangements in May 2012, to gather sufficient evidence to recommend, or not, granting a nuclear site licence. Within the PSA workstream this engagement had the objective of verifying the following:

- NNB GenCo has adequate control of the PSA programme.
- NNB GenCo has adequate control of the PSA model and documentation.
- There is evidence of suitable and adequate use of PSA in NNB GenCo's hold point control process.
- Adequate PSA has been developed given the point in time of the build programme.
- NNB GenCo is able to demonstrate an adequate intelligent customer capability.
- NNB GenCo has Suitably Qualified and Experienced Personnel (SQEP) to deliver adequate PSA for the second Pre-construction Safety Report (PCSR2) and later.
- Site specific parameters are bounded by the Generic Design Assessment (GDA) design envelope, where informed by and relevant to PSA.
- Robust PSA arrangements have been developed or are being developed, including for suitable and sufficient PSA to support the design development and analysis.
- NNB GenCo is making adequate progress against its PSA plan for PCSR2.
- The site is suitable for the construction and operation of a UK EPR™.

Matters arising from ONR's work

A number of potential areas for improvement have been identified that for this point in the programme are being adequately progressed by NNB GenCo. No significant matters were identified.

Conclusions

In terms of NNB GenCo's competence and capability in the PSA workstream area, no significant issues have been identified that preclude me recommending ONR to grant a nuclear site licence for NNB GenCo to install and operate two EPR™ units at Hinkley Point C. I therefore conclude, based on the PSA workstream, that NNB GenCo's arrangements appear adequate to manage nuclear safety for the point in time at which the nuclear site licence is to be granted.

I have also reviewed a number of documents submitted to ONR as part of the early batches, relevant to the PSA workstream, and also carried out a preliminary assessment of a small sample of PCSR2 PSA supporting references. Based on this assessment I consider that these documents are adequate in terms of their scope and content for nuclear site licensing purposes. A number of queries have been raised with NNB GenCo during this assessment that have been adequately addressed for licensing. Any outstanding issues can be dealt with from a permissioning perspective. It is therefore concluded, based on the PSA workstream, that:

- NNB GenCo has demonstrated that there is a high level of confidence that the Hinkley Point C site can support the licensable activity.
- 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.

It is noted that some of the areas of work discussed in this report are still being developed and ONR will continue to engage with NNB GenCo to monitor and encourage progress in these areas.

Recommendations

From the perspective of the PSA workstream, I recommend that ONR should grant a nuclear site licence to NNB GenCo to install and operate two EPR™ units at Hinkley Point C.

LIST OF ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
BMS	(ONR) How2 Business Management System
BSO	Basic Safety Objective
CNRP	Civil Nuclear Reactor Programme
EPR™	The Pressurised Water Reactor developed and trademarked by AREVA
GDA	Generic Design Assessment
HPC	Hinkley Point C
HSE	Health and Safety Executive
IAEA	International Atomic Energy Agency
IPR	Intervention Project Record
LC	Licence Condition
LOOP	Loss Of Offsite Power
LUHS	Loss of Ultimate Heat Sink
NGL	EDF Energy Nuclear Generation Ltd
NNB GenCo	New Nuclear Build Generation Company Ltd
ONR	Office for Nuclear Regulation (an agency of HSE)
PCSR	Pre-construction Safety Report
PCSR2	Second Pre-construction Safety Report
PSA	Probabilistic Safety Analysis
SAP	Safety Assessment Principle(s) (HSE)
SFAIRP	So far as is reasonably practicable
SQEP	Suitably Qualified and Experienced Personnel
SSC	System, Structure and Component
SSG	Specific Safety Guide
TAG	Technical Assessment Guide(s) (ONR)
TSC	Technical Support Contractor
WENRA	Western European Nuclear Regulators' Association

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1 INTRODUCTION

1.1 Background

1 New Nuclear Build Generation Company Ltd (NNB GenCo) has submitted its formal application for a nuclear site licence to install and operate two EPR™ units at Hinkley Point C. The Office for Nuclear Regulation's (ONR) intervention strategy to inform a decision on whether, or not, a nuclear site licence should be granted to NNB GenCo in respect of Hinkley Point C is set out in Ref. 6.

2 ONR's approach to licensing has been 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.

3 As part of the safety report and associated substantiation intervention ONR Pre-construction Safety Report (PCSR) technical topic leads were required to develop and carry out an intervention focused on their topic. Probabilistic Safety Analysis (PSA) is one such topic listed in Appendix C of ONR's Hinkley Point C licensing intervention strategy (Ref. 6). The PSA intervention developed to support licensing is summarised in the Civil Nuclear Reactor Programme (CNRP) Intervention Project Record (IPR) NNB-HPC1-IPR16 (Ref. 7). This assessment report summarises the outcome of the PSA licensing intervention.

4 The assessment was undertaken in accordance with the requirements of the ONR How2 Business Management System (BMS) procedure AST/001 (Ref. 1). The ONR Safety Assessment Principles (SAP) (Ref. 2), together with supporting Technical Assessment Guides (TAG) (Ref. 3) have been used as the basis for this assessment.

1.2 Scope

5 The scope of this report informs the organisational capability intervention, and the safety report and the associated substantiation intervention outlined in ONR's licensing intervention strategy (Ref. 6).

1.3 Methodology

6 The methodology for the assessment follows ONR BMS document AST/001, Assessment Process (Ref. 1), in relation to mechanics of assessment within ONR.

7 This assessment has been focused primarily on NNB GenCo's arrangements for PSA, NNB GenCo's capability in the PSA technical area, and its interface with the Architect Engineer as it is not intended to produce the site specific PCSR until post licensing. Notwithstanding this, a number of supporting references to the PCSR have been produced by NNB GenCo and reviewed by ONR.

2 ASSESSMENT STRATEGY

8 The intended assessment strategy for the licensing of NNB GenCo with respect to Hinkley Point C for the PSA topic area is set out in this section. This identifies the standards and criteria that have been applied and the scope of the assessment.

2.1 Standards and criteria

9 The relevant standards and criteria adopted within this assessment are principally the SAPs, Ref. 2, internal ONR TAGs, Ref. 3, relevant national and international standards, and relevant good practice informed from existing practices adopted on UK nuclear licensed sites. The key SAPs and relevant TAGs are detailed within this section. National and international standards and guidance, e.g. relevant parts of the International Atomic Energy Agency (IAEA) standards (Ref. 5) and the Western European Nuclear Regulators Association (WENRA) reference levels (Ref. 4), have been referenced where appropriate within the assessment report. Relevant good practice, where applicable, has also been cited within the body of the assessment.

2.1.1 Safety Assessment Principles

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

2.1.2 Technical Assessment Guides

11 The following Technical Assessment Guides have been used as part of this assessment (Ref. 3):

- T/AST/030 PSA
- T/AST/045 Radiological analysis – fault conditions

2.1.3 National and international standards and guidance

12 The following international standards and guidance have been used as part of this assessment (Refs. 4 and 5):

- WENRA Reactor Reference Safety Levels
- Specific Safety Guide, SSG-3, Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants
- Specific Safety Guide, SSG-4, Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants
- INSAG-25 Framework for an Integrated Risk Informed Decision Making Process

2.2 Assessment scope

13 The purpose of this assessment report is to summarise the outcome of the intervention outlined in the IPR NNB-HPC1-IPR16 (Ref. 7) to support ONR's overall licensing strategy. The objectives of the intervention are to conclude whether from the perspective of PSA:

- NNB GenCo has demonstrated adequate arrangements to manage nuclear safety for the point in time at which the licence is to be granted.
- NNB GenCo has demonstrated that there is a high level of confidence that the Hinkley Point C (HPC) site can support the licensable activity.
- NNB GenCo has demonstrated that it is capable of producing a site specific safety report and relevant design substantiation.

14 Overall, the purpose is to recommend whether ONR should, or should not, grant a nuclear site licence.

15 The anticipated outcomes of the intervention are confirmation that:

- NNB GenCo is capable to develop a suitable and sufficient PSA.
- Suitable and sufficient PSA is/will being/be used to support the design development and analysis.
- Adequate progress has been made on developing and implementing suitable PSA arrangements, and developing the PSA, given the point in time in the build programme.

