

REGULATORY OBSERVATION

REGULATOR TO COMPLETE

RO unique no.:	RO-UKHPR1000-0020
Revision:	0
Date sent:	20/09/19
Acknowledgement required by:	11/10/19
Agreement of Resolution Plan Required by:	28/02/2020
CM9 Ref:	2019/199838
Related RQ / RO No. and TRIM Ref: (if any):	RQ-UKHPR1000-0088 (CM9 2018/149334) RQ-UKHPR1000-0184 (CM9 2019/19509) RQ-UKHPR1000-0237 (CM9 2019/124138)
Observation title:	Veracity of PSA Data
Lead technical topic:	Related technical topic(s):
15. Probabilistic Safety Analysis	9. Fault Studies 11. Human Factors

Regulatory Observation

Background

ONR's safety assessment guidance expects that the overall level of risk arising from the design of new nuclear power plants be analysed with probabilistic safety analysis (PSA). ONR expects PSA be used as a key tool in any new nuclear power plant design to help demonstrate that the level of risk represented by the design has been reduced ALARP. The validity of any PSA estimation of the level of risk depends on the veracity of the data that is used to create the PSA model.

The requesting party (RP) has submitted PSA models and associated reports that are being assessed by ONR. The reliability information that has been used as an input to the UK HPR1000 PSA is stated by the RP (Ref. 5) to be 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. 1), or from the 2015 version of NUREG-6928 (Ref. 2). ONR has observed:

- that the PSA reliability information that was used as an input to the UK HPR1000 PSA has not been sufficiently justified;
- the process by which the Chinese operating experience used to create the Chinese national database was obtained, screened and bounded has not been adequately justified;
- the reliability information may be optimistic due to the small sample size of the Chinese nuclear fleet data; and,
- it is not clear that the RP's approach used to combine the two generic databases has used appropriate methods.

Based on assessment to date regarding the UK HPR1000 PSA reliability information (Refs 4, 5, 6 and 7) ONR judges there to be a gap between regulatory expectations and the RP's submissions on this subject. Further work will need to be done by the RP to ensure that the PSA meets UK expectations during GDA. Thus, this RO has been generated to address this shortfall.

Relevant Legislation, Standards and Guidance

The following Safety Assessment Principles (SAPs) (Ref. 8) are relevant to this RO.

Fault analysis: PSA	Adequate representation	FA.13
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The PSA model should provide an adequate representation of the facility and/or site.

656. Facility-specific data should be used as far as possible for the calculation of the frequencies and probabilities used in PSA. However:
- (a) where facility-specific data is not available, use of generic data may be acceptable provided its applicability is justified and the data sources selected are used in a consistent and systematic manner.
 - (b) where facility-specific data is not sufficient, it should be combined with applicable generic data using a well-established mathematical technique.
 - (c) where neither facility-specific nor generic data is available, use of expert judgement may be acceptable, provided that the basis for the judgement is justified and documented, and careful consideration given to the impact of these judgements on the PSA results.

Fault analysis: PSA	Use of PSA	FA.14
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PSA should be used to inform the design process and help ensure the safe operation of the site and its facilities.

662. PSA models and data should be suitable for their intended application, and sensitivity and uncertainty analyses undertaken as appropriate. In cases where the PSA is not full scope, due account should be taken of the potential impact of aspects not covered.

Fault analysis: assurance of validity of data and models	Use of data	AV.3
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The data used in the analysis of aspects of plant performance with safety significance should be shown to be valid for the circumstances by reference to established physical data, experiment or other appropriate means.

686. The limits of applicability of the available data should be identified and extrapolation beyond these limits should not be used unless justified.

The ONR PSA Technical Assessment Guide (TAG) (Ref. 9) provides further details of ONR's expectations for reliability data that is used as an input to the PSA models for the UK HPR1000, in particular Sections 4.5 part 3) – PSA Data, 4.9 and Table A1-2.6.1.

Regulatory Expectations

ONR's regulatory expectations are that the PSA reliability information which is used as the basis for the UK HPR1000 PSA should be appropriately justified, in line with the standards and guidance noted above. In response, ONR would therefore expect the RP to provide information which should:

1. Contain reliability figures that were sourced from a long 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.
2. The reliability figures have been obtained, sourced, and selected, rejected, given precedence and assigned boundaries according to a valid methodology.
3. Where several sources of data are combined, the method to combine them is coherent and complete.

References

- [1] *Chinese Components Reliability Data Report for Nuclear Power Plant*, NNSA, November 2016.
- [2] *Industry-average performance for components and initiating events at U.S. commercial nuclear power plants*, NUREG/CR-6928, US NRC, 2007. www.nrc.gov/docs/ML0706/ML070650650.pdf
- [3] RQ-UKHPR1000-0088, CM9 Ref. 2018/149334
- [4] *Level 1 Internal Events PSA*, GHX00650001DOZJ02GN, Rev. A, CGN, October 2018, CM9 Ref. 2018/350941
- [5] *PSA Data Analysis Report*, GHX00650015DOZJ02GN, Rev. E, CGN, April 2019, CM9 Ref. 2019/96114
- [6] RQ-UKHPR1000-0184, CM9 Ref. 2019/19509
- [7] RQ-UKHPR1000-0237, CM9 Ref. 2019/124138
- [8] *Safety Assessment Principles for Nuclear Facilities*, 2014 Edition, Revision 0, Office for Nuclear Regulation, 2014. www.onr.org.uk/saps/saps2014.pdf
- [9] *Nuclear Safety Technical Assessment Guide, Probabilistic Safety Assessment*, NS-TAST-GD-030 Revision 5, Office for Nuclear Regulation, 2016. www.onr.org.uk/operational/tech_asst_guides/index.htm

Regulatory Observation Actions

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

In response to this Regulatory Observation Action, GNS should:

- Provide an adequate justification to demonstrate that the 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. 1) 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 1 and 2), they should provide a suitable and sufficient approach for combining the two generic database that meets UK expectations.

Resolution required by '*to be determined by General Nuclear System Resolution Plan*'

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

In response to this Regulatory Observation Action, GNS should:

- Update the UK HPR1000 PSA with any changes to the UK HPR1000 reliability information that have arisen as a result of Action 2.

Resolution required by '*to be determined by General Nuclear System Resolution Plan*'

REQUESTING PARTY TO COMPLETE

Actual Acknowledgement date:

RP stated Resolution Plan agreement date: