



New Reactor Division – Generic Design Assessment
Step 2 Assessment of the Probabilistic Safety Analysis of the UK HPR1000 Reactor

Assessment Report ONR-GDA-UKHPR1000-AR-18-008
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EXECUTIVE SUMMARY

This report presents the results of my probabilistic safety analysis (PSA) assessment of the UK HPR1000 undertaken as part of Step 2 of the Office for Nuclear Regulation's (ONR) Generic Design Assessment (GDA).

The GDA process calls for a step-wise assessment of the Requesting Party's (RP) safety submission with the assessments increasing in detail as the project progresses. Step 2 of GDA is an overview of the acceptability, in accordance with the regulatory regime of Great Britain, of the design fundamentals, including ONR's review of key nuclear safety and nuclear security claims (or assertions). The aim is to identify any fundamental safety or security shortfalls that could prevent ONR from permitting the construction of a power station based on the design.

During GDA Step 2 my work has focused on the assessment of the PSA aspects within the UK HPR1000 Preliminary Safety Report (PSR), and a number of supporting references and supplementary documents submitted by the RP, focusing on design concepts and claims.

The standards I have used to judge the adequacy of the RP's submissions in the area of PSA have been primarily ONR's Safety Assessment Principles (SAPs), in particular SAPs FA.10, FA.11, FA.12, FA.13 and FA.14, and ONR's PSA Technical Assessment Guide NS-TAST-GD-030.

My GDA Step 2 assessment work has involved regular engagement with the RP in the form of technical exchange workshops and progress meetings, including meetings with the plant designers. I have also reviewed some aspects of the PSA documentation produced for the Chinese reference plant design, Fangchenggang Unit 3 (FCG3), as an input to my assessment.

The UK HPR1000 PSR is primarily based on the reference design, FCG3, which is currently under construction in China. Thus, I have assessed PSA documentation based on the reference design, FCG3, and not the UK HPR1000 PSA because the UK HPR1000 PSA is still under development. Key aspects of the UK HPR1000 preliminary safety case related to PSA, as presented in the PSR, its supporting references and the supplementary documents submitted by the RP, can be summarised as follows:

- The FCG3 PSA models include the Level 1 PSA for operation modes at power, shutdown and low power, the spent fuel pool PSA, internal fire PSA, internal flooding PSA and Level 2 PSA, and have followed methods to create the PSA models that meet ONR expectations. The UK HPR1000 PSA models are expected to follow similar methods and have a similar PSA scope.
- The FCG3 PSA results indicate that the risks of the FCG3 design are understood and the ONR numerical targets would be met. As the UK HPR1000 design is based on the FCG3 design, the RP claims that it has confidence that the UK HPR1000 PSA will similarly demonstrate the risk to the public associated from the design and will demonstrate that the ONR numerical targets are met.
- The FCG3 PSA has been used to understand the risks from the design and to modify the design where necessary to lower the level of risk. The RP has established an approach whereby the UK HPR1000 PSA will be used to support the design of the UK HPR1000 and where necessary to help justify modifications to the design to lower the level of risk.
- Although the UK HPR1000 PSA model has not been submitted during Step 2, the FCG3 PSA model results were submitted in order to help share confidence, as the UK HPR1000 design is similar to the reference design (FCG3).

During my GDA Step 2 assessment of the UK HPR1000 aspects of the safety case related to PSA I have identified the following areas of strength:

- The RP has established a strategy and programme to develop a full scope Level 1 and Level 2 PSA for the UK HPR1000 aligned to UK regulatory expectations.
- The FCG3 PSA appears to follow international good practices. Although I have not assessed this in detail as part of my assessment, this provides confidence moving forward in GDA.
- The RP PSA team have demonstrated a good understanding of what will be required to produce a PSA that meets UK regulatory expectations.
- The FCG3 PSA results show that the level of risk presented by the reference design is low, although further evidence will be needed to substantiate this. As the design of the UK HPR1000 is similar to the reference design I would expect the RP will be able to demonstrate that the level of risk presented by the UK HPR1000 design is similarly low.

During my GDA Step 2 assessment of the UK HPR1000 aspects of the safety case related to PSA I have identified the following areas that require follow-up:

- the validity of the Chinese nuclear power plant operational experience for use in the UK;
- the RP's approach to the screening, bounding and grouping of initiating events;
- the RP's screening methodology for hazards;
- the human reliability assessment screening methodology to be applied for the UK;
- the approach, content and timeframe for submission of the assessment of seismic risk, such as in a seismic PSA;
- the implementation of the approach developed by the RP to use PSA to support the UK HPR1000 design process; and
- the detailed comparison of the UK HPR1000 PSA results with the ONR Safety Assessment Principle (SAP) numerical targets.

During my GDA Step 2 assessment, I have not identified any fundamental safety shortfalls in the area of PSA that might prevent the issue of a Design Acceptance Confirmation (DAC) for the UK HPR1000 design.

LIST OF ABBREVIATIONS

ALARP	As Low As Reasonably Practicable
BMS	Business Management System
BSL	Basic Safety Level (in SAPs)
BSO	Basic Safety Objective (in SAPs)
CDF	Core Damage Frequency
CGN	China General Nuclear Power Corporation
C&I	Control & Instrumentation
DAC	Design Acceptance Confirmation
DBA	Design Basis Analysis
EA	Environment Agency
EDF	Électricité de France
FCG3	Fangchenggang Unit 3
GDA	Generic Design Assessment
GNI	General Nuclear International
GNS	Generic Nuclear System Ltd
HEP	Human Error Probability
HF	Human Factors
HRA	Human Reliability Analysis
IAEA	International Atomic Energy Agency
IE	Initiating Event
LRF	Large Release Frequency
NPP	Nuclear Power Plant
ONR	Office for Nuclear Regulation
OPEX	Operational Experience
PCSR	Pre-construction Safety Report
PIE	Postulated Initiating Event
PSA	Probabilistic Safety Analysis
PSR	Preliminary Safety Report (includes security and environment)

RGP	Relevant Good Practice
RP	Requesting Party
RQ	Regulatory Query
RY	Reactor Year
SAP(s)	Safety Assessment Principle(s)
SFP	Spent Fuel Pool
SRL	Safety Reference Level
TAG	Technical Assessment Guide(s)
TSC	Technical Support Contractor
WENRA	Western European Nuclear Regulators' Association

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Table 1: Relevant Safety Assessment Principles Considered During the Assessment

1 INTRODUCTION

1. The Office for Nuclear Regulation's (ONR) Generic Design Assessment (GDA) process calls for a step-wise assessment of the Requesting Party's (RP) safety submission with the assessments increasing in detail as the project progresses. General Nuclear System Ltd (GNS) has been established to act on behalf of the three joint requesting parties (China General Nuclear Power Corporation (CGN), Électricité de France (EDF) and General Nuclear International (GNI)) to implement the GDA of the UK HPR1000 reactor. For practical purposes GNS is referred to as the 'UK HPR1000 GDA Requesting Party'.
2. During Step 1 of GDA, which is the preparatory part of the design assessment process, the RP established its project management and technical teams and made arrangements for the GDA of the UK HPR1000 reactor. Also, during Step 1 the RP prepared submissions to be assessed by ONR and the Environment Agency (EA) during Step 2.
3. Step 2 commenced in November 2017. Step 2 of GDA is an overview of the acceptability, in accordance with the regulatory regime of Great Britain, of the design fundamentals, including ONR's assessment of key nuclear safety and nuclear security claims (or assertions). The aim is to identify any fundamental safety or security shortfalls that could prevent ONR permitting the construction of a power station based on the design.
4. My assessment has followed my GDA Step 2 Assessment Plan for Probabilistic Safety Analysis (PSA) (Ref. 1) prepared in October 2017 and shared with RP to maximise openness and transparency.
5. This report presents the results of my PSA assessment of the UK HPR1000 as presented in the UK HPR1000 Preliminary Safety Report (PSR) (Ref. 2) and its supporting documentation (Refs 3 to 14).

2 ASSESSMENT STRATEGY

6. This section presents my strategy for the GDA Step 2 assessment of the PSA aspects of the UK HPR1000 (Ref. 1). It also includes the scope of the assessment and the standards and criteria I have applied.

2.1 Scope of the Step 2 PSA Assessment

7. ONR's Safety Assessment Principles (SAPs) (see Section 2.2) require the risks arising from nuclear facilities during fault conditions to be assessed using three techniques: design basis analysis (DBA), probabilistic safety analysis (PSA), and severe accident analysis (SAA). This GDA Step 2 PSA assessment for the UK HPR1000 focuses on PSA.
8. The objective of my GDA Step 2 assessment was to assess relevant design concepts and claims made by the RP related to PSA. In particular, my assessment has focused on the following:
- confirming whether the claims related to PSA that underpin the safety of the UK HPR1000 are complete and reasonable in the light of ONR's understanding of the reactor technology;
 - reviewing the scope of the PSA to confirm whether it covers all significant sources of radioactivity, all relevant initiating events, and all modes of operation;
 - reviewing the PSA data used for the PSR to confirm whether it meets relevant good practice (RGP); and
 - reviewing the PSA methodologies used to create the various models to confirm whether they meet modern standards and RGP.
9. During GDA Step 2 I have also evaluated whether the safety claims related to PSA are supported by a body of technical documentation sufficient to allow me to proceed with GDA work beyond Step 2.
10. Finally, during Step 2 I have undertaken the following preparatory work for my Step 3 assessment:
- increased familiarisation with the UK HPR1000 design to provide a basis for planning subsequent, more detailed, assessment during Steps 3 and 4 of GDA;
 - I have started discussion with the RP on a programme of submission in the area of PSA for Steps 3 and 4 of the GDA; and
 - I have begun to hold technical discussions with the RP on some of the areas of the PSA model that should be further developed during GDA (e.g. dormant or stand-by system modelling, assessment of seismic risk, etc.).

2.2 Standards and Criteria

11. For ONR, the primary goal of the GDA Step 2 assessment is to reach an independent and informed judgment on the adequacy of a preliminary nuclear safety and security case for the reactor technology being assessed. Assessment was undertaken in accordance with the requirements of the Office for Nuclear Regulation (ONR) How2 Business Management System (BMS) guide NS-PER-GD-014 (Ref. 15).
12. In addition, the SAPs (Ref. 16) constitute the regulatory principles against which duty holders' and RPs' safety cases are judged. Consequently the SAPs are the basis for ONR's nuclear safety assessment and have therefore been used for the GDA Step 2 assessment of the UK HPR1000. The SAPs 2014 Edition is aligned with the International Atomic Energy Agency (IAEA) standards and guidance.

13. Furthermore, ONR is a member of the Western European Nuclear Regulators Association (WENRA). WENRA has developed Reference Levels, which represent good practices for existing nuclear power plants, and Safety Objectives for new reactors.
14. The relevant SAPs, IAEA standards and WENRA Reference Levels are embodied and expanded on in the Technical Assessment Guide (TAG) on PSA (Ref. 17). This guide provides the principal means for assessing the PSA aspects in practice.

2.2.1 Safety Assessment Principles

15. The key SAPs (Ref. 16) applied within my assessment are SAPs FA.10, FA.11, FA.12, FA.13 and FA.14 (see also Table 1 for further details).

2.2.2 Technical Assessment Guides

16. The following Technical Assessment Guide has been used as part of this assessment (Ref. 18):

- ND-TAST-GD-030 – Probabilistic Safety Analysis

2.2.3 National and International Standards and Guidance

17. The following national and international standards and guidance have been considered as part of this assessment:

- Relevant IAEA standards (Ref. 18)
 - SSG-3 – Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants
 - SSG-4 – Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants
 - INSAG-9 – Potential Exposure in Nuclear Safety
- WENRA references (Ref. 19)
 - Safety Reference Levels (SRLs) 14, Issue O: Probabilistic Safety Analysis (PSA)

2.3 Use of Technical Support Contractors

18. During Step 2 I have not engaged Technical Support Contractors (TSCs) to support the assessment of the PSA for the UK HPR1000.

2.4 Integration with Other Assessment Topics

19. Early in GDA, I recognised the importance of working closely with other inspectors (including Environment Agency's inspectors) as part of the PSA assessment process. Similarly, other assessors sought input from my assessment of the PSA for the UK HPR1000. I consider these interactions are key to the success of the project in order to prevent or mitigate any gaps, duplications or inconsistencies in ONR's assessment. From the start of the project, I have endeavoured to identify potential interactions between the PSA and other technical areas, with the understanding that this position will evolve throughout the UK HPR1000 GDA.
20. The key interactions I have identified are:

- Human factors (HF): provides input to the human reliability analysis aspects of the PSA assessment. This formal interaction has commenced during GDA Step 2 (e.g. assessment of Ref. 9 – the Human Reliability Analysis (HRA) methodology). This work is being led by the PSA Inspector in coordination with the HF team.
- Fault studies: provides input to the Design Basis Assessment (DBA) aspects of the PSA assessment. This formal interaction has commenced during GDA Step 2 (e.g. Ref. 20). This work is being led by the PSA Inspector in coordination with the fault studies team.
- Structural integrity: provides input to the assessment of the containment structural analysis for the Level 2 PSA. This formal interaction has not commenced during GDA Step 2, but will begin during Step 3. Structural integrity will also provide input to the assessment of the external hazards PSA; this area of work will be led by the external hazards assessment team with input from the structural integrity team and in coordination with the PSA team.
- Civil engineering: provides input to the assessment of the containment structural analysis for the level 2 PSA regarding fragilities of structures. This formal interaction has not commenced during Step 2, but will begin during Step 3. This assessment task will be led by the civil engineering team in coordination with the PSA team.
- Internal hazards: provides input to the internal hazards Level 1 PSA. This formal interaction has commenced during Step 2. This assessment task is being led by the internal hazards team in coordination with the PSA team.
- External hazards: provides input to the external hazards PSA regarding definition of hazards' magnitudes and frequencies. This formal interaction has commenced during Step 2. This assessment task is being led by the external hazards team in coordination with the PSA team.
- Radiological protection: provides input to the assessment of the Level 3 PSA. This formal interaction has not commenced during GDA Step 2, but will begin during Step 3. This work is being led by the PSA team.
- The PSA assessment provides input to the reliability aspects of the control & instrumentation (C&I) assessment. This formal interaction has commenced during GDA Step 2. This work is being led by the C&I team.

3 REQUESTING PARTY'S SAFETY CASE

21. During Step 2 of GDA RP submitted a PSR and other supporting references, which present a preliminary nuclear safety case for the UK HPR1000. This section presents a summary of RP's preliminary safety case in the area of PSA. It also identifies the documents submitted by RP which have formed the basis of my PSA assessment of the UK HPR1000 during GDA Step 2.

3.1 Summary of the RPs' Preliminary Safety Case in the Area of PSA

22. The aspects covered by the UK HPR1000 preliminary safety case in the area of PSA can be broadly grouped under 4 headings which can be summarised as follows:

- Adequacy, validity and scope of the UK HPR1000 PSA: the RP has submitted methodologies (Refs 3, 6 to 7 and 9 to 14) to support the adequacy of the PSA models currently being generated. The RP has provided a strategy and programme to develop the UK HPR1000 PSA (Ref. 5). This work programme includes submission of the updated PSA models and reports through to the end of Step 2 and into Step 3.
- Level of risk associated with UK HPR1000: the UK HPR1000 PSA is under development and has not been submitted to ONR during Step 2. However, significant PSA modelling has been completed for the reference plant, FCG3. This includes Level 1 PSA for at-power, low power, shutdown, internal hazards (including internal fire PSA and internal flooding PSA), Level 2 PSA and spent fuel pool (SFP) PSA. The RP has presented their PSA results (Ref. 2) for the expected core damage frequency (CDF) for plant faults and internal events. The RP claims that the FCG3 PSA results meet the targets defined for CDF and LRF, and that this provides confidence that the PSA to be developed for the UK HPR1000 will be able to demonstrate compliance with the numerical targets defined in the ONR SAPs and that the level of risk is as low as reasonably practicable (ALARP).

FCG3 PSA Model	PSA Results Reported in Ref. 1 (/ry)
Reactor CDF - plant faults	4.70E-07
Reactor CDF – hazards	1.79E-07
Reactor CDF – total	6.49E-07
Large Release Frequency (LRF) (total)	6.47E-08

- Use of the PSA to support the UK HPR1000 design process: the RP has stated in Chapter 14 of the PSR (Ref. 2) that the UK HPR1000 PSA will be used “to understand the nuclear safety risk profile, and to inform decisions on improvements to the design”. The RP also shows in Chapter 14 that the reference plant PSA was used to influence the evolution of the design in various areas of the plant. The RP makes a continuing commitment to use the UK HPR1000 PSA to further understand risk from the design and to influence future design modifications to lower risk.
- ALARP considerations: there was no specific information in this area, although the conclusions of Ref. 2 state that the UK HPR1000 PSA, once completed, will be used to inform the ALARP demonstration. The consideration of the adequacy of the input of the PSA into the ALARP demonstration against ONR's

expectations in SAPs FA.10 and FA.14 will be a key part of my assessment beyond Step 2.

3.2 Basis of Assessment: RPs' Documentation

23. The RPs' documentation that has formed the basis for my GDA Step 2 assessment of the safety claims related to the PSA aspects of the UK HPR1000 is presented in Refs 2 to 14:
- Ref. 2 is the PSR Chapter 14, PSA. This PSR chapter presents a summary of the FCG3 PSA models and results.
 - Ref. 3 is the methodology of initiating event analysis for PSA. This report presents the RPs' proposed methodology for choosing, screening, bounding and assigning a frequency for all initiating events (IEs) to be modelled in the UK HPR1000 PSA.
 - Ref. 4 is the data analysis report for PSA. This report presents the RPs' demonstration that the data to be used in the UK HPR1000 PSA is valid and derived by methods that would meet UK expectations.
 - Ref. 5 is the proposed UK GDA PSA work programme. This report presents the strategy for submitting the necessary documentation and models during Steps 2, 3 and 4 of GDA for PSA.
 - Ref. 6 is the methodology of internal event Level 1 PSA. This document presents the RPs' approaches for modelling the UK HPR1000 Level 1 PSA.
 - Ref. 7 is the RPs' approach for identification and screening of internal & external hazards in PSA. It outlines the approach that the RP intends to use to develop the scope of the internal and external hazards modelling in the UK HPR1000 PSA.
 - Ref. 8 is the initiating event list of internal event Level 1 PSA. This report presents the list of the IEs proposed to be assessed in the UK HPR1000 PSA together with a full pre-screening list of all IEs that were considered prior to screening.
 - Ref. 9 is the methodology of HRA. It presents the RPs' approaches for assessing the risk from human operators in the UK HPR1000 PSA.
 - Ref. 10 is the Methodology of Internal Fire PSA. This report presents the approaches that the RP will use to model internal fires in the UK HPR1000 PSA.
 - Ref. 11 is the methodology of external hazards PSA. It presents the RPs' approaches to be used in modelling external hazards in the UK HPR1000 PSA.
 - Ref. 12 is the methodology of internal flooding PSA. It presents the RPs' approaches to be used in modelling internal flooding hazards in the UK HPR1000 PSA.
 - Ref. 13 is the methodology of SFP PSA. This report outlines the RPs' approaches for assessing the risk from the SFP in the UK HPR1000 PSA.
 - Ref. 14 is the methodology of the Level 2 PSA. This report outlines the RPs' approaches for modelling the UK HPR1000 Level 2 PSA.
24. In addition, during April 2018 RP submitted to ONR, for information, an advance copy of the UK HPR1000 Pre-Construction Safety Report (PCSR). Chapter 14 (Ref. 21) addresses PSA. Having early visibility of the scope and content of this chapter has been useful in the planning and preparation of my GDA Step 3 assessment work.

4 ONR ASSESSMENT

25. This assessment has been carried out in accordance with HOW2 guide NS-PER-GD-014, "Purpose and Scope of Permissioning" (Ref. 15).
26. My Step 2 assessment work has involved regular engagement with the RPs' PSA specialists including one technical exchange workshop in China and six progress meetings. In addition I was given access to and have reviewed some aspects of the FCG3 PSA as part of my assessment.
27. During my GDA Step 2 assessment, I have identified some gaps in the documentation formally submitted to ONR. Consistent with ONR's Guidance to Requesting Parties (Ref. 22), these normally lead to Regulatory Queries (RQs) being issued. At the time of writing my assessment report, in PSA, during Step 2, I have raised six RQs to facilitate my assessment.
28. Details of my GDA Step 2 assessment of the UK HPR1000 preliminary safety case in the area of PSA, including the conclusions I have reached, are presented in the following sub-sections of this report. This includes the areas of strength I have identified, as well as the items that require follow-up during subsequent Steps of the GDA of the UK HPR1000.

4.1 Adequacy, Validity and Scope of the UK HPR1000 PSA

4.1.1 Assessment

29. I have reviewed the following aspects of the proposed UK HPR1000 PSA strategy submitted by the RP against ONR's expectations in SAPs FA. 11, FA.12 and FA.13:
- a PSA data analysis report (Ref. 4);
 - the proposed UK GDA PSA work program (Ref. 5);
 - the methodology proposed for postulated initiating event (PIE) identification (Ref. 20);
 - the methodology proposed for Level 1 at-power PSA (Ref. 6);
 - the methodology proposed for the identification and screening of internal & external hazards in PSA (Ref. 7);
 - the methodology proposed for human reliability analysis (Ref. 9);
 - the methodology for internal fire PSA (Ref. 10);
 - the methodology for external hazards PSA (Ref. 11);
 - the methodology for internal flooding PSA (Ref. 12);
 - the methodology for SFP PSA (Ref. 13); and
 - the methodology for Level 2 PSA (Ref. 14).
30. The RP has submitted a PSA data analysis report (Ref. 4). The purpose of this report is to provide the component reliability data that will be used in the UK HPR1000 PSA. The report outlines the rationale for selecting the data and sources of the data. A mix of OPEX from Chinese nuclear power plants (NPP) and United States Nuclear Regulatory Commission (NUREG) contractor report (CR) generic data will be used in the PSA. The stated priority is to use facility-specific OPEX first and generic data if OPEX is not available. The RP has not provided significant justification to support the validity of the use of the Chinese NPP OPEX in the UK HPR1000 PSA, and this is an area that I will follow-up within Step 3.
31. The RP has submitted a work programme (Ref. 5) that includes a schedule for delivery of the UK HPR1000 PSA model during GDA, with significant portions scheduled for submission to ONR prior to the beginning of Step 3 and early during Step 3. This will allow for a detailed review of the UK HPR1000 PSA model during GDA timescales.

32. The RP's position on Level 3 PSA was stated via RQ-UKHPR1000-0064 (Ref. 23). The fuel & core inspector raised RQ-UKHPR1000-0064 which asked the RP to outline the approach and sequence of actions planned to demonstrate compliance with the SAP numerical targets. In this RQ, the RP committed to performing Level 3 PSA during GDA timescales. It is understood that the RP will complete the Level 3 PSA methodology in early Step 3, and complete the Level 3 PSA modelling during Step 4. I am content with this approach and will assess the Level 3 PSA methodology during Step 3.
33. The RP has submitted Ref. 20, a proposed methodology of postulated initiating event (PIE) identification to describe their approach to identify initiating events for use in fault studies and the UK HPR1000 PSA model. I have reviewed this approach together with the fault studies topic lead. While this methodology is high level, in my opinion, it meets the expectations outlined in the PSA TAG (Ref. 17) for the current stage of GDA. However, I will expect this topic area to be further developed during Step 3.
34. The RP has submitted a document for the initiating event list of internal event Level 1 PSA (Ref. 8). This list was created using the methodology discussed above (Ref. 20). Ref. 8 is an important document for the UK HPR1000 PSA because it sets out the accident sequences that will be evaluated in the UK HPR1000 PSA models. In my opinion, there is a shortfall in this document explaining how IEs are identified, screened, bounded and grouped. Thus, I raised RQ-UKHPR1000-0056 against this document (Ref. 23) to ask the RP for the IE list pre- and post-screening and grouping, to understand how this will be performed for the UK HPR1000 PSA. In the RPs' response to this RQ, the source of the IEs was stated to be primarily from generic IE lists (Ref. 24) and the Chinese EPR PSA. I will follow-up with assessment of this during Step 3. The RP presented their FCG3 IE lists both pre- and post-bounding and screening. This response helped to bring clarity to how Ref. 8 is and will be used in practice. Thus, I am content with the approach outlined in Ref. 8 in light of the further information provided in the response to RQ-UKHPR1000-0056 (Ref. 23).
35. The screening, bounding and grouping of the IEs in the UK HPR1000 PSA have not been assessed in detail during Step 2, as this would be only useful when the UK HPR1000 PSA models and results have been completed. It is an area I will follow-up in Step 3 to understand if the IE analysis methodology presented in Ref. 20 has resulted in a reasonable list of IEs to assess or if the methodology has been overly conservative, thus resulting in a limited list of IEs.
36. The RP has submitted Ref. 6, methodology for Level 1 PSA, to describe their approach for modelling the UK HPR1000 PSA. This methodology contains a mix of detailed descriptions whilst other areas are more high-level. However, in my opinion, it meets the expectations outlined in the PSA TAG (Ref. 17) for the current stage of GDA to create the UK HPR1000 PSA that will be assessed in Step 3.
37. Of note, Ref. 6 states that the PSA computer code that was used for the FCG3 PSA (RiskSpectrum) will also be used for the UK HPR1000 PSA. This is a widely used international PSA code that meets ONR expectations.
38. The RP has submitted Ref. 7, identification and screening of internal & external hazards in PSA. This document lists what internal and external hazards are in scope for analysis during GDA. I have identified areas of this report that contain shortfalls against the expectations outlined in the PSA TAG (Ref. 17). I will follow-up with these shortfalls during Step 3. These include:
 - The screening methodology is high level for qualitative screening and while this is reasonable for this stage in GDA I would expect further details and clarity to be provided as GDA progresses.

- The document discusses the rationale for screening hazards in and out, or leaving them unscreened. This rationale is very high level, and while adequate for this stage in GDA, I expect that the recorded justification and rationale for screening and bounding will be developed further with more detail and clarity as GDA progresses.
 - For those hazards that are assigned “unscreened” for GDA, these are defined as potential hazards that will not be analysed during GDA, but instead during the licensing phase. I have raised RQ-UKHPR1000-0139 to better understand why the RP has confidence that if it does not analyse these hazards during GDA, the risk will be understood and measured. At the time of writing, the RP has not yet responded to this RQ so I will review the response to this RQ during Step 3 to understand the RPs’ proposed approach.
 - The RP has stated in Ref. 7 that an assessment of seismic hazards will be submitted in GDA; however it has not committed to an approach, scope of assessment or submission date. I expect an assessment of seismic hazards (such as a seismic PSA) to be completed during GDA and have discussed these expectations with the RP. Thus, this area remains a shortfall and I will follow-up during Step 3 of the GDA.
39. Ref. 9 is the methodology submitted by the RP in the area of HRA. I have discussed my assessment of this document with the ONR HF inspector. The document is high level and I would expect further details and clarity to be provided as GDA progresses. The methodology for developing and screening Type-A human errors (i.e. those errors which occur prior to the postulated initiating event) may need attention during Step 3 to ensure that all Type-A human errors are included in the model. This methodology does not present the methods that will be followed to consider qualitative assessment of human actions when quantifying the human error probabilities (HEPs) for use in the PSA. The HF inspector has raised RQ-UKHPR1000-0134 (Ref. 23) which contains several of my PSA questions. I will review the response to this RQ and follow-up during Step 3.
40. The RP has submitted Ref. 10, methodology of internal fire PSA to describe the proposed approach for modelling internal fire PSA for GDA. The RPs’ approach for internal fire PSA follows the ASME/EPRI established approach (Refs 25, 26 and 27). Overall, I am content with the information provided on modelling internal fire PSA.
41. The RP has submitted Ref. 13, methodology for SFP PSA. This document outlines the differences in methods used that are unique for the SFP area of the plant. It notes that the techniques used to perform PSA are largely the same as outlined in the Level 1 PSA methodology (Ref. 6). The main differences lie in the definition of the IEs and the end states of the accident sequence (primarily fuel route faults). The IE selection concerns I have outlined above are also applicable for this methodology. However, aside from my existing screening approach concerns, I consider this document reasonable for Step 2.
42. The RP has submitted Ref. 14, methodology for Level 2 PSA. While this methodology is high level, in my opinion, it meets the expectations outlined in the PSA TAG (Ref. 17) for the current stage of GDA.
43. It is also noted that close working relationships between the RPs’ PSA team and other technical areas have been apparent during several PSA meetings. The PSA team provides support to many of the RPs’ GDA teams, for example fault studies, human factors, C&I and the internal and external hazards teams. I consider this appropriate and encouraging.

4.1.2 Strengths

44. During my assessment of the adequacy, validity and scope of the UK HPR1000 PSA, I have identified the following strengths:
- the strategy and programme to develop a modern standards full scope Level 1 and Level 2 PSA for the UK HPR1000 meets ONR expectations for Step 2;
 - the proposed UK HPR1000 PSA Level 1 PSA methodology meets ONR expectations for Step 2; and
 - internal Fire PSA methodology follows international good practice;

4.1.3 Items that Require Follow-up

45. During my assessment of the adequacy, validity and scope of the UK HPR1000 PSA I have identified the following potential shortfalls that I will follow-up during Step 3 of GDA:
- the RP has not justified the validity for the use of Chinese NPP OPEX for use in the UK;
 - the RP has not demonstrated that the proposed approach for screening, bounding and grouping of initiating events in Level 1 PSA and SFP PSA will result in sufficient depth of the analysis;
 - the scope, approach and submission schedule of seismic hazard analysis (such as seismic PSA) during GDA timescales has not been stated by the RP;
 - the RP has not demonstrated clearly that the proposed approach for screening of hazards will result in an adequate depth of modelling; and
 - the RP has not demonstrated clearly that the proposed approach for HRA screening will meet UK regulatory expectations.

4.1.4 Conclusions

46. Based on the outcome of my assessment of the adequacy, validity and scope of the UK HPR1000 PSA, I have concluded that I have confidence that the UK HPR1000 PSA should meet regulatory expectations identified in SAPs FA.11, FA.12 and FA.13.
47. The RP has proposed a work plan (Ref. 5) to submit a significant portion of the PSA model prior to the start of Step 3, with most of the remainder due to be submitted early in Step 3. In my opinion, the submitted plan will allow for assessment within the projected timescales of the GDA. Most of the approaches and methods that have been proposed are likely to meet UK expectations. Some outstanding areas of analysis (e.g. seismic hazard analysis such as seismic PSA, IE screening and HRA methods) will be followed up during Step 3.

4.2 Risk Associated with UK HPR1000

4.2.1 Assessment

48. The UK HPR1000 PSA is under development and has not been submitted to ONR in Step 2. The PSR (Ref. 1) presents the results of the reference design (FCG3) Level 1 and Level 2 PSA, including at-power operation, low power and shutdown modes, internal hazards and the spent-fuel pool. These results identify the CDF and dominant contributors from the FCG3 Level 1 PSA and the LRF and relative contributors for the FCG3 Level 2 PSA.
49. As the UK HPR1000 PSA models and results will not be completed until late in Step 2, I was not able to take them into account in my Step 2 assessment. Instead I used the FCG3 PSA results along with a high level interrogation of the FCG3 PSA model. The RP presented the FCG3 PSA model and I reviewed several fault trees and event trees

including support systems and safety systems. The review sampled several system fault trees to the bottom level basic events and the RP showed many examples of their modelling. I reviewed modelling from the FCG3 Level 1 PSA, FCG3 Level 2 PSA, at-power, low power and shutdown FCG3 PSA, FCG3 fire PSA, FCG3 flooding PSA and a recent seismic PSA that the RP had completed for a different nuclear station (i.e. not FCG3). This interaction helped to raise my confidence in the capability of the RP to produce a high quality PSA model for all significant plant operating states for the UK HPR1000 design. I have observed evidence that the RP has produced high quality, large scope PSAs and thus I have confidence in the RPs' ability to repeat this for the UK HPR1000.

50. As there is no Level 3 PSA for the reference plant (FCG3) and the Level 3 PSA for the UK HPR1000 is in development, there is no directly comparative result for the ONR SAP Numerical Targets. The RP claims that the FCG3 PSA results demonstrate that the FCG3 design meets the targets for CDF and LRF. As the ONR SAPs do not have explicit targets for CDF and LRF, as a surrogate, I have compared the FCG3 PSA results provided by the RP against SAP NT.1 Numerical Targets 7 and 9. The FCG3 Level 1 CDF ($6.49E-07$ /reactor year (ry)) is less than the BSO of Target 7, and the FCG3 Level 2 LRF ($6.47E-08$ /ry) is less than the BSO of Target 9.
51. The estimate of the FCG3 CDF reported in the PSR (Ref. 1) is less than the International Nuclear Safety Group's (INSAG) recommended CDF target for new reactors (Ref. 18). Furthermore, the reported FCG3 CDF is less than INSAG's recommended target for individual risk of fatality for new reactors, and is also less than the basic safety objectives (BSOs) for SAP NT.1 numerical targets 7 and 8 (>1000 mSv). The FCG3 LRF is less than the BSO for Target 9.
52. The FCG3 PSA model that has given rise to the reported results by the RP in the PSR (Ref. 1) is, in my opinion, based on what appears to be a robust modern standard PSA, albeit I have not completed an assessment of this. Thus, the results that have been reported by the RP indicate that the level of risk associated with the UK HPR1000 design is likely to meet ONR expectations. I will assess the UK HPR1000 PSA models against these targets, once submitted in Step 3.
53. The RP has provided a work programme and schedule of deliverables to address the strategy for PSA delivery during Step 3 (Ref. 5). Thus, I have confidence that as the PSA programme develops during GDA, the risk associated with the UK HPR1000 design will be well understood by the RP. The further analysis that is planned for the rest of GDA should continue to increase my confidence.

4.2.2 Strengths

54. During my assessment of the level of risk associated with the UK HPR1000, I have identified the following strengths:
 - the RP has demonstrated the wide scope and depth of the FCG3 PSA, which has increased my confidence in the RPs' ability to repeat this scope and depth for the UK HPR1000 PSA;
 - the RP has demonstrated the significant quality of the FCG3 PSA;
 - the RP has demonstrated their use of modern standards to create the FCG3 PSA; and
 - the RP has shown that the reference design is low risk based on the FCG3 PSA results. This increases my confidence in the ability of the RP to demonstrate the low risk of the UK HPR1000 design through use of PSA.

4.2.3 Items that Require Follow-up

55. During my GDA Step 2 assessment of the level of risk associated with the UK HPR1000 I have identified the following potential shortfalls that I will follow-up during Step 3 of GDA:
- the UK HPR1000 PSA model and results have not been presented during Step 2, and I will assess these once submitted during Step 3; and
 - although the RP has committed to performing a seismic hazard analysis (such as seismic PSA) during GDA, the RP has not decided on the scope, approach or submission schedule for this analysis or if alternative methods will be used during GDA timescales to demonstrate the risk from seismic events.

4.2.4 Conclusions

56. Based on the outcome of my Step 2 assessment of the level of risk associated with the UK HPR1000, I have concluded that the risk associated with the UK HPR1000 design should meet ONR expectations for new reactors when compared against SAP NT.1 (numerical targets). At this point in time I have not assessed the UK HPR1000 PSA model, but the risk profile for the reference design (FCG3) provides evidence that the risk profile for the design is balanced and meets ONR expectations (except for seismic risks for which the scope, approach and submission schedule have yet to be confirmed). I will assess the UK HPR1000 PSA once submitted in Step 3.

4.3 Use of the PSA to Support the UK HPR1000 Design Process

4.3.1 Assessment

57. I have reviewed the adequacy of the use of PSA to support the development of the UK HPR1000 design against regulatory expectations in SAP FA.10 and FA.14. The RPs' safety submissions have provided high-level information on this topic (Refs 1 and 6), and while this is reasonable at this stage I expect further details to be provided as GDA progresses.
58. Chapter 14 of the PSR (Ref. 1) states that the FCG3 PSA that was developed through the course of the design of HPR1000 (FCG3), has supported the design evolution by influencing design changes in the following areas of the HPR1000 design:
- three train design for safety system;
 - containment heat removal system (CHRS);
 - definition of Design Extension Condition A (DEC-A); and
 - provision for manual operation of the reactor cavity water injection valves.
59. The Level 1 internal events methodology (Ref. 6) discusses how the UK HPR1000 PSA will influence the design and safety of the plant as it is developed and refined during GDA. In this document, the RP has provided an explanation of how it intends to use the PSA to inform the UK HPR1000 design process and to demonstrate that the level of risk associated with the UK HPR1000 is ALARP.
60. While the approach has been explained at high level in Refs 1 and 6, further details are needed on the approach to risk inform the UK HPR1000 design and to understand how this is formally linked with the UK HPR1000 design management process. Thus, I have raised RQ-UKHPR1000-0132 (Ref. 23) to obtain further information on this topic. I will review the response to this RQ in Step 3. I will also consider the need to undertake an inspection of the implementation of the process with the support of the GDA management of safety and quality assurance (MSQA) inspector.

4.3.2 Items that Require Follow-up

61. During my assessment of the use of the PSA to support the UK HPR1000 design process, I have identified a potential shortfall that I will follow-up during Step 3:
- implementation of the approach outlined in Refs 1 and 6 for use of the PSA to support the UK HPR1000 design process.

4.3.3 Conclusions

62. Based on the outcome of my assessment of the use of the PSA to support the UK HPR1000 design process, I have concluded that the information presented provides me with confidence that:
- the reference design (FCG3) has been influenced by the outcome of the FCG3 PSA, which will be carried forward to the UK HPR1000; and
 - the RP has established an approach to ensure that the PSA will be used to continue the development of the UK HPR1000 design during GDA.
63. To enable a detailed assessment against ONR expectations in SAPs FA.10 and FA.14 further information is required. I will review the details of the approach proposed and related processes in Step 3.

4.4 ALARP Considerations

4.4.1 Assessment

64. I have considered the adequacy of the RPs' safety submissions to demonstrate that the level of risk associated with the UK HPR1000 is ALARP against ONR's expectations in SAP FA.14.

4.4.2 Strengths

65. In the PSR (Ref. 1) one of the stated goals for the UK HPR1000 PSA is to help demonstrate that risks from the design are understood and ALARP. The preliminary PSA results in the PSR meet the SAP NT.1 numerical targets (as discussed previously in this report).

4.4.3 Items that Require Follow-up

66. During my assessment of the ALARP considerations, I have identified the following shortcomings that I will follow-up during Step 3:
- On the basis of the information reviewed in Step 2, the level of risk associated with the UK HPR1000 has been presented as meeting the SAP NT.1 numerical targets. This is part of the demonstration that the RP will use to show the level of risks is ALARP. However as the UK HPR1000 PSA has not been submitted at the time of writing this report, I will assess this claim during Step 3.
 - The draft PCSR (Ref. 28) contains significantly more information on this topic and Chapter 33 of this reference will be assessed during Step 3 to understand the adequacy of the RPs' ALARP demonstration.

4.4.4 Conclusions

67. As the UK HPR1000 PSA is under development, the information submitted is insufficient to provide confidence that the level of risk associated with the UK HPR1000 design will be ALARP.

68. The consideration of the adequacy of the input of the UK HPR1000 PSA into the ALARP demonstration against ONR expectations in SAPs FA.10 and FA.14 will be a key part of my assessment beyond Step 2. During Step 3 I will review the adequacy of the RPs' approach to use the full-scope UK HPR1000 PSA to underpin the ALARP demonstration and to identify further design improvements if required, against ONR's expectations in SAPs FA.10 and FA.14.

4.5 Categorisation of Safety Functions and Classification of Systems, Structures and Components

69. I have not assessed the safety categorisation and classifications of systems, structures and components during Step 2. It is likely that there will be a connection between the PSA model and categorisation and classifications (e.g. for discussing the probability of failure of systems, structures and components) however I expect this to be a topic area I will assess during Step 3, when the PSA model and results have been submitted.

4.6 Out of Scope Items

70. No items have been left outside the scope of my GDA Step 2 assessment of the UK HPR1000 PSA.
71. However, as described earlier, much of my assessment to date has been based on the FCG3 PSA produced for the reference design, as the UK PSA remains in development. At the moment, I do not consider that there will be fundamental changes to the PSA as a result of moving to the UK models.
72. It should be noted that the above does not invalidate the conclusions from my GDA Step 2 assessment. My Step 3 assessment will be based on the submitted UK HPR1000 PSA; I will capture this within my GDA Step 3 Assessment Plan.

4.7 Comparison with Standards, Guidance and Relevant Good Practice

73. In Section 2.2, above, I have listed the standards and criteria I have used during my GDA Step 2 assessment of the UK HPR1000 PSA, to judge the adequacy of the preliminary safety case. In this regard, my overall conclusions can be summarised as follows:
- SAPs: My Step 2 assessment concludes that the FCG3 PSA is suitable and sufficient to support the UK HPR1000 GDA safety submissions made for Step 2. There are areas that require further development during the next steps of the GDA and the RP is aware of these. The RP needs to complete their PSA modelling for the UK HPR1000 (including Level 1 PSA, fire PSA, flooding PSA, Level 2 PSA and SFP PSA), to decide on the scope of analysis for seismic hazards and to provide more evidence on the approach and evidence for the UK HPR1000 PSA's use in demonstrating that the level of risk is ALARP. The risks presented in the FCG3 PSA give me confidence that due to the similarity in design, and the high quality, modern standards methods being used, I have confidence that the UK HPR1000 PSA will help demonstrate that the level of risk meets the SAP NT.1 numerical targets. The PSA work programme (Ref. 5) provides for delivery in a timely manner of the UK HPR1000 PSA models and results reports. The remaining area which has not been decided on yet is seismic hazard analysis (such as seismic PSA). The RP has committed to deciding on the delivery options for these areas prior to Step 3 of GDA.
 - TAGs: The FCG3 PSA models were reviewed in China, and the UK HPR1000 PSA models have not been submitted yet. While I did not undertake an assessment against regulatory expectations as presented in the TAG for this PSA, the modelling I observed in China and discussions during Step 2 help to

provide me with confidence that the TAG expectations are likely to be met. I will assess this during Step 3.

4.8 Interactions with Other Regulators

74. I have had no interactions with other regulators regarding the UK HPR1000 PSA for my Step 2 assessment.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

75. During Step 2 of GDA RP submitted a PSR and other supporting references, which present a preliminary nuclear safety case for the UK HPR1000. These documents have been formally assessed by ONR. The PSR together with its supporting references present the claims in the area of PSA that underpin the safety of the UK HPR1000.
76. During Step 2 of GDA I have targeted my assessment on content of the PSR and its references that is of most relevance to the area of PSA, against the expectations of ONR's SAPs and TAGs and other guidance which ONR regards as Relevant Good Practice. From the UK HPR1000 assessment completed so far, I conclude the following:
- The shortcomings identified in my review indicate that the RP will need to complete additional work to complete the UK HPR1000 PSA to meet regulatory expectations. I will follow-up these shortcomings during GDA Steps 3 and 4.
 - The reference design (FCG3) PSA models were useful to build confidence during Step 2, and although the UKHPR1000 PSA models will be submitted in Step 3, early sight of the reference design models was beneficial.
 - In my opinion, completion of the RPs' current programme of PSA work will enable ONR to understand the risk from the UK HPR1000 design. This programme of work is likely to enable a judgement on the adequacy of the arguments and evidence later in GDA.
77. Overall, during my GDA Step 2 assessment, I have not identified any fundamental safety shortfalls in the area of PSA that might prevent the issue of a Design Acceptance Confirmation (DAC) for the UK HPR1000 design.

5.2 Recommendations

78. My recommendations are as follows
- Recommendation 1: ONR should consider the conclusions of my assessment in deciding whether to proceed to Step 3 of GDA for the UK HPR1000.
 - Recommendation 2: All the items identified in Step 2 to be followed up should be included in ONR's GDA Step 3 PSA assessment plan for the UK HPR1000.

6 REFERENCES

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3. Methodology of Initiating Event Analysis, PSA, GDA-REC-GNS-749, Rev. B, CGN, January 2018, TRIM Ref 2018/40803
4. PSA Data Analysis Report, PSA, GDA-REC-GNS-750, January 2018, Rev. C, CGN, TRIM Ref 2018/40809
5. UK GDA PSA Work Program, PSA, GDA-REC-GNS-751, January 2018, Rev. B, CGN, TRIM Ref 2018/40818
6. Methodology of Internal Event Level 1 PSA, PSA, GDA-REC-GNS-1258, Rev. A, CGN, April 2018, TRIM Ref 2018/139577
7. The Identification and Screening of Internal & External Hazards in PSA, GDA-REC-GNS-1259, Rev. A, CGN, April 2018, TRIM Ref 2018/139583
8. Initiating Event List of Internal Event Level 1 PSA, GDA-REC-GNS-1346, Rev. B, CGN, April 2018, TRIM Ref 2018/145780
9. Methodology of Human Reliability Analysis, GDA-REC-CGN-1609, Rev. A, CGN, May 2018, TRIM Re 2018/179779
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12. Methodology of Internal Flooding PSA, GDA-REC-CGN-1610, Rev. A, CGN, May 2018, TRIM Ref 2018/180088
13. Methodology of Spent Fuel PSA, GDA-REC-CGN-1608, Rev. A, CGN, May 2018, TRIM Ref 2018/180090
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17. Technical Assessment Guides

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19. Western European Nuclear Regulators' Association.

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21. GDA-REC-CGN-818, Pre-Construction Safety Report, Chapter 14, Probabilistic Safety Assessment, April 2018, TRIM Ref 2018/105322
22. Guidance on Mechanics of Assessment within the Office for Nuclear Regulation (ONR) – TRIM Ref. 2013/204124
23. UK HPR1000 - Regulatory Query (RQ) Tracking Sheet, TRIM Ref 2017/407871
24. US Nuclear Regulatory Commission

Rates of Initiating Events at US Nuclear Power Plants, NUREG/CR-5750, February 1999

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28. Pre-Construction Safety Report, Chapter 33, ALARP Evaluation, GDA-REC-CGN-000835, Rev. B, April 2018, TRIM 2018/105284
29. Scope for UK HPR1000 GDA Project, HPR-GDA-REPO-0007, May 2018, TRIM 2018/179809
30. GDA Step 2 Level 4 PSA Meeting – China Trip – 27th January to 2nd February 2018, ONR-NR-CR-17-675

Table 1

Relevant Safety Assessment Principles Considered During the Assessment

SAP No and Title	Description	Interpretation	Comment
FA.10 Fault analysis: PSA Need for a PSA	Suitable and sufficient PSA should be performed as part of the fault analysis and design development and analysis.	This principle sets the framework and requirements for a PSA study. The overriding aim of the PSA assessment is to assist ONR's judgements on the safety of the facility and whether the risks of its operation are being made as low as reasonably practicable.	Addressed in Section 4 of this report. The need for PSA has been recognised from the outset. This assessment report concludes that the existing PSA which forms the basis for the PSR is suitable and sufficient to support the UK HPR1000 GDA safety submission at Step 2. The UK HPR1000 PSA is scheduled to be completed during GDA and submitted mostly prior to and during early Step 3. Hence the SAP is not fully met at this time, but I am confident it will be met in future Steps.
FA.11 Fault Analysis – PSA – Validity	PSA should reflect the current design and operation of the facility or site.	This principle establishes the need for each aspect of the PSA to be directly related to existing facility and site information, documentation or the analysts' assumptions in the absence of such information. The PSA should be documented in such a way as to allow this principle to be met.	Addressed in Section 4 of this report. This assessment report concludes that the RP has started to set up the basis to develop a full scope PSA in a way that ensures a strong link with the UK HPR1000 design. However, further information is needed. Hence the SAP is not fully met at this time, but I am confident it will be met in future Steps.
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.	In order to meet this principle the scope of the PSA should cover all sources of radioactivity at the facility (for example, fuel ponds, fuel handling facilities, waste storage tanks, radioactive sources and reactor core), all types of initiating faults (for example, internal faults, internal hazards and external hazards) and all operational modes (for example, nominal full power, low power, shutdown, start-up, refuelling and maintenance outages).	Addressed in Section 4 of this report. As indicated previously the PSA is under development. This assessment report concludes that further information is needed to provide confidence that the UK HPR1000 PSA will meet the regulatory expectations in this area. There is one area of PSA scope that is still unaddressed (seismic hazard analysis such as seismic PSA). Hence the SAP is not fully met at this time, but I am confident it will be met in future Steps.
FA.13 Fault Analysis – PSA – Adequate	The PSA model should provide an adequate representation of the site and its facilities.	The aim of this principle is to ensure the technical adequacy of the PSA. Inspectors should review PSA models, data and results to be satisfied that the PSA has a robust technical basis and thus provides a	Addressed in Section 4 of this report. As indicated previously the PSA is under development. This assessment report concludes that further information is needed to provide confidence that the

representation		credible picture of the contributors to the risk from the facility.	UK HPR1000 PSA will meet the regulatory expectations in this area. Although, I believe that the RP has set up the basis to deliver the information required for a meaningful assessment during Step 3; the SAP is not fully met at this time, but I am confident it will be met in future Steps.																		
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.	The aim of this principle is to establish the expectations on what uses the duty-holders should make of the PSA to support decision-making and on how the supporting analyses should be undertaken.	Addressed in Section 4 of this report. This assessment concludes that the RP has set up the basis to ensure that the PSA will be used to continue the development of the design and the severe accident features and strategies during GDA. However, further information is needed and ultimately a UK HPR1000 PSA is required to support design and operational features. Hence the SAP is not fully met at this time, but I am confident it will be met in future Steps.																		
NT.1 Numerical Targets – Target 7	Individual risk to people off the site from accidents.	BSL 10^{-4} /yr. BSO 10^{-6} /yr.																			
NT.1 Numerical Targets – Target 8	Frequency dose targets for accidents on an individual facility – any person off the site.	<table border="1"> <thead> <tr> <th></th> <th>BSL</th> <th>BSO</th> </tr> </thead> <tbody> <tr> <td>Offsite dose 0.1-1 mSv</td> <td>1</td> <td>10^{-2}</td> </tr> <tr> <td>Offsite dose 1-10 mSv</td> <td>10^{-1}</td> <td>10^{-3}</td> </tr> <tr> <td>Offsite dose 10-100 mSv</td> <td>10^{-2}</td> <td>10^{-4}</td> </tr> <tr> <td>Offsite dose 100-1000 mSv</td> <td>10^{-3}</td> <td>10^{-5}</td> </tr> <tr> <td>Offsite dose >1000 mSv</td> <td>10^{-4}</td> <td>10^{-6}</td> </tr> </tbody> </table>		BSL	BSO	Offsite dose 0.1-1 mSv	1	10^{-2}	Offsite dose 1-10 mSv	10^{-1}	10^{-3}	Offsite dose 10-100 mSv	10^{-2}	10^{-4}	Offsite dose 100-1000 mSv	10^{-3}	10^{-5}	Offsite dose >1000 mSv	10^{-4}	10^{-6}	The UK HPR1000 PSA is under development. The RP has provided the results for the HPR1000 (FCG3) PSA for internal events, and internal fire and flooding. This assessment report concludes that the CDF will not challenge the Basic Safety Objectives (BSOs) for SAPs' targets 7 and 9. Currently there is not sufficient information to fully understand the risk profile for this reactor, as this would require the submission of the UK HPR1000 PSA. Hence the SAP is not met at this time, but I am confident it will be met in future Steps.
	BSL	BSO																			
Offsite dose 0.1-1 mSv	1	10^{-2}																			
Offsite dose 1-10 mSv	10^{-1}	10^{-3}																			
Offsite dose 10-100 mSv	10^{-2}	10^{-4}																			
Offsite dose 100-1000 mSv	10^{-3}	10^{-5}																			
Offsite dose >1000 mSv	10^{-4}	10^{-6}																			
NT.1 Numerical Targets – Target 9	Total risk of 100 or more fatalities.	BSL 10^{-5} /yr $^{-7}$ /yr BSO 10																			