16 This assessment report will inform the organisational capability lead correspondent's overall assessment report and the PCSR workstream lead correspondent's overall assessment report.

2.2.1 PSA intervention strategy

17 To address the objectives and anticipated outcomes of the intervention a mixture of level 4 meetings, assessment of PSA deliverables, where available given the point in time in the PSA programme, and inspection have been used to gather evidence to form a judgement on NNB GenCo's deployment of Suitably Qualified and Experienced Personnel (SQEP) resource as well as the effectiveness of its arrangements:

- to produce a safety report that will support NNB GenCo's request for ONR's permission to start safety related construction;
- to ensure the continued evolution of a safety report that supports NNB GenCo's construction and installation programme;
- to ensure that the design of safety related structures, systems and components (SSCs) is compliant with the extant safety report; and
- to control the procurement and manufacture of early activities and long lead items that have the potential to affect safety.

18 Within the PSA workstream this has been interpreted as verifying the following:

- NNB GenCo has adequate control of the PSA programme.
- NNB GenCo has adequate control of the PSA model and documentation.
- There is evidence of suitable and adequate use of PSA in NNB GenCo's hold point control process.
- Adequate PSA has been developed given the point in time of the build programme.
- NNB GenCo is able to demonstrate an adequate intelligent customer capability.
- NNB GenCo has SQEP staff to deliver adequate PSA for the second PCSR (PCSR2) and later.
- Site specific parameters are bounded by the Generic Design Assessment (GDA) design envelope, where informed by and relevant to PSA.
- Robust PSA arrangements have been developed or are being developed, including for suitable and sufficient PSA to support the design development and analysis.
- NNB GenCo is making adequate progress against its PSA plan for PCSR2 (Ref. 8).

19 In addition, assessment of the PSA aspects of a number of key topics (the early batch submissions – see paragraph 27), where relevant, has been carried out to provide confidence that the site is suitable for the construction and operation of a UK EPR™.

2.2.2 Use of technical support contractors

20 No technical support contractors have been used to support this assessment.

2.3 Integration with other assessment topics

21 The nature of PSA means that there are interactions with other technical areas since aspects of the assessment in those areas constitute inputs to the PSA assessment. There have been interactions between PSA and other technical areas such as electrical, control and instrumentation, fault studies and radiological protection. This is expected to increase as the programme progresses.

2.4 Out-of-scope items

22 The focus of this assessment has mainly been on PSA arrangements as opposed to the PSA model, supporting analyses and documentation. Given that significant PSA deliverables are not anticipated until post licensing and that the GDA PSA was considered adequate for GDA (see Section 4.3.2) this is not unexpected.

3 NUCLEAR SITE LICENCE APPLICANT'S SAFETY CASE

23 NNB GenCo formally applied for a nuclear site licence for Hinkley Point C in letter ONR-HPC-20143R, dated 29 July 2011 (Ref. 9). This was supported by an application dossier (Ref. 10) that supports NNB GenCo's application. ONR agreed (Ref. 12) that this dossier did not need to include a Hinkley Point C site specific PCSR. For the purposes of granting a nuclear site licence ONR indicated to NNB GenCo that it would accept a document that illustrates the structure of the Hinkley Point C site specific PCSR document.

24 Although only a few PSA deliverables are anticipated on licensing timescales and therefore do not explicitly support the case for a nuclear site licence, NNB GenCo's capability in the PSA area can be partly judged from its strategy for PCSR2, and the progress being made in this area.

25 NNB GenCo's specification for PCSR2 (Ref. 11) provides the scope, content and structure of the whole PCSR safety case. Included in this specification is an overview of the PSA approach for PCSR2. This is further expanded in the specification for PSA aspects of the Hinkley Point C PCSR2 (Ref. 8). This latter document provides an overview of the PSA deliverables for PCSR2 and a programme for their delivery.

26 Notwithstanding that ONR did not require a Hinkley Point C site specific PCSR as part of the application dossier, ONR expected relevant sections or chapters of the PCSR, not including PSA, to be developed sufficiently to support licence granting, notably around confirmation that the site specific parameters are bounded by the GDA design envelope, with appropriate arrangements in place to address any discrepancies.

27 In order to provide the necessary high level of confidence that the site is suitable for the construction and operation of a UK EPR™, NNB GenCo was required to justify a number of key topics including:

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

28 NNB GenCo supplied a number early batch submissions to cover these topics. Elements of the following topics and batches were determined to be relevant to PSA and hence were assessed to support nuclear site licensing:

- external hazards – Batches 1.1 and 2.1 – Ref. 15
- site is of sufficient size – Batch 3.1 – Ref. 13
- adequate cooling – normal and fault – Batch 5 – Ref. 14

4 ONR ASSESSMENT

29 This assessment has been carried out in accordance with ONR How2 BMS document AST/001, "Assessment Process" (Ref. 1).

4.1 Scope of assessment undertaken

30 The scope of the assessment has incorporated all relevant aspects of the PSA strategy described in Section 2 of this report. The following areas have been considered and are discussed in Section 4.3 of this report:

- NNB GenCo competence and capability:
  - PSA strategy for PCSR2 (Section 4.3.1.1)
  - use of PSA (Section 4.3.1.2)
  - NNB GenCo oversight of PSA and quality assurance (Section 4.3.1.3)
  - NNB GenCo interface with the Architect Engineer (Section 4.3.1.4)
  - suitably qualified and experienced personnel arrangements for the PSA workstream (Section 4.3.1.5)
  - control of PSA programme (Section 4.3.1.6)
  - control of PSA model, documentation and assumptions (Section 4.3.1.7)
  - hold point control process (Section 4.3.1.8)
- safety report:
  - early batches (Section 4.3.2.1)
  - PCSR2 PSA supporting documentation (Section 4.3.2.2)

4.2 Interventions with NNB GenCo

31 Given that PSA is not an explicit part of the dossier supporting NNB GenCo's application for a nuclear site licence and significant PSA deliverables are not anticipated until post licensing, only a limited assessment of PSA deliverables has been carried out to form a view on whether from the PSA topic area to recommend, or not, granting a nuclear site licence. This has included sampling a small number of PCSR2 supporting references, where available. The recommendation on granting a nuclear site licence is predominantly based on the outcome of the level 4 meetings, outlined in Table 2, and a PSA inspection carried at NNB GenCo's Qube office (Ref. 16).

4.3 Assessment

32 This section summarises ONR's assessment and the conclusions and findings for each of the broad topic areas listed in Section 4.1.

4.3.1 NNB GenCo competence and capability

33 The following subsections consider a range of areas to form an overall view on NNB GenCo's competence and capability.

4.3.1.1 PSA strategy for PCSR2

34 As an input to forming a view on NNB GenCo's capability to develop a site specific PCSR to support a request to commence the first nuclear safety related construction I have considered NNB GenCo's understanding of what is required in terms of developing a suitable and sufficient PSA to support construction. This has in the main been through a review of NNB GenCo's strategy for PCSR2 and forward work programme (Refs. 8 and 11), and discussion with NNB GenCo during the various interventions outlined in Table 2.

35 NNB GenCo's approach for PCSR2 is to develop the GDA PSA to represent the Hinkley Point C design and site, but only as far as feasible given the understanding of the design at the point in time. For example, for PCSR2 site specific data for initiating event frequencies for external hazards are to be used wherever the GDA is non-bounding or overly conservative and significantly affects the PSA insights.

36 NNB GenCo's PCSR2 PSA strategy focuses on the following areas:

- PSA arrangements, i.e. processes and procedures
- PSA modelling updates – focused on revised loss of offsite power frequency, ultimate heat sink modelling, and snow and wind in the level 1 PSA
- PCSR2 PSA documentation and changes in PCSR2 subchapters
- forward work plan
- developing a qualitative risk gap analysis

37 I consider that based on the PSA strategy set out in Ref. 8 and discussions with NNB GenCo that NNB GenCo has a sufficient understanding of the role of the PSA to support construction and are focusing on reasonable activities that are capable to lead to the development of a suitable and sufficient PSA. For example, NNB GenCo has focused on the PSA arrangements and modelling changes that take account of site specific features, e.g. loss of offsite power, loss of heat sink, and external hazards. The strategy also considers appropriate GDA PSA findings (Ref. 31), particularly those linked to the earlier milestone (nuclear island safety related concrete) and areas out of scope for GDA.

