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REGULATORY OBSERVATION Resolution Plan

RO Unique No.:	RO-UKHPR1000-0014
RO Title:	Spent Fuel Building – Design of Nuclear Lifting Operations to Demonstrate Relevant Risks are Reduced to ALARP
Technical Area(s)	Mechanical Engineering
Revision:	Rev 0
Overall RO Closure Date (Planned):	30/04/2021
Linked RQ(s)	RQ-UKHPR1000-0261 (2019/183333) RQ-UKHPR1000-0262 (2019/183338) RQ-UKHPR1000-0263 (2019/183359) RQ-UKHPR1000-0267 (2019/183368) RQ-UKHPR1000-0268 (2019/183392) RQ-UKHPR1000-0270 (2019/183397) RQ-UKHPR1000-0404 (2019/218988)
Linked RO(s)	-
Related Technical Area(s)	2. Civil Engineering 3. Control & Instrumentation 5. Conventional Health & Safety 9. Fault Studies 10. Fuel & Core 11. Human Factors 12. Internal Hazards 16. Radiological Protection 17. RadWaste, Decommissioning & Spent Fuel Management
Other Related Documentation	-

Scope of Work

Background

After reviewing the documents submitted, ONR judges that there are features of the UK HPR1000 Fuel Handling and Storage System (PMC [FHSS]) that may expose operators to conventional health and safety and radiological hazards/risks that may be avoidable. Therefore, ONR raised a Regulatory Observation (RO-UKHPR1000-0014) titled “Spent Fuel Building – Design of Nuclear Lifting Operations to Demonstrate Relevant Risks are Reduced to ALARP” to address the issues they have identified associated with nuclear lifting and handling operations in the fuel building.

RO-UKHPR1000-0014 places the following actions:

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- RO-UKHPR1000-0014.A1– Fuel Building handling operations and hazard identification
- RO-UKHPR1000-0014.A2– Fuel Building consequence analysis
- RO-UKHPR1000-0014.A3 – Fuel Building optioneering and demonstration relevant risks are reduced SFAIRP

Scope of work

Recognising ONR's concerns, this RO focuses on the safety demonstration of the design of Fuel Handling and Storage System. It includes all activities beginning with the receipt of new fuel assembly on site and ending with spent fuel off-reactor delivery in the fuel building to the Spent Fuel Interim Storage (SFIS) facility. The purpose of the work is to demonstrate the risks related to nuclear, conventional health and safety and radiological protection are reduced ALARP.

This resolution plan describes the Requesting Parties current plan to satisfy the concerns presented in this RO. It contains the general strategy, planned activities, submissions, timescales, as well as resources assignment.

Plan and Deliverable Description

The main actions required to resolve this RO are described as follows.

RO-UKHPR1000-0014.A1 – Fuel Building handling operations and hazard identification

Actions requested by the Regulator as stated in the RO:

- 1) *Generate detailed flow diagrams that adequately describe the new and spent fuel handling operations.*
- 2) *Review the design of the Spent Fuel Building and identify the nuclear, radiological and conventional health and safety hazards that are present.*

Resolution Plan:

- 1) To supplement the description of the new fuel and spent fuel handling operations, to facilitate ONR's understanding of the design of UK HPR1000, a new document will be produced. This document will detail the steps of fuel handling process and operations. Detailed flow diagrams of nuclear lifting operations will be included in this document.
- 2) The design and layout of the fuel handling and storage system will be reviewed. This multidiscipline review will identify the nuclear, radiological and conventional health and safety hazards associated with the nuclear lifting operations. Examples include crane clashes, dropped load, falls from height, etc. Summary reports will be produced to present the design and layout review and hazards identification.

Deliverables (reports):

- 1) Fuel Handling Process and Operations
 - The scope and constitution of fuel handling and storage system
 - The detailed operations of fuel handling process

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- Detailed flow diagrams of these sub-processes and operations
- 2) Fuel Handling Related Operations Hazards
- Potential failure mode of fuel handling equipment
 - Potential human errors during fuel handling process
 - Identification of potential hazards

Resources: CGN Mechanical Engineering (ME) team, Human Factors team, Radiological Protection team, Conventional health and safety team.

RO-UKHPR1000-0014.A2 – Fuel Building consequence analysis

Actions requested by the Regulator as stated in the RO:

- 1) *Undertake a proportionate consequence analysis/assessment to determine the worst case scenarios (e.g. at the fully raised position) that could result from the hazards identified.*

Resolution Plan:

Further consequence analysis/assessment of the hazards identified via ROA 1 will be undertaken. This will identify the potential worst case consequence from each hazard, with respect to significant nuclear safety, radiological dose and conventional health and safety.

Deliverable (report):

- 3) Fuel Handling Related Operations Consequence Assessment
 - Analyse the consequence of potential hazards
 - Determine the worst case scenarios

Resources: CGN ME team, PSA team, Internal Hazards team, Radiological Protection team, Civil Engineering team.

RO-UKHPR1000-0014. A3 – Fuel Building optioneering and demonstration relevant risks are reduced SFAIRP

Actions requested by the Regulator as stated in the RO:

- 1) *Compliance with the statutory requirements of UK legislation;*
- 2) *For new fuel handling, spent fuel storage and handling, and spent fuel export operations, the chosen option(s) which reduces risks SFAIRP has been selected; and*
- 3) *A process of optimisation has been followed in a robust, transparent manner, which forms part of the UK HRP1000 generic safety case.*

Resolution Plan:

The results of ROA1 and ROA2 (Lifting Hazards and Consequences) will inform ROA3 (ALARP judgement).

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The fundamental requirement of UK legislation is that risk assessments should be undertaken for all nuclear lifting operations in order to ensure that the risks are reduced SFAIRP. To meet this requirement the following actions will be undertaken:

- a) Compliance analysis with UK legislation - The design and layout of the fuel handling and storage system will be reviewed against statutory requirements and RGP. Any gaps between the UK HPR1000 design and UK legislation will be identified.

Note - Should any specific gaps against UK mandatory requirements be identified these will be discussed with ONR at the earliest opportunity.

- b) Optioneering – In order to address the identified gaps, the following work will be undertaken:
- 1) Define and characterise the problem (potential area for improvement);
 - 2) Generate the potential options to address the problem;
 - 3) Assess the options and their merits/drawbacks;
 - 4) Identify, develop and justify the best option or options;
 - 5) Implement the reasonably practicable options.

Finally, it will be concluded the selected option has reduced the risks to an ALARP level and therefore no further reasonably practicable improvements can be implemented into the design.

The optioneering will be carried out according to the guidance in *Optioneering and Decision-Making*, Reference [1].

The existing *ALARP Assessment of the PMC [FHSS] SSCs* will be updated to justify the fuel handling operations.

Two new ALARP assessment reports will be specifically produced to cover concerns contained in this RO.

- The first ALARP report considers the Arrangement of BFX Cranes, which is to justify the design and layout of the cranes installed in the fuel building.
- The second report is ALARP Assessment Report of the Spent Fuel Delivery Operations, which is to justify the design and layout of spent fuel off-reactor delivery process in the fuel building.

The ALARP assessment will be carried out according to the guidance in *ALARP Methodology*, Reference [2].

In these reports, compliance analysis with RGP will be addressed. The optioneering process will be presented to demonstrate the option(s) which reduces risks SFAIRP has been selected. All the issues raised by ONR in this RO will be covered by these assessment reports.

Deliverables (reports):

- 4) ALARP Assessment of the PMC [FHSS] SSCs– existing report to be updated
 - Introduce the evolution of reference design

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- Analyse the compliance with UK mandatory requirements and RGPs
 - Review relevant operation experiences
 - Collect insights from risk assessment
 - Optioneering and decision-making
- 5) ALARP Assessment of the BFX Cranes Arrangement
- Identify potential risks of the current BFX crane arrangement and lifting process against UK mandatory requirements and RGP
 - Undertake optioneering for the BFX Cranes Arrangement and process if there are risks identified
 - Reasonably practicable design improvements
- 6) ALARP Assessment Report of the Spent Fuel Delivery Process
- Identify potential risks of the current spent fuel delivery process against UK mandatory requirements and RGP
 - Undertake optioneering of the spent fuel delivery process if there are risks identified
 - Reasonably practicable design improvements

Resources: CGN ME team, systems engineering sections and equipment design sections involved.

Reference

- [1] General Nuclear System, Ltd., Requirements on Optioneering and Decision-Marking, HPR/GDA/PROC/0012, Rev. 0, 2018
- [2] CGN, ALARP Methodology, GHX00100051DOZJ03GN, Rev. B, 2018

Impact on the GDA Submissions


The results of the gap analysis may lead to design modifications. These will be reflected in the UK HPR1000 safety case documentation. The list of impacted submissions, for RO-HPR1000-0014, will be submitted before December 31, 2020.

Examples of affected UK HPR1000 safety case documentation may include:

- UK PCSR Sub-chapters
- System Design Manuals
- Support Evidence Documents

Deliverables:

The list of RO-HPR1000-0014 submissions is presented below.


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Timetable and Milestone Programme Leading to the Deliverables

The planned submissions and date are listed in the following table.

No.	Report Title	Planned Submission Date
1	Fuel Handling Process and Operations	31 December 2019
2	Fuel Handling Related Operations Hazards	31 March 2020
3	Fuel Handling Related Operations Consequence Assessment	30 June 2020
4	ALARP Assessment of the PMC [FHSS] SSCs – updated version	30 September 2020
5	ALARP Assessment of the BFX Cranes Arrangements	31 December 2020
6	ALARP Assessment of the Spent Fuel Delivery Process	31 December 2020

See attached Gantt Chart in APPENDIX A.

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APPENDIX A RO-UKHPR1000-0014 Gantt Chart

Task and Schedule	2019		2020												2021				
	30-Nov	31-Dec	31-Jan	29-Feb	31-Mar	30-Apr	31-May	30-Jun	31-Jul	31-Aug	30-Sep	31-