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### REGULATORY OBSERVATION Resolution Plan

<b>RO Unique No.:</b>	RO-UKHPR1000-0047
<b>RO Title:</b>	Suitable and sufficient Level 2 PSA for UK HPR1000
<b>Technical Area(s)</b>	PSA
<b>Revision:</b>	0
<b>Overall RO Closure Date (Planned):</b>	2021-04-30
<b>Linked RQ(s)</b>	RQ-UKHPR1000-0227 RQ-UKHPR1000-0308 RQ-UKHPR1000-0425 RQ-UKHPR1000-0576
<b>Linked RO(s)</b>	RO-UKHPR1000-0020 RO-UKHPR1000-0043
<b>Related Technical Area(s)</b>	2. Civil Engineering 19. Severe Accident Analysis
<b>Other Related Documentation</b>	

#### Scope of Work


#### **Background and Regulator's Expectations**

The Requesting Party (RP) has submitted Level 2 Probabilistic Safety Assessment (PSA) model and report (Ref. 1) for UK HPR1000.

Office for Nuclear Regulation (UK) (ONR) has reviewed the report, the associated model, and the supporting documentation, four RQs were raised by ONR. The full responses to the RQs were assessed and interactions with the Requesting Party (RP) were also held to understand the views of the RP. Based on the assessment conducted to date, there are still shortfalls of Level 2 PSA that need to be finished during Generic Design Assessment (GDA) in order to ensure that a suitable and sufficient level 2 PSA is produced during GDA.

ONR expects the RP to:

- 1) Develop and document a rationale and clear definition of Large Release, and showing how that rationale leads to the grouping of release categories into 'large vs. non-large' that has been used in the PSA.
- 2) Develop and document reasoned basis for the release category attributes inclusion or exclusion from the release category definitions, and consider relevant good practice to consider the

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warning time attribute and disposition in the release category definitions.

- 3) Develop and document the models used to characterise the loss of containment integrity explicitly with justification, to consider the relevant good practice to include analysis of leakage from the containment as well as rupture of the containment. Adequacy of the modelling performed should be justified.
- 4) Develop and document detailed probabilistic analysis to all potentially significant severe accident phenomena, and take account of the context in which the phenomena occurs, i.e. the detailed evaluations as needed could be performed using boundary conditions that are representative of the accident sequences in which the modelled phenomena occur. All rationales used in developing probability estimates and performing screening or prioritisation of phenomena need to be properly documented and presented.
- 5) Develop and document a structured assessment of the survivability (or operability) of equipment credited in the containment event trees. The results of this assessment may identify equipment which will not survive certain severe accident stresses or it may conclude that most or all equipment will continue to operate, in either case, appropriate analysis and/or justification is expected to support the development of a realistic PSA model.
- 6) Develop and document a systematic Level 2 PSA ALARP review by a detailed discussion of accident contributions to the overall Level 2 PSA risk metrics, including an identification of vulnerabilities, opportunities for improvement of human response or other ALARP measures.

### **Description of the Response and the Scope of Work**

This resolution plan provides a response for the gaps in Level 2 PSA, including the following aspects:

- 1) Develop and document a clear definition of Large Release.
- 2) Develop and document sufficient level of detail documentation on release category definitions and interface with the Level 3 PSA.
- 3) Develop and document a sufficient level of detail and scope of containment fragility and supporting analysis.
- 4) Develop and document sufficient level of detail of phenomenology analysis supporting the containment event tree modelling.
- 5) Develop and document a structured analysis of equipment survivability.
- 6) Develop and document a systematic Level 2 PSA ALARP review.

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### Deliverable Description

#### **RO-UKHPR1000-0047.A1 – Produce and document a suitable and sufficient Level 2 PSA**

Regulatory Observation states that:

- ✓ *Action 1.1 : Produce appropriate analysis and justifications to address all the shortfall discussed in the RO relating to:*
  - *Action 1.1 -1: Definition of Large Releases*
  - *Action 1.1 -2:Release category definitions and interface with the Level 3 PSA*
  - *Action 1.1 -3:Containment fragility and supporting analysis*
  - *Action 1.1 -4:Phenomenology analysis supporting the containment event tree modelling*
  - *Action 1.1 -5:Equipment survivability analysis*
  - *Action 1.1 -6:Level 2 PSA ALARP review*
- ✓ *Action 1.2 : Document the analysis and justifications in a revised Level 2 PSA to be submitted as part of Step 4 assessment to ONR.*

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

**For Action 1.1: Produce appropriate analysis and justifications to address all the shortfalls discussed in the RO, RP's plan are given as follows:**

**For Action 1.1-1: Definition of Large Releases, RP will:**

- ✓ Present a clear definition of 'large release' based on the international good practices and RP's understanding of it.
- ✓ Define the release categories into 'large vs. non-large' group based the definition of large release.