38 Overall, I consider that NNB GenCo's PCSR2 PSA strategy is capable of producing a PSA that should meet ONR PSA expectations for PCSR2 as set out in SAPs FA.10 to FA.14 (Ref. 2) and ONR TAG 030 (Ref. 3).

4.3.1.2 Use of PSA

39 At this early stage in the design and construction of Hinkley Point C, PSA arrangements for the use of PSA have been an area of focus between ONR and NNB GenCo. This was to ensure that the basis for the development and use of PSA was sufficient. The following have been discussed with NNB GenCo:

- development of a suitable and sufficient PSA; and
- use of PSA in risk informed design.

40 In response to challenges from ONR, NNB GenCo has developed its understanding in these areas, and developed documents, strategies and processes to provide appropriate evidence.

Development of suitable and sufficient PSA

41 I have reviewed NNB GenCo's draft "definition of a suitable and sufficient PSA" (Ref. 32). This also links to the GDA assessment finding AF-UK EPR-PSA-046 (Ref. 31). This

provides an overview of the attributes of what a suitable and sufficient PSA is for the different stages in the design, construction and operation for Hinkley Point C. In general, I consider this to be a useful strategy document that contains the key attributes that I would expect for the different stages in the design, build and operation of Hinkley Point C, and should ensure that future safety submissions are judged capable of meeting ONR SAP FA.10. Notwithstanding this, some areas for improvement were identified and shared with NNB GenCo (Ref. 33). However, these are not considered significant, are more focused on clarity of the operational PSA attributes and will be taken forward within the ongoing interactions with NNB GenCo. Overall, I consider that NNB GenCo has made adequate progress on this with respect to nuclear site licensing.

Use of PSA in risk informed design

42 NNB GenCo needs to ensure that the developing PSA is used in an iterative manner as the Hinkley Point C design develops. This is to help ensure that the level of risk is, and remains, As Low As Reasonably Practicable (ALARP). In order to demonstrate appropriate use of PSA to inform the design NNB GenCo has drafted an Interface Specification (Ref. 34) and an associated guidance document (Ref. 35). Furthermore, I have engaged with NNB GenCo regularly on this topic via the interventions outlined in Table 2.

43 I consider based on the drafted arrangements and discussions with NNB GenCo that PSA should be used in an appropriate manner to support the developing design of Hinkley Point C and should ensure that future safety submissions are capable of meeting ONR SAPs FA.10 and FA.14. I further consider that NNB GenCo has made adequate progress in this area to support nuclear site licensing.

44 Notwithstanding that I judge this area to be progressing adequately in terms of nuclear site licensing, a number of potential areas for improvement were shared with NNB GenCo via a level 4 meeting (Ref. 36) and it will continue to be an important ONR focus on permissioning timescales. A key area highlighted was developing a better understanding of the use of PSA during development of the design; the following action (action 1400-EDF – see Table 3) was agreed:

- NNB GenCo to provide clarity on “Development of the Design” as used in the Risk Informed Design Interface Specification and the role of PSA in this. This is anticipated to be via a presentation to the next PSA Level 4 face-to-face meeting.

45 Although a number of areas for improvement were identified I do not consider that these should prevent a nuclear site licence being granted. ONR will continue to engage with NNB GenCo to seek evidence that the use of PSA is embedded within NNB GenCo’s arrangements and implemented.

4.3.1.3 NNB GenCo oversight of PSA and quality assurance

46 In order to gain confidence in NNB GenCo’s intelligent customer capability I have examined NNB GenCo’s oversight of the production of PSA deliverables by the Architect Engineer, contractors and NNB GenCo’s own staff in order to produce suitable and sufficient PSA.

47 In terms of undertaking oversight of PSA deliverables, based on discussion with NNB GenCo staff (Ref. 16), they are aware of the appropriate arrangements (processes and procedures); for example, the “Design Review and Acceptance” procedure (NNB-OSL-PRO-000035) for work carried out by the Architect Engineer or its contractors and the Work Instruction “Quality Arrangements for Technical Work Within Design Authority” (NNB-OSL-WIN-000022) for work carried out within Design Authority. I have sampled

implementation of these arrangements, including application of the primary surveillances. There was clear evidence from the areas sampled of NNB GenCo taking ownership of the work carried out by the Architect Engineer and ensuring the deliverables will meet the needs of the UK EPR™ project.

48 Notwithstanding the above, a number of areas for improvement were identified and have been recorded as actions – see Table 3 for the outstanding actions. However, I do not consider resolution of these actions is necessary for nuclear site licensing.

49 In terms of quality assurance of the PSA deliverables, I consider adequate arrangements are in place with NNB GenCo influencing improvements in the Architect Engineer in this area:

- NNB GenCo has learnt lessons identified early during production of PCSR2 where there were quality issues for some of the PSA deliverables (work supporting the loss of ultimate heat sink (LUHS)). These issues were captured by NNB GenCo's arrangements and NNB GenCo has taken appropriate action to influence improved processes within the Architect Engineer.
- The Architect Engineer is producing a report describing its quality assurance processes and comparing them with NNB GenCo procedures; this was discussed during the intervention in March 2012 (Ref. 30). This should give NNB GenCo a clear understanding of the Architect Engineer's arrangements, identify any gaps, enable any improvements to be taken forward, and help to define NNB GenCo's interactions within the Architect Engineer's arrangements.
- It is also noted that NNB GenCo's audit process has a role in maintaining oversight of the Architect Engineer's work.
- One of the lessons learnt by NNB GenCo was the need for much clearer work specifications – from the specifications sampled during the intervention in May 2012 (Ref. 16) improvements in this area were noted.

50 Overall I consider that NNB GenCo is taking appropriate action to ensure adequate oversight of the PSA deliverables, especially those produced outside NNB GenCo. The steps taken to identify issues in deliverables from the Architect Engineer and influence improvements are considered positive. There appear to be no significant issues in NNB GenCo's oversight of PSA and quality assurance that would prevent me from recommending granting a nuclear site licence.

4.3.1.4 Interface with the Architect Engineer

51 During the May 2012 inspection (Ref. 16) NNB GenCo provided a clear overview of the arrangements to manage the interface between the Architect Engineer and NNB GenCo, with the management plan "HPC PCSR2 Safety Case Production and Management" (HPC-NNBOSL-XX-000-WIN-000001) and the "NNB GenCo and Architect Engineer interface specification: manage AE/NNB project request" (NNB-PCP-SPE-000005) being key documents. The following were noted:

- In terms of PCSR2 the interface with the Architect Engineer appears to be adequately managed in the PSA area. However, it is noted that detailed plans and specifications are still to be produced for later PSA programmes, e.g. post PCSR2.
- There was clear evidence, based on the terms of reference, latest agenda, minutes of meetings and open actions, of regular interactions between the NNB GenCo PSA team and the Architect Engineer via monthly "PSA Topical Meetings". This forum appears to play a key role in NNB GenCo ensuring it maintains its intelligent

customer capability in the PSA area and appears invaluable in maintaining an adequate interface with the Architect Engineer.

52 Based on the interventions outlined in Table 2, I have observed a positive relationship between NNB GenCo and the Architect Engineer with NNB GenCo currently demonstrating an adequate intelligent customer capability.

53 In summary, from the perspective of PSA I consider, taking account of the point in time in the PSA programme, that NNB GenCo has an adequate relationship with the Architect Engineer. Notwithstanding this, further oversight will be maintained during permissioning including consideration of observing one of the PSA Topical Meetings.

4.3.1.5 Suitably qualified and experienced personnel arrangements for the PSA workstream

54 The arrangements for demonstrating suitably qualified and experienced personnel in PSA were sampled as part of the May 2012 intervention (Ref. 16). During this intervention NNB GenCo PSA specialists provided a clear overview of the SQEP arrangements as applied to the PSA specialist role and were aware of the appropriate procedure "Management of Competency" (NNB-OSL-PRO-000018) and "NNB Nuclear Baseline" (NNB-HRE-ASS-000001). Furthermore, it was evident that the arrangements were being appropriately applied in the PSA area. Notwithstanding this, the following observations were made:

- The competencies for the PSA specialist role were very high level and not focused on the different PSA technical areas, e.g. level 1, level 2, level 3 PSA, data, human reliability analysis, hazards etc.
- The competencies were focused on PSA applications, e.g. simulator training, incident/accident investigation etc.

55 Overall these arrangements did not appear sufficient in the PSA area because:

- They do not identify the required PSA expertise necessary to effectively challenge and understand fully the deliverables from the Architect Engineer or others.
- They do not provide a route to demonstrate SQEP for the NNB GenCo PSA team.
- They do not assist in the development of NNB GenCo PSA team expertise.

However, I do not consider this to be a specific issue with the level of PSA expertise within NNB GenCo, but more related to how it is demonstrated.

56 In terms of nuclear site licensing, based on the interventions with NNB GenCo (see Table 2), I currently consider there to be SQEP PSA staff within NNB GenCo and the Architect Engineer. It is also noted that this resource has grown over the period of the interventions, although further SQEP staff are likely to be required on longer timescales depending on the PSA strategy adopted by NNB GenCo. I therefore do not consider that this issue needs to be addressed prior to granting a nuclear site licence. An appropriate action has been raised and agreed (action 1329-EDF – see Table 3) that will be addressed prior to first ONR permissioning:

- NNB GenCo should review the adequacy of its SQEP arrangements for the PSA specialist role taking due account of relevant practice in other areas, e.g. SQEP mentor guides within EDF Energy Nuclear Generation Ltd (NGL).

4.3.1.6 Control of PSA programme for PCSR2

57 The control of the PSA programme for PCSR2 has been monitored mainly through the interventions outlined in Table 2. Overall, I consider that NNB GenCo has adequate control over the PSA programme for PCSR2. This is based on the following:

- The PSA aspects of PCSR2 are adequately summarised in the overall PCSR2 specification (Ref. 11) and the PSA PCSR2 specification (Ref. 8).
- The May 2012 intervention (Ref. 16) sampled evidence of NNB GenCo's management of the PSA programme:
  - Monthly project meetings and programme updates are supplemented with more frequent (weekly) reporting from the Architect Engineer in the key stages of the work.
  - Clearer work specifications have been used during the last 6 months – this was an area where NNB GenCo learnt lessons from experience in the early parts of the PCSR2 PSA programme and implemented improvements.
- Additional PSA resource was introduced focused on delivery of the PSA programme and interface with the Architect Engineer.
- There has been no significant slippage in the PSA programme in the last 6 months.

58 In summary, I do not consider that there are any issues relating to NNB GenCo's control of the PSA programme to preclude granting a nuclear site licence.

4.3.1.7 Control of PSA model, documentation and assumptions

59 The control of the PSA model, documentation and assumptions were raised as findings in the GDA of the UK EPR™ (Ref. 31):

- AF-UK EPR-PSA-010: The licensee shall ensure that the detailed Level 1 PSA document is updated so that it is fully consistent with the current PSA model.
- AF-UK EPR-PSA-011: The licensee shall ensure that the process for maintaining and developing the PSA model configuration and supporting document trail is retained post GDA, or an equivalent process put in its place.
- AF-UK EPR-PSA-014: The licensee shall provide and implement a consistent process to ensure capture of the assumptions that are currently dispersed throughout the PSA reports and its supporting documentation and gather them together in a single place within the PSA documents. This should be done in a systematic and traceable way, and the assumptions sentenced as part of a future PSA development.
- AF-UK EPR-PSA-045: The Licensee shall provide and implement the procedure to maintain the PSA and keep it living. This should include PSA task procedures and methodologies.

In all these cases a milestone of nuclear island safety related concrete was stated in the EPR™ GDA PSA step 4 report (Ref. 31).

60 NNB GenCo's progress with respect to addressing these findings has been discussed during the various PSA interventions (see Table 2). Furthermore, based on the May 2012 intervention (Ref. 16) the following were noted:

- The GDA process (response to GDA regulatory observation RO-UKEPR-68) has been followed for work carried out by AREVA, e.g. changes in the model have been tracked using a logbook. The adequacy of this approach, in particular the adequacy of the logbook to trace the impact of the changes in the model in the supporting documentation, will be considered as part of ONR's assessment of the PCSR2 submission.
- The process for controlling the model and documentation within the Architect Engineer may not fully meet ONR expectations. However, NNB GenCo recognises the need to improve the process and interim measures are being implemented (e.g. calculation notes).
- The overall documentation strategy, including standard and level of detail, has not yet been formalised. Further discussion on this between NNB GenCo and ONR is required on permissioning timescales.
- A key challenge for NNB GenCo is ensuring sufficient understanding and ownership of the interim PSA model. This is because the GDA PSA documentation has not been updated consistent with the GDA PSA model, it was developed by AREVA as part of GDA and NNB GenCo's focus on developing a new PSA model, via the family PSA[2] programme[3]. Therefore, NNB GenCo should ensure adequate processes are in place to enable it to enact an adequate intelligent customer function in the interim; part of this may require formal support from AREVA. The following action (action 1331-EDF – see Table 3) was therefore agreed:
  - NNB GenCo should provide information on the measures adopted to ensure intelligent customer capability (e.g. provide sufficient assurance to ONR that NNB GenCo has adequate understanding of the interim PSA model, and supporting documentation and studies) and has adequate capability (e.g. competent resources and knowledge) in place to fully support the use of PSA in Hinkley Point C until the development of the alternative PSA model.
- NNB GenCo provided an overview of its approach to keep track of PSA assumptions via an electronic log. These were also categorised by the type of assumption, e.g. modelling assumption, design intent assumption (prior to the detailed design being finalised), etc. Generally the approach adopted appeared to be positive. However, it was noted that NNB GenCo did not intend to draw out all the GDA PSA assumptions, but only those considered the most important in the PCSR main documentation (supporting documentation have not been reviewed for this purpose) and also those related to developments NNB GenCo has made to the model; moving to a new PSA model (family PSA) was cited as the main reason. It was also noted that some assumptions in the log appeared more related to methodology. ONR noted that although the choice of methodology should be substantiated, this should not be confused with PSA assumptions and should therefore be recorded separately to the log of assumptions.

61 Overall, in terms of licensing NNB GenCo has provided sufficient assurance over the adequacy of its control of the PSA model, documentation and assumptions for PCSR2.

[2] The family PSA programme, referred to in this report has since be renamed the Common Operating PSA.

[3] The family PSA programme is a proposed programme to develop a generic core PSA that will form the starting point of Flamanville 3 and Hinkley Point C PSAs.

Although a number of areas for improvement were identified I do not consider that these should prevent a nuclear site licence being granted as NNB GenCo is aware of the shortfalls and is taking appropriate action to address these. ONR will continue to engage with NNB GenCo to monitor and encourage progress in all of the areas discussed above.

4.3.1.8 Hold point control process

62 The hold point control process, including initial primary and secondary hold points, has been reviewed and also discussed during the interventions outlined in Table 2. Generally, in terms of PSA, the hold points and the process appear sufficient for NNB GenCo to adequately control the build of Hinkley Point C. ONR expectation is that suitable and sufficient PSA is required as an enabler to release a hold point (via adequate safety justification).

63 Based on the interventions, NNB GenCo recognises some of the challenges in the use of PSA within the hold point control process, for example:

- Timing of PSA in this process is very important to de-risk the project.
- There is a need to anticipate the work to address the gaps in the current PSA model in a timely manner in order to adequately support a specific hold point.

ONR's expectation is that this should be addressed in a comprehensive and detailed programme to develop PSA to support construction.

64 Overall, no issues as regards the hold point process have been noted for licensing, but this is a key area for future early engagement. As part of the permissioning strategy ONR will sample the use of PSA within the relevant enablers to release hold points.

