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REGULATORY OBSERVATION Resolution Plan

RO Unique No.:	RO-UKHPR1000-0020
RO Title:	Veracity of PSA Data
Technical Area(s)	PSA
Revision:	0
Overall RO Closure Date (Planned):	2020-11-30
Linked RQ(s)	
Linked RO(s)	
Related Technical Area(s)	Fault Studies, Human Factors
Other Related Documentation	

Scope of Work

Background and Regulator's Expectations

The Requesting Party (RP) has submitted Internal Events Level 1 Probabilistic Safety Assessment (PSA) model and report (Ref. 1) for UK HPR1000. The component reliability data used in Internal Events Level 1 PSA is described in PSA Data Analysis Report (Ref. 2), including data source, component boundary, failure mode and detailed reliability data.

In UK HPR1000 PSA, the reliability information is sourced from two generic reliability databases where for each component a failure rate or probability of failure is selected from either a Chinese national generic database owned by the Chinese regulator (Ref. 3), or from NUREG/CR-6928 (Ref. 4).


There is a gap between regulatory expectations and the RP's submissions, which needs further work to be done by the RP to ensure that the PSA meets UK expectations during Generic Design Assessment (GDA) phase. These works will be described in the resolution plan for RO-UKHPR1000-0020.

Office for Nuclear Regulation (UK) (ONR)'s regulatory expectation is that the PSA reliability information which is used as the basis for the UK HPR1000 PSA should be appropriately justified.

Description of the Response and of the Scope of Work

This resolution plan provides a response for the gap on reliability data used in internal events Level 1 PSA in order to provide justification, including:

- a) To provide information which should contain reliability figures that were sourced from a long

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enough window of time so that failures can be widely observed and equipment has had a long enough running life to show realistic failure rates.

- b) To depict how the reliability figures have been obtained, sourced, and selected, rejected, given precedence and assigned boundaries according to a valid methodology.
- c) Where several sources of data are combined, to show the method to combine them is coherent and complete.

Deliverable Description

RO-UKHPR1000-0020.A1 – Demonstration of the Validity of the Reliability Information used as an Input to the UK HPR1000 PSA

The Regulatory Observation Action 1 states that:

General Nuclear System Limited should provide an adequate justification to demonstrate that the reliability information used as an input to the UK HPR1000 PSA is suitable and sufficient for use in the safety case, and meets ONR's regulatory expectations.


Based upon the current approach adopted for UK HPR1000, of combining data sources, specific justification is needed in the following aspects:

- *Where the reliability data in the NNSA database (Ref. 3) used in the UK HPR1000 PSA differs significantly from other generic databases, the RP needs to provide justification for why the data remains valid for use in the UK HPR1000 PSA.*
- *The NNSA database has a relatively small sample size compared to other international reliability databases. Because of this, the number of demands and hours of operation for components and the corresponding number of failures are observed to be significantly less than other international generic reliability databases. The RP needs to justify that although the NNSA database has a relatively smaller sample size it remains sufficient and suitable for use.*
- *If the RP chooses to combine reliability information (i.e. using data inputs from Refs 3 and 4), they should provide a suitable and sufficient approach for combining the two generic database that meets UK expectations.*

In response to the Regulatory Observation, related works are planned as follows:

For this action, the RP's planned response consists of the following steps to justify the component reliability data used in Internal Events Level 1 PSA.

- a) To provide the National Nuclear Safety Administration (China) (NNSA) database (Ref. 3) development process in the updated version of *PSA Data Analysis Report* (Rev F, to be submitted in January 2020), including the methodology and criteria. The main processes are as

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follows and each process will be described in detail.

- 1) To describe the scope of the collected data;
 - 2) To define the component types, boundaries and failure modes;
 - 3) To present the detailed reliability data to be collected;
 - 4) To collect data from different nuclear power plants;
 - 5) To group the data;
 - 6) To process the data to generate a consolidated component reliability database (including explanation for the use of “5 events”);
 - 7) To organize expert review to validate the consolidated data;
 - 8) To form the final NNSA database (Ref. 3).
- b) To provide the component reliability data selection process in UK HPR1000 PSA in the updated version of *PSA Data Analysis Report* (Revision F, to be submitted in January 2020), including the way to use different databases, the relationship between NNSA database (Ref.3) and NUREG/CR-6928 (Ref. 4) in UK HPR1000 PSA.
- c) To perform and provide a comparison analysis between NNSA database (Ref.3) and NUREG/CR-6928 (Ref. 4) in the updated version of *PSA Data Analysis Report* (Revision F, to be submitted in January 2020). The reasons for using NUREG/CR-6928 (Ref. 4) data are mainly as follows:
- 1) It reflects the latest operating experience in the US;
 - 2) It includes large amount of component types and sample sizes;
 - 3) It is internationally and widely acknowledged.

The comparison items are as follows:

No.	Comparison Items
1	Sample size, including the total demand number or running time
2	Failure events number
3	Failure rate/probability
4	Component boundary
5	Bayesian updating method and χ^2 method

- d) To provide justifications for data selection for each component reliability data used in UK HPR1000 PSA based on results of comparison analysis in the updated version of *PSA Data*

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Analysis Report (Revision F, to be submitted in January 2020). The justifications will take into account the following criteria:

No.	Criterion
1	Sample size
2	Failure events number
3	Applicability analysis from the factors of manufacturers, design level and operating management mode
4	Failure rate/probability
5	Component boundaries in PSA model, NNSA database (Ref. 3) and NUREG/CR-6928 (Ref. 4).

RO-UKHPR1000-0020.A2 – Update of the UK HPR1000 PSA

The Regulatory Observation Action 2 states that:

- *General Nuclear System Limited should update the UK HPR1000 PSA with any changes to the UK HPR1000 reliability information that have arisen as a result of Action 1.*

In response to the Regulatory Observation, related works are planned as follows:

For this action, CGN's planned response consists of reflecting, based on the justifications result, any updated data (if any) and any related sensitivity analysis to assess the impacts of the updated data in the next updated version of PSA models and reports, including:


- 1) *Internal Events Level 1 PSA Model and Report* (Revision B, to be submitted in March 2020);
- 2) *Spent Fuel Pool Level 1 PSA Model and Report* (Revision A, to be submitted in February 2020);
- 3) *Level 2 PSA Model and Report* (Revision A, to be submitted in July 2020);


In GDA process, if other potential works may be impacted by this change, they will also be updated.

Impact on the GDA Submissions

The updated information will be incorporated into the following documents:

- To be added in the submission list:
 - PSA Data Analysis Report, Revision F, 15/01/2020*
- Already in the submission list:
 - 1) *Internal Events Level 1 PSA Report and Model, Revision B, 31/03/2020;*

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<p>2) <i>Spent Fuel Pool Level 1 PSA Report and Model</i>, Revision A, 28/02/2020;</p> <p>3) <i>Level 2 PSA Report and Model</i>, Revision A, 30/07/2020.</p>			
Timetable and Milestone Programme Leading to the Deliverables			
<p>See attached Gantt Chart in APPENDIX A.</p>			
Reference			
<p>[1] CGN, Internal Events Level 1 PSA, GHX00650001DOZJ02GN, Rev. A, October 2018, CM9 Ref. 2018/350941.</p> <p>[2] CGN, PSA Data Analysis Report, GHX00650015DOZJ02GN, Rev. E, April 2019, CM9 Ref. 2019/96114.</p> <p>[3] NNSA, Chinese Components Reliability Data Report for Nuclear Power Plant, November 2016.</p> <p>[4] NRC, Industry-average performance for components and initiating events at U.S. commercial nuclear power plants, NUREG/CR-6928, 2015. https://nrcoe.inl.gov/resultsdb/.</p>			

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APPENDIX A RO-UKHPR1000-0020 Gantt Chart

Tasks and Schedule	2019				2020											
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
RO Action 1																
Update and submission of "PSA Data Analysis Report (Rev F)"					▲											
RO Action 2																
Development and submission of "Spent Fuel Pool Level 1 PSA Model and Report (Rev. A)"						▲										
Update and submission of "Internal Events Level 1 PSA Model and Report (Rev. B)"							▲									
Development and submission of "Level 2 PSA Model and Report (Rev. A)"												▲				
Assessment																
Regulators Assessment																
Target RO Closure Date																▲