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REGULATORY OBSERVATION Resolution Plan	
RO Unique No.:	RO-UKHPR1000-0002
RO Title:	Demonstration that the UK HPR1000 Design is Suitably Aligned with the Generic Site Envelope
Technical Area(s)	External Hazards
Revision:	Rev 0
Overall RO Closure Date (Planned):	30/12/2019
Linked RQ(s)	RQ-UKHPR1000-0008/RQ-UKHPR1000-0009
Linked RO(s)	-
Related Technical Area(s)	2. Civil Engineering 3. Control & Instrumentation 7. Electrical Engineering 14. Mechanical Engineering 20. Structural Integrity
Other Related Documentation	-

Scope of Work

Background

General Nuclear System Limited (GNS) submitted a UK HPR1000 Generic Site Report (Ref. 1) which defines the Generic Site Envelope and a Preliminary Safety Report (PSR) Chapter 18 (Ref. 2) which gives values for external hazards magnitudes based on Fangchenggang 3 (FCG 3) nuclear power plant.

There are some gaps in the design basis between FCG 3 and UK HPR1000 Generic Site Envelope, including some new external hazards considered in UK HPR1000 and design basis parameter values for FCG 3 that do not bound the Generic Site Envelope. These gaps will be described in the resolution plan to RO-UKHPR1000-0002.

In Step 2 of GDA, ONR has stated through RO-UKHPR1000-0002 that they have insufficient information to form a judgement on the likely impact on the UK HPR1000 design due to the differences in external hazards design basis assumed for FCG 3 and the Generic Site Envelope, and hence UK HPR1000's suitability for deployment in the UK.

ONR's expectation is that the UK HPR1000 safety case for GDA should provide an adequate demonstration that the design is robust against external hazards and relevant risks are reduced to As Low As Reasonably Practicable (ALARP).

Abbreviations and Acronyms

ALARP	As Low As Reasonably Practicable
EMC	Electromagnetic Compatibility
FCG3	Fangchenggang nuclear power plant Unit 3
GDA	Generic Design Assessment
GNS	General Nuclear System Limited
HVAC	Heating, Ventilation and Air Conditioning System
ONR	Office for Nuclear Regulation
PSR	Preliminary Safety Report
RO	Regulatory Observation
RRI	Component Cooling Water System
SEC	Essential Service Water System
SSCs	Structures, Systems and Components
UK	United Kingdom of Great Britain and Northern Ireland
UK HPR1000	The UK Version of the Hua-long Pressurized Reactor

Scope of work

According to the PSR Chapter 18 and UK HPR1000 Generic Site Envelope, the gaps identified include extreme air/water temperature, extreme snow, extreme icing, seismic and space weather.

The impacted technical disciplines due to the gaps will be identified, the main technical disciplines by preliminary assessment have been identified as follows:

- Civil Engineering
  Main impact caused by extreme snow, extreme icing and seismic;
- Control & Instrumentation
  Main impact caused by space weather;
- Electrical Engineering
  Main impact caused by space weather;
- Mechanical Engineering
  Main impact caused by extreme air/water temperature;
- Structural Integrity
  Main impact caused by seismic.

A gap evaluation will be conducted and the impacted SSCs will be identified which require potential modification. The design will demonstrate that the risk from external hazards is ALARP. To address RO-UKHPR1000-0002, nine topic reports will be produced in the Deliverable Description:

- External hazards gap identification and evaluation report;
- External hazards gap resolution strategy report;
- HVAC systems analysis report;
- Structural analysis and design report;

- Seismic analysis for structure report;
- Control & Instrumentation System protection design against space weather report;
- Electrical Power System protection design against space weather report;
- SEC/RRI system analysis report;
- Modification of UK HPR1000 design for external hazards summary report.

This Resolution Plan describes the current plan to address RO-UKHPR1000-0002; however, as the work develops, it may be necessary to choose an alternative means to address RO-UKHPR1000-0002 in agreement with the regulators.

Deliverable Description

RO-UKHPR1000-0002.Action 1 – FCG 3 design bases and Generic Site Envelope external hazards gap analysis

The RO action 1 states that:

GNS should provide a suitable and sufficient evaluation/gap analysis of the impact of the differences between the external hazards, and their magnitudes, used for the FCG 3 reference plant design and those defined in the Generic Site Envelope. ONR would expect GNS to:

- *Identify external hazards in the Generic Site Envelope not considered in the design of FCG 3;*
- *Identify external hazards whose design bases for the FCG 3 reference plant do not bound the Generic Site Envelope;*
- *Explain how the gaps identified will be addressed during GDA (ie what methodologies/ processes/procedures), and by when;*
- *Identify the relevant SSCs affected by the difference in design basis between FCG3 and the Generic Site Envelope.*

Resolution Plan

For Action 1, a gap identification and evaluation report will be submitted before 31/08/2018, the main aspects are as follows:

- Gap identification of external hazards between FCG 3 and Generic Site Envelope;
- Identification of impacted technical disciplines of the gaps;
- Identification of main SSCs affected by the gaps;
- The procedure to address the identified gaps.

Gaps have been identified by comparison of the external hazard and its magnitude in PSR Chapter 18 with UK HPR1000 Generic Site Envelope in RQ-UKHPR1000-0008 (Ref. 3) and from information presented by GNS during Level 4 meetings with ONR in January 2018 (Ref. 4). The

main gaps are described in table T-1.

T-1 The Main Identified Gaps

Parameter		FCG Unit3	Generic Site Envelope
Air Temperature	Maximum	37.9°C	41.5°C
	Minimum	-1.8°C	-22°C
Snow	Maximum	None	1.5 kPa
Water Temperature	Maximum	38°C	28°C
	Minimum	8.9°C	-2°C
Icing	Clear Ice Thickness	None	117 mm
	Clear Ice Density	None	9 kN/m
Seismic	Shear wave velocity	1100 m/s to 3000 m/s	Site specific
Space weather	---	None	---

RO-UKHPR1000-0001.Action 2– Substantiation of relevant UK HPR1000 SSCs against external hazards

The RO action states that:

In response to this Regulatory Observation Action, ONR would expect GNS to provide a proportionate justification, taking into account:

- *The response to ROA1 under this RO;*
- *The claims made in the external hazards safety case;*
- *The nuclear safety significance (ie categorisation and classification) of the relevant SSCs;*
- *The UK requirement to demonstrate that, overall, relevant risks are reduced to ALARP.*

Resolution Plan

Preliminary assessments by the impacted topic areas have identified SSCs impacted by the gaps in site characteristic parameters, an outline plan of deliverables has been developed:

1) External Hazards Gap Resolution Strategy Report

The objective of this report is to provide the strategy to evaluate the gaps and to demonstrate the risks caused by gaps are ALARP, this report will be submitted before 31/10/2018. The main aspects are:

- Claims made in external hazards safety case;

- The strategy to evaluate gaps for relevant SSCs;
- The strategy to demonstrate the risks are reduced to ALARP.

2) HVAC Systems Analysis Report

The objective of this report is to provide the gap analysis for HVAC systems which affected by air temperature, this report will be submitted before 30/04/2019. The main aspects are:

- Air temperature design basis analysis;
- The gaps identified for HVAC systems;
- The gaps analysis for HVAC systems;
- ALARP analysis for HVAC systems.

3) Structural Analysis and Design Report

The objective of this report is to provide the gap analysis for civil structure design which affected by snow and icing, this report will be submitted before 30/04/2019. The main aspects are:

- Main contents of structural design of the buildings;
- Modelling of the structures;
- Single load case analysis (including snow and icing load cases);
- Load combination analysis;
- Structure analysis;
- Strength and serviceability analysis.

4) Seismic Analysis for Structure Report

The objective of this report is to provide the gap analysis for seismic protection design which affected by shear wave velocity, this report will be submitted before 30/04/2019. The main aspects are:

- Seismic analysis model;
- Seismic analysis input data;
- Soil-Structure interaction analysis process and results;
- Seismic analysis results, e.g. acceleration, response spectrum, etc.;
- Stability analysis of buildings;
- ALARP analysis for seismic protection design.

5) Control & Instrumentation System Protection Design against Space Weather

The objective of this report is to address the gap analysis for Control & Instrumentation System protection design affected by space weather. It mainly addresses Electromagnetic Compatibility (EMC) qualification, this report will be submitted before 31/12/2018. The main aspects are:

- Space weather effect;
- The general requirements of space weather protection;
- Protection measures for Control & Instrumentation System design.

6) Electrical Power System Protection Design against Space Weather

The objective of this report is to address the gap analysis for Electrical Power System protection design affected by space weather. It mainly addresses geomagnetic induced current and electromagnetic compatibility, this report will be submitted before 30/04/2019. The main aspects are:

- Space weather effect;
- The general requirements of space weather protection;
- Protection measures for Electrical Power System design.

7) SEC/RRI System Analysis Report

The objective of this report is to evaluate SEC/RRI system design affected by UK HPR1000 generic site water temperature, this report will be submitted before 31/12/2018. The main aspects are:

- Water temperature design basis analysis;
- The evaluation of SEC/RRI systems for UK generic site water temperature;
- ALARP analysis for SEC/RRI system design.

RO-UKHPR1000-0001.Action 3– Impact on the UK HPR1000 generic design

The RO action states that:

In response to this Regulatory Observation Action, GNS should identify any aspects of the generic design that require modification to meet the requirements of the generic safety case and GDA Generic Site Envelope. The response should provide GNS' strategies, plans and timescales to deal with any necessary modifications that may need to be made to the UK HPR1000 generic design during GDA. This should also include a clear identification and justification for any work that may need to be undertaken post-GDA.

Resolution Plan

According to the analysis result from Action 2, a summary report of planned modifications of the UK HPR1000 generic design will be submitted before 31/08/2019, the main aspects are as follows:

- Summary of SSCs requiring modification;
- Strategies, plans and timescales to deal with any necessary modifications including post-GDA.

Detailed implementation of the potential modifications will be managed via the UK HPR1000 design modification process which considers all inputs and interfaces for potential modifications to ensure a holistic consideration of risk reduction and ALARP justification.

For the nine documents outlined in response to Action 1, 2 and 3. The anticipated timescales to submit these documents are given in Appendix A. A period to allow ONR consideration of the technical reports for the close out of the RO is included in the schedule.

Impact on the GDA Submissions

The updated information will be incorporated into PCSR Chapter 18 V0 /V1/V2 submitted at the different GDA Steps.

Related PCSR chapters and their supporting submissions will also be impacted. The full extent of interfacing PCSR chapter and supporting references impacted will be determined once the gap analysis and identification of SSCs impacted is completed.

Timetable and Milestone Programme Leading to the Deliverables

See attached Gantt Chart in APPENDIX A.

References

[1] UK HPR1000 Generic Site Report Rev. 0, HPR/GDA/REPO/0015, November 2017. TRIM 2017/422938.

[2] Preliminary Safety Report Chapter 18 External Hazards, Rev. 0, HPR/GDA/PSR/0018. TRIM 2017/401381.

[3] Definition and applicability of the Generic Site Envelope (external hazards) – Full Response RQ-UKHPR1000-0008, 8 January 2018. TRIM 2018/7185.

[4] ONR-CR-NR-17-661, External Hazards Workshop Level 4.TRIM 2018/43923.

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APPENDIX A RO-UKHPR1000-0002 Gantt Chart