4.3.1.9 Summary

65 The PSA is recognised by NNB GenCo and ONR as a challenging area in the new build programme, partly as a result of:

- input from and to many areas – this requires a clear strategy and detailed plan;
- uncertainty from the GDA position (design is not currently fixed, and documentation and model are not up-to-date); and
- family PSA developed in parallel.

However, based on the interventions to date, NNB GenCo has taken the initiative to identify shortfalls early and has taken steps to attempt to address these. Furthermore, the relationship with the Architect Engineer appears positive.

66 For the point in time in the overall build programme, implementation of NNB GenCo's processes and procedures within the PSA workstream generally appears adequate, and NNB GenCo has provided sufficient assurance on its capability to manage and develop a suitable and sufficient PSA.

67 In terms of NNB GenCo's competence and capability in the PSA workstream no issues have been identified that preclude me recommending ONR to grant a nuclear site licence for NNB GenCo to install and operate two EPR™ units at Hinkley Point C.

4.3.2 Safety report

68 The following subsections summarises my assessment and findings of NNB GenCo's safety substantiation. As stated in ONR's licensing intervention strategy, for the purpose of granting a licence ONR agreed that NNB GenCo's nuclear site licence application

dossier need not include a site specific PCSR. Given this, only very limited aspects of the site specific PCSR have been delivered to ONR; this is also true of PSA. In line with the licensing strategy (Ref. 6) my assessment has been of the following two aspects from a PSA perspective:

- 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.

69 I have sampled both a number of the early batch submissions, where relevant to PSA, in line with ONR's expectations (Ref. 12), and a number of PCSR2 PSA supporting references where produced and shared with ONR. The outcome of this is summarised in the following subsections.

70 A detailed assessment against TAG 030 (PSA – Ref. 3) was not considered appropriate at this stage as the batches were presented in isolation of the PSA and relevant documentation, and these are not anticipated or expected until post licensing. Confidence can be gained at this stage from the fact that no PSA issues were raised as part of the GDA PSA step 4 assessment (Ref. 31) and that the site specific PSA is based on this PSA. Furthermore, the following broad conclusions were raised in the GDA PSA step 4 report (Ref. 31):

- The scope of the PSA includes internal faults, internal and external hazards, all operating states and reasonable allowances for maintenance and test. It also includes all significant sources of radioactivity. This is considered adequate for GDA.
- The PSA is an adequate representation of the design described in the GDA submissions and it is clear that the PSA has been used to inform the development of the design.
- Integration of the level 1 and level 2 PSA models is a strength of the analysis.
- The PSA results presented by EDF and AREVA meet the Basic Safety Objectives (BSO) of Targets 7, 8 and 9 from NT.1 of the SAPs (Ref. 2).

71 A detailed PSA assessment will not be carried out until after PCSR2 is published in late 2012. Notwithstanding this, I consider the above conclusions to remain applicable for this point in time.

4.3.2.1 Early batches

72 ONR expects relevant sections or chapters of the PCSR to be developed sufficiently to support licence granting, notably around confirmation that the site specific parameters are bounded by the GDA design envelope, with appropriate arrangements in place to address any discrepancies.

73 In terms of batches 1.1 and 1.2 I have sampled the following documents[4] from the perspective of PSA (Ref. 15):

- Attachment 1, PCSR2 Subchapter 2.1, site description and data

[4] Other documents from this batch were not sampled as they were not considered directly relevant in terms of the PSA workstream.

- Attachment 2, PCSR2 Subchapter 2.2, verification of bounding character of GDA site envelope
- Attachment 3, Hinkley Point: the probability of a loss of offsite power to the C power station
- Attachment 4, frequency of loss of offsite power (LOOP) for use in the HPC PCSR PSA
- Attachment 5, aircraft impact risk frequencies considered for LOOP, LUHS and PSA level 3 releases
- Attachment 6, evaluation of dispersion for accidental radiological consequences assessment
- Attachment 23, clogging and in situ growth by marine organisms – evaluation of risk at Hinkley Point C Power Station

74 I have also considered the following batches:

- Batch 3.1, site is of sufficient size (Ref. 13)
- Batch 5, adequate cooling – normal and fault (Ref. 14)

75 A number of comments were raised in relation to these batches that are summarised in Table 4 of this report. Furthermore, I attended specific level 4 meetings in relation to Batch 3.1 (Ref. 29) and Batch 5 (Ref. 44), and NNB GenCo has provided a written response (Ref. 45) to each of the licensing related comments, which are summarised in Table 4.

76 In terms of the level 3 PSA, it is not possible to confirm that the site specific parameters are bounded by the GDA design envelope because parameters such as the atmospheric stability category that are limiting for one pathway (e.g. inhalation) and one endpoint (e.g. individual risk) will not be limiting for another pathway (e.g. food contamination) and another endpoint (e.g. collective risk). It is therefore only possible to show that the outcomes of the modelling assessments are largely conservative overall. Furthermore, only the modelling once activity has been released to the environment has been examined at this stage. The choice of faults or the size of the resultant source terms has not been considered; this will be examined as part of permissioning. Subject to the above constraints and having sampled the relevant documents, and also given the presentations made by NNB GenCo in level 4 meetings, there appear to be no significant issues and the scope and content for licence granting purposes appears adequate.

77 In terms of NNB GenCo's responses to the queries raised, I consider these to be adequate for nuclear site licensing; any outstanding issues can be dealt with as part of permissioning. Table 4 includes a summary of the status of each comment and an assessment of their adequacy.

78 Based on the documents from the batches that I have sampled, NNB GenCo's response to the queries raised and discussions at the relevant level 4 meetings I consider that NNB GenCo's claims and arguments are sufficient to support nuclear site licensing. NNB GenCo has considered the Hinkley Point C site specific parameters, compared these with the GDA design envelope and, where possible, shown them to be either bounded by the GDA design envelope or is taking appropriate action where found not to be bounded.

79 Overall, from the perspective of PSA, I consider the scope and content of the batches to be adequate in terms of nuclear site licensing given the point of time in the overall

programme. Notwithstanding this, further detailed assessment of all aspects of the PSA will be carried out to support permissioning.

4.3.2.2 PCSR2 PSA supporting documentation

80 Only a limited number of PCSR2 supporting documents have been produced and shared with ONR to date, with the vast majority planned to be submitted with PCSR2 in late 2012. This section presents the outcome of a preliminary assessment of the documentation produced and shared on the following areas:

- hazards screening methodology
- seismic PSA strategy
- level 3 PSA

81 In terms of the hazard screening methodology NNB GenCo has shared its draft methodology (Ref. 38) and discussed this and the preliminary results at the September 2011 level 4 meeting (Refs. 22 and 37). I carried out a preliminary review the hazard screening methodology against relevant parts of TAG 030 (Ref. 3) and the IAEA level 1 PSA specific safety guide (SSG-3) – Ref. 5. From this the following were noted:

- Based on the draft information, it appears that the list of internal and external hazards is reasonable, and the approach and criteria for the screening of hazards is reasonable and justified.
- Screening regarding combination of hazards appears to be only based on those hazards screened in – it should be based on a complete list of hazards (including those screened out).
- The assumptions made to screen out hazards should be clearly identified in the PSA documentation and a process should be put in place to ensure that the relevant assumptions are captured in future development of hazard protection strategies and procedures, etc.
- The list of hazards that needs to be included in the PSA as per GDA assessment finding AF-UK EPR-PSA-032 (Ref. 31) is quite onerous. ONR expectation is for the point in time in the safety case production when PSA is required will be identified and justified in the final screening methodology document, to be produced to support PCSR2.

NNB GenCo provided sufficient assurance that the above areas will be fully considered and where necessary addressed in its forward work programme (post licensing). I will continue to engage with NNB GenCo to ensure that its approach is adequate.

82 Overall I consider that NNB GenCo has made reasonable progress in hazards screening, and there are no significant issues as regards nuclear site licensing. Notwithstanding this, and given only a preliminary assessment of draft documentation has been carried out, a more detailed assessment against TAG 030 will be carried out following submission of PCSR2 as part of permissioning.

83 NNB GenCo has produced a seismic PSA strategy (Ref. 39) for Hinkley Point C. This concluded that an integrated seismic PSA will be produced, and its development will be staged throughout the permissioning stages of Hinkley Point C. Based on a preliminary review of this strategy and discussion at the January 2012 PSA level 4 meeting (Ref. 26) I consider that this approach should be able to meet ONR expectations as set out in the relevant SAPs and TAG 030, and also address the relevant GDA finding (AF-UK EPR-PSA-037 – Ref. 31). In terms of nuclear site licensing, NNB GenCo has made adequate

progress in this area. However, I will continue to engage with NNB GenCo as part of permissioning to better understand how the strategy is to be implemented (technically, i.e. the detailed approach, and timescales to ensure the seismic PSA is adequately developed to support relevant design and procurement decisions).

84 In terms of level 3 PSA NNB GenCo has produced the following supporting documents:

- methodology for UK societal risk level 3 PSA (Ref. 40)
- worker risk methodology (Ref. 41)
- methodology for assessing worker risk for the UK EPR™ worker release categories (Ref. 42)
- preliminary worker risk assessment for the UK EPR™ (Ref. 43)

85 There were no Issues arising from GDA (Ref. 31), and it was concluded that although the level 3 PSA was not state of the art, in view of the assurance provided by the correspondence between the numerical outcomes and those from independent calculations performed for ONR (as part of GDA – Ref. 31), it was considered adequate for the purposes of GDA. However, the following GDA Finding was raised:

- The licensee should ensure that the level 3 PSA is developed to modern standards, in particular by placing less reliance on design basis dose assessments and by fully incorporating probabilistic factors such as weather. For each new plant the site-specific level 3 PSA will need to incorporate site specific source term and release frequency analyses together with site specific dispersion and consequence modelling parameters (such as weather data and distribution of population and agriculture) for all releases.

A milestone for this finding of fuel load was stated in the EPR™ GDA PSA step 4 report (Ref. 31). It is the output from the level 3 PSA that permits comparison of the proposed design with the numerical targets in the SAPs. As explained in paragraph 70, it will be much further on in the design process that site specific radiological consequences are quantified. However, the consequences assessed during the GDA process using generic site parameters were at or about the numerical values for the BSOs, giving a substantial degree of confidence that two EPR™ units can be installed and operated at Hinkley Point C. The fuel load milestone is much later than nuclear island safety related concrete applicable to other areas of PSA. Notwithstanding this the licence applicant, NNB GenCo, has developed assessment substantially beyond that which was provided by the Requesting Parties, in particular as detailed in the documents referenced above (Refs. 40 to 43). As these are still under development I have only carried out a preliminary assessment of these, however this has been sufficient to give me confidence that NNB GenCo is making adequate progress against its plan for PCSR2, and has, and is applying, sufficient SQEP resources. The proposals are consistent with the SAPs and with the guidance given in TAG 45 (Ref. 3).

4.3.2.3 Summary

86 I have reviewed a number of documents submitted to ONR as part of the early batches, relevant to the PSA workstream and also carried out a preliminary assessment of a small sample of PCSR2 PSA supporting references.

87 Based on this assessment I consider that these documents are adequate in terms of their scope and content for nuclear site licensing purposes. A number of queries have been raised with NNB GenCo during this assessment that have been adequately addressed for

licensing. I consider that any outstanding issues can be dealt with from a permissioning perspective.

88 No issues have been identified that preclude recommending granting a nuclear site licence.

4.3.3 Actions raised in level 4 interactions

89 Table 3 summarises all actions that have been raised within the PSA workstream level 4 meetings and remain open (July 2012). I do not consider that any of these actions are licensing issues and their closure will be progressed with NNB GenCo on permissioning timescales.

90 Overall, NNB GenCo has generally made adequate progress in addressing actions raised during interventions with ONR within the PSA workstream.

5 CONCLUSIONS AND RECOMENDATIONS

5.1 Conclusions

91 This report presents the findings of the ONR PSA workstream assessment of NNB GenCo's application, supporting information and arrangements for a nuclear site licence at Hinkley Point C. This assessment supports ONR's decision whether to grant a nuclear site licence, or not, for NNB GenCo to install and operate two EPR™ units at Hinkley Point C.

92 This report has been produced in line with ONR's overall licensing strategy (Ref. 6) and the PSA IPR: NNB-HPC1-IPR16 (Ref. 7). It informs both ONR's organisational capability intervention, and safety report and the associated substantiation intervention from ONR's licensing strategy.

93 Based on the interventions carried out and preliminary assessment of available documentation, and taking account of the point in time in the build programme, the following key conclusions are made in terms of nuclear site licensing:

- NNB GenCo's PCSR2 PSA strategy is capable of producing a PSA that should meet ONR PSA expectations for PCSR2 as set out in SAPs FA.10 to FA.14 and ONR TAG 030.
- NNB GenCo has made adequate progress in developing PSA arrangements, particularly relating to development of suitable and sufficient PSA, and use of PSA in risk informed design.
- NNB GenCo is taking appropriate action to ensure adequate oversight of the PSA deliverables, especially those produced outside NNB GenCo.
- NNB GenCo currently has an adequate relationship with the Architect Engineer.
- NNB GenCo's PSA SQEP arrangements require further development as they are too high level. However, as I currently consider there to be SQEP staff in PSA within NNB GenCo and the Architect Engineer, I do not consider this to be a significant shortfall for licensing.
- I do not consider that there are any significant issues relating to NNB GenCo's control of the PSA programme.
- NNB GenCo has provided sufficient assurance over the adequacy of its control of the PSA model, documentation and assumptions for PCSR2.
- No issues as regards the hold point process have been noted, but this is a key area for future early engagement.

94 In terms of NNB GenCo's competence and capability in the PSA workstream area, no significant issues have been identified that preclude me recommending ONR to grant a nuclear site licence for NNB GenCo to install and operate two EPR™ units at Hinkley Point C. I therefore conclude, based on the PSA workstream, that NNB GenCo's arrangements appear adequate to manage nuclear safety for the point in time at which the nuclear site licence is to be granted.

95 I have also reviewed a number of documents submitted to ONR as part of the early batches, relevant to the PSA workstream, and also carried out a preliminary assessment of a small sample of PCSR2 PSA supporting references. Based on this assessment I consider that these documents are adequate in terms of their scope and content for nuclear site licensing purposes. A number of queries have been raised with NNB GenCo

during this assessment that have been adequately addressed for licensing. Any outstanding issues can be dealt with from a permissioning perspective. It is therefore concluded, based on the PSA workstream:

- NNB GenCo has demonstrated that there is a high level of confidence that the Hinkley Point C site can support the licensable activity.
- 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.

96 It is noted that some of the areas above are still being developed and ONR will continue to engage with NNB GenCo to monitor and encourage progress in these areas and indeed all other areas of work referred to in this report.

5.2 Recommendations

97 My recommendation is as follows:

- From the perspective of the PSA workstream I recommend that ONR should grant a nuclear site licence to NNB GenCo to install and operate two EPR™ units at Hinkley Point C.

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Table 1

Relevant Safety Assessment Principles considered during the assessment

SAP No.	SAP Title	Description
FA.10	Fault analysis: PSA – Need for PSA	Suitable and sufficient PSA should be performed as part of the fault analysis and design development and analysis.
FA.11	Fault analysis: PSA – Validity	PSA should reflect the current design and operation of the facility or site.
FA.12	Fault analysis: PSA – Scope and extent	PSA should cover all significant sources of radioactivity and all types of initiating faults identified at the facility or site.
FA.13	Fault analysis: PSA – Adequate representation	The PSA model should provide an adequate representation of the site and its facilities.
FA,14	Fault analysis: PSA – Use of PSA	PSA should be used to inform the design process and help ensure the safe operation of the site and its facilities.
NT.1	Numerical targets and legal limits - Assessment against targets	A safety case should be assessed against numerical targets and legal limits for normal operation, design basis faults, and radiological accident risks to people on and off the site.
NT.2	Numerical targets and legal limits – Time at risk	There should be sufficient control of radiological hazards at all times.