**For Action 1.1-2: Release category definitions and interface with the Level 3 PSA, RP will:**

- ✓ Select the Release Category(RC) attributes for UK HPR1000.
- ✓ Develop the RCs grouping map to determine the RC groups and present a clear definition for each RC.
- ✓ Assign the containment event tree(CET) sequences end states with RCs and calculate RC frequency.
- ✓ Present the interface with the Level 3 PSA, give the source term and frequency of each RC to support the analysis of Level 3 PSA, including the basic inventory, release parameters, release fractions, iodine species fractions, release energy, release location and release phase.

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**For Action 1.1-3 Containment fragility and supporting analysis, RP will:**

- ✓ Firstly, identify the failure modes of containment including functional failure.
- ✓ Secondly, develop the adequate models used for the containment performance analysis.

**For Action 1.1-4 Phenomenology analysis supporting the containment event tree modelling, RP will :**


- ✓ Select a typical phenomenon, and develop the probability based on the plant specific deterministic analysis of UK HPR1000.
- ✓ Perform justification and applicability analysis for the probability from generic data based on the analysis of the following aspects:
  - The mechanism of the phenomenon.
  - Severe accident mitigation measures.
  - The advanced design of the containment of UK HPR1000.

**For Action 1.1-5 Equipment survivability, RP will :**

- ✓ Firstly, present methodology and requirement of equipment qualification for UK HPR1000, especially for the severe accident equipment qualification.
- ✓ Secondly, identified equipments modelled in Level 2 PSA which may be affected by the severe accident environment, but without severe accident equipment qualification.
- ✓ Thirdly, make an assumption that the equipment identified in previous step is survivable and perform sensitivity analysis for its survivability.

**For Action 1.1-6 Level 2 PSA ALARP review, RP will develop and document a detailed process for using the Level 2 PSA and its results to identify the potential options for design improvement to reduce the risks of the generic UK HPR1000 design to ALARP.** The process includes:

- ✓ Use the PSA results to identify potential improvements.
- ✓ Use the PSA to inform the optioneering of improvements identified through other means.

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<p><b>For Action 1.2 Document the analysis and justifications in a revised Level 2 PSA to be submitted as part of Step 4 assessment to ONR , RP plans to document the works referred in Action 1.1 in the following reports:</b></p> <ul style="list-style-type: none"> <li>✓ The documentation from Action 1.1-1 to Action 1.1-5 will be provided in the Level 2 PSA(Rev.A) report to be submitted by 30/09/2020.</li> <li>✓ The documentation of Action 1.1-6 will be provided in the PSA ALARP Demonstration Report (Rev. C) to be submitted by 31/12/2020.</li> </ul>			
<b>Impact on the GDA Submissions</b>			
<ul style="list-style-type: none"> <li>• Level 2 PSA report (Rev. A) to be submitted by 30/09/2020.</li> <li>• PSA ALARP Demonstration Report (Rev. C) to be submitted by 31/12/2020.</li> <li>• Level 3 PSA report (Rev. A) to be submitted by 15/01/2021.</li> </ul>			
<b>Timetable and Milestone Programme Leading to the Deliverables</b>			
See attached Gantt Chart in APPENDIX A.			
<b>Reference</b>			
<u>References</u> [1] CGN, Internal Events Level 2 PSA, 2018, CM9 2018/378858			

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APPENDIX A RO-UKHPR1000-0047 Gantt Chart

Tasks and Schedule	2020												2021			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
<b>RO Action 1.2</b>																
Submission of " Level 2 PSA (Rev A)"																
<b>RO Action 1.2</b>									▲							
Submission of "PSA ALARP Demonstration Report" (Rev. C)																
<b>Assessment</b>													▲			
Regulators Assessment																
Target RO Closure Date																▲