Table 2

Interventions carried out related to the PSA topic

Date	Topic	Intervention report/notes TRIM reference
16 March 2011	Level 4 Site Specific PSA Kick-Off Meeting	2011/222178
3 May 2011	Level 4 – PSA Progress Meeting (teleconference)	2011/254104
13 June 2011	PSA progress teleconference meeting	2011/321467
4 July 2011	Level 4 – PSA Progress Meeting (teleconference)	2011/401497
1 August 2011	PSA teleconference keep-in-touch meeting	2011/436385
1 September 2011	Level 4 PSA programme progress meeting	2011/468307
3 October 2011	PSA progress teleconference meeting	2011/505602
17 October 2011	Level 4 level 3 PSA progress meeting (teleconference)	2012/297852
7 November 2011	Level 4 PSA progress meeting	2011/619606
5 December 2011	Level 4 – PSA Progress Meeting (teleconference)	2011/619606
27 January 2012	Level 4 PSA progress meeting	2012/82428
5 March 2012	PSA progress keep-in-touch teleconference	2012/119757
12 March 2012	Tripartite Grid connection meeting with EDF NNB Genco and National Grid Electricity Transmission	2012/164782
23 March 2012	Level 4 Meeting – PCSR2 Batch 3 – Justification that the Site is of Sufficient Size	2012/139220
26 March 2012	Level 4 PSA progress meeting	2012/144865
8-9 May 2012	PSA licensing intervention at the Qube	2012/224137

Table 2

Interventions carried out related to the PSA topic

Date	Topic	Intervention report/notes TRIM reference
11 June 2012	PSA progress keep-in-touch teleconference	N/A
11 July 2012	Level 4 PSA programme progress meeting	2012/293278
17 July 2012	Level 4 meeting: PCSR2 Early Submission Batch 5 - Heat Sink Summary Document	2012/296241

Table 3

Outstanding PSA actions as of July 2012[5]

Action ID	Action	Status
1070-EDF	Check whether there is OPEX from SZB/French fleet concerning "unexpected" doses to maintenance workers or other accidental doses (e.g. over-exposures). Consider whether personal contamination needs to be included in the Worker Risk Methodology and provide justification within the Worker Risk Methodology Document.	This has been discussed during the level 4 PSA meetings. ONR have agreed to provide clarity to NNB GenCo. Progress is considered adequate for licensing.
1135-EDF	Provide ONR with a summary of the expected developments by Areva that are identified for the US EPR™ L2 PSA model, to be considered for incorporation for UK EPR™.	NNB GenCo is waiting for a response from AREVA USA. Progress is considered adequate for licensing.
1204-EDF	NNB GenCo to carry out sensitivity analyses to the assumed very long (>24 hrs) LOOP frequency and the mission time of the very long LOOP, and share the results of this including insights with ONR.	NNB GenCo is waiting for a response to a GDA Technical Query. The action also relates to a comment on the early batches (see comment 2 in Table 4). Progress is considered adequate for licensing.
1327-EDF	NNB GenCo should share the overall "back-fitted" PSA quality plan and surveillance plan with ONR as part of the PCSR2 submission.	Permissioning action; therefore, progress is considered adequate for licensing.
1328-EDF	NNB GenCo should develop and maintain an overall PSA quality plan and surveillance plan in advance of commencing all future PSA work programmes. The quality plan and surveillance plan for the initial post PCSR2 programme of work, e.g. for first addenda, should be shared with ONR.	Permissioning action; therefore, progress is considered adequate for licensing.

[5] Actions tracked via TRIM 2010/613203.

Table 3

Outstanding PSA actions as of July 2012[5]

Action ID	Action	Status
1329-EDF	NNB GenCo should review the adequacy of its SQEP arrangements for the PSA specialist role taking due account of relevant practice in other areas, e.g. SQEP mentor guides within NGL, and share this review with ONR (date to be agreed), and implement any changes by 31 March 2013. NNB GenCo's initial plan for addressing this issue should be shared with ONR by 30 September 2012	Permissioning action; therefore, progress is considered adequate for licensing.
1330-EDF	NNB GenCo to ensure that there is an adequate link from relevant licence condition arrangements to use of PSA to risk inform the design. NNB GenCo should review the arrangements and share this review with ONR by 30 September 2012 and implement any changes by 31 March 2013	Permissioning action; therefore, progress is considered adequate for licensing.
1331-EDF	NNB GenCo should provide information on the measures adopted to ensure intelligent customer capability (e.g. provide sufficient assurance to ONR that NNB GenCo has adequate understanding of the interim PSA model, and supporting documentation and studies) and has adequate capability (e.g. competent resources and knowledge) in place to fully support use of PSA in HPC until the development of the alternative PSA model	Permissioning action; therefore, progress is considered adequate for licensing.
1400-EDF	NNB GenCo to provide clarity on “Development of the Design” as used in the Risk Informed Design Interface Specification and the role of PSA in this. This is anticipated to be via a presentation to the next PSA Level 4 face-to-face meeting.	Permissioning action; therefore, progress is considered adequate for licensing.

Table 4

Comments on early batch submissions

Batch/Comment	Comment	NNB GenCo response	Status for licensing[6]
Batch 1.1			
1	Sub chapter 2.2 presents an assessment of the HPC site envelope against the GDA generic site envelope. However, there appears to be limited consideration of whether those hazards screened out of the GDA generic site envelope could be relevant for HPC. Notwithstanding that the scope of subchapter 2.2 states "those elements of site description or data which do not have a GDA value are not included within this bounding case assessment", I consider this chapter should have considered the screening criteria used in the GDA and whether any additional hazards (above those for GDA) would be screened in for HPC. Some discussion of the "group 3" hazards should have been included within this report to adequately justify: "the environmental conditions would not preclude the use of the site with respect to external hazards".	The complete hazard identification and screening analysis for HPC and the current hazards analysis for external hazards will be provided within Sub-Chapter 13.1 of the HPC PCSR2. This includes an explanation of the hazard identification process and an assessment of the identified hazards. This Sub-Chapter will be provided alongside the other PCSR2 documentation in accordance with our current proposed timescales of October 2012. Earlier submission of this report will not be possible in order to ensure compliance with the LC14 procedures enacted within NNB.	CLOSED – In terms of licensing I consider NNB GenCo's response to be acceptable. The adequacy of the hazards screening will be considered further once PCSR2 has been submitted.

[6] Comments raised for licensing will be considered during the development of the PSA permissioning strategy.

Table 4

Comments on early batch submissions

Batch/Comment	Comment	NNB GenCo response	Status for licensing[6]
	Therefore I consider the scope and content of the batches is not adequate in this respect.		
2	Given the increase (factor of 5) in the predicted loss of offsite power (LOOP) frequency (2-24 hours), and the dominance of LOOP in the overall core damage frequency, further substantiation of the HPC design with respect to relevant hazards is required to address "the environmental conditions would not preclude the use of the site with respect to external hazards". It is noted that an action has been placed with NNB in the electrical workstream interactions to provide a sensitivity study of the LOOP results.	The LOOP sensitivity studies will be carried out within the Generic Design Assessment (GDA). On completion they will undergo Intelligent Customer review by NNB in the Probabilistic Safety Analysis (PSA) work stream supported by the electrical work stream. The NNB response to the findings of the studies will be made available to the ONR post NSL intervention. This study is being tracked under the Level 4 meeting action 1204-EDF.	CLOSED – In terms of licensing NNB GenCo's response is considered adequate. It is noted that there is also an ongoing action related to this point (see Action 1204-EDF in Table 3).
3	The following issues have been identified that will require follow-up on permissioning timescales: 1. The basis of the hazards screening criteria. 2. The basis of the frequency for: long (greater than 24 hrs) loss of offsite power (LOOP); and loss of ultimate heat sink (LUHS).	N/A as indicated as a permissioning issue.	CLOSED – Permissioning issue; therefore, progress is considered adequate for licensing. This will be considered for including in the PSA permissioning strategy.
4	In the longer term it will be necessary for NNB to address the GDA findings in this area, however these relate to Fuel on Site not First Nuclear Concrete. The change to PC COSYMA	N/A as indicated as a permissioning issue.	CLOSED – Permissioning issue; therefore, progress is considered adequate for licensing. This will be considered for including in the PSA permissioning strategy.

Table 4

Comments on early batch submissions

Batch/Comment	Comment	NNB GenCo response	Status for licensing[6]
	will largely address this for level 3 PSA but there may be a problem for Fault Studies. I have previously stressed this to NNB. I don't believe that there is any problem meeting the numerical targets, it's a presentational point with regard to the robustness of the demonstration in a UK context.		
Batch 2.2	No comments	N/A	N/A
Batch 3.0	No comments	N/A	N/A
Batch 5			
5	I have carried out a preliminary review of batch 5. Whilst I do not believe there to be any show stoppers for granting of a nuclear site licence (from the areas I have considered), I do have a number of areas that should be followed up. It is noted that I have only reviewed the main report provided and generally not the supporting references. In terms of the requested feedback on three items: the scope and content of batch 5 (from the areas I have considered) is on balance adequate, although some discussion on the points identified to be followed up post licensing	The intent had been to align the PSA analysis and the Heat Sink summary document. Unfortunately the timing of the document production and analysis did not allow for this. The PSA values from the GDA were therefore used. The values for the LUHS initiating event now calculated in the HPC PCSR2 PSA demonstrate that the GDA value is bounding and its continued use at this stage in the Heat Sink Summary document. It should be noted that the Heat Sink as a support system has now been added into the HPC PCSR2 PSA model and therefore insights for the contribution it make due to random failures in	CLOSED – NNB GenCo's response is considered adequate for licensing.

Table 4

Comments on early batch submissions

Batch/Comment	Comment	NNB GenCo response	Status for licensing[6]
	would be helpful. However, I would anticipate that understanding NNB's position via a Level 4 discussion on Batch 5 should be sufficient for licensing and these areas will be followed up on from a permissioning perspective (post licensing).	other fault scenarios are captured. During the development of the Heat Sink PSA model, it was identified that the I&C for the protection of clogging of the drum screens and chain screens (e.g. to initiate CRF pump trip) was not adequate to support risk targets. Discussions have been ongoing with CNEPE to improve the design as a result. Following a workshop, the design changes are being taken forward. This is an example of Risk Informed Design supported by the PSA. Further discussions on the comments raised are welcomed and can be included as an agenda at the next PSA L4 meeting.	
6	It is not clear in this report what the design of the heat sink for GDA was. Given the PSA results presented are from GDA, it is important that this is explicit so that the relevance of the PSA results can be determined. NNB GenCo should also explicitly draw this out when presenting the PSA results.	The GDA did not include a specific design for the heat sink noting this is a site specific feature. Therefore the GDA PSA model made the following design assumptions in the assessment of Loss of Ultimate Heat Sink: a) The heat sink would provide four segregated trains of water to the four SEC (ESWS) pumps and two trains of water to the two SRU (UCWS) pumps. b) The diversification route to the SRU pumps was capable of supplying adequate	CLOSED – NNB GenCo's response is considered adequate for licensing.

Table 4

Comments on early batch submissions

Batch/Comment	Comment	NNB GenCo response	Status for licensing[6]
		water supplies in the event of loss of the forebay and normal water supply. The HPC design, included in the recent HPC PSA model, maintains these same features. The calculated value for Loss of Ultimate Heat Sink at HPC evaluating explicit failures within the heat sink leading to the loss of supply to four trains of SEC (and SRU for cooling to the Fuel Pond) is lower than that assumed in the GDA. The discussion on the Loss of Ultimate Heat Sink analysis presented in Sub chapter 15.2 identifies those aspects of design that are undergoing further development to improve the frequency of LUHS.	
7	The role of PSA to inform the design, and maintenance and inspection plan is unclear. This is particularly the case given reliance on the GDA PSA and the uncertainty in its relevance.	See response to comment number 5.	CLOSED – NNB GenCo's response is considered adequate for licensing.
8	The target reliability of the heat sink is based on the loss of ultimate heat sink (LUHS) frequency from GDA. However, this value in GDA is fairly arbitrary given it is based on a statistical approach for no events: chi squared approach (0.7 over time period). It therefore	See response to comment number 5. The use of the words "target reliability" is slightly misleading. It has not been used in any specifications to designers or manufacturers. It was used in the interim until the HPC specific	CLOSED – NNB GenCo's response is considered adequate for licensing.

Table 4

Comments on early batch submissions

Batch/Comment	Comment	NNB GenCo response	Status for licensing[6]
	appears inappropriate to use such a target reliability if it is being used to inform the HPC design, as it has little basis.	value was available for internal DIN checks that the proposed design would not exceed the value. Although the heat sink design for HPC had been developed when the Heat Sink Summary Document was produced, the HPC PSA model for heat sink was not completed and the GDA PSA value was used as a bounding position. Now the more detailed HPC PSA model is available, this will be used to confirm the proposed design is suitable and where not will be used to iterate to the optimised design for the heat sink. This iterative process is already evident in the identification and redesign associated with the head loss and level sensors within the CFI system.	
9	Given I'm aware that HPC specific LUHS PSA work is being carried out by NNB GenCo, I find it strange that this work hasn't been drawn on to support this report. I note that this is referred to in the report and captured as item number 12 in the ongoing items. However, given the large contribution of LUHS to the core damage frequency (CDF), I find it surprising that this study was not completed in parallel to this design development. Indeed a key aspect of ONR's SAPs in relation to PSA are SAPs FA.10 and FA.14 (FA.10: "Suitable and sufficient PSA	See response to comment number 5.	CLOSED – This has been discussed during the level 4 meetings. I consider the basis for not doing this at this stage to be acceptable. This will be examined once PCSR2 has been submitted. Response is considered adequate for licensing.

Table 4

Comments on early batch submissions

Batch/Comment	Comment	NNB GenCo response	Status for licensing[6]
	should be performed as part of the fault analysis and design development and analysis"; and FA.14: "PSA should be used to inform the design process and help ensure the safe operation of the site and its facilities"), which do not appear to have been met. I would like to understand the interaction between the PSA team and the development of the heat sink design to ensure suitable and sufficient PSA is being used to inform the design.		
10	Given the uncertainty in the LUHS frequency, NNB GenCo should have provided a sensitivity study, including consideration of the dominant fault sequences and cutsets. This sensitivity study should also inform the simple quantitative ALARP analysis presented in Appendix H, as this is based on the arbitrary LUHS frequency from GDA. Notwithstanding the uncertainty in the quantitative ALARP analysis, I do not consider the conclusions from it would change.	See response to comment number 5.	CLOSED – This has been discussed during the level 4 meetings. I consider the basis for not doing this at this stage to be acceptable. This will be examined once PCSR2 has been submitted. Response is considered adequate for licensing.
11	The approach to ALARP does not appear to be fully consistent with ONR expectations, in that consideration of options should start from the safest option and that option which reduces risk the most and is considered reasonably practicable should be implemented.	Discussed at 17 July 2012 level 4 meeting (Ref. 44). NNB GenCo agreed to provide a clearer summary of its optioneering approach, including a summary of all options considered, including those ruled out and alternative ultimate heat sinks.	CLOSED – NNB GenCo has provided sufficient assurance for licensing. This will therefore continue to be followed up on permissioning timescales.

Table 4

Comments on early batch submissions

Batch/Comment	Comment	NNB GenCo response	Status for licensing[6]
	Furthermore, there does not appear to be any discussion of relevant good practice in the design of open heat sinks. For example what is the practice worldwide in terms of redundancy in the design? This should be the starting point. Notwithstanding this, some of the aspects of the decision making are summarised well.		
12	In terms of the justification that there is "adequate cooling capability for all normal and fault conditions", I do not consider that the issues I have raised undermine this claim. However, they may be considered indicative of the capability of the potential licensee. So although I do not consider them to be show stoppers for granting of a nuclear site licence, I feel them worthy of some discussion at a Batch 5 Level 4 meeting.	Noted.	CLOSED – discussed in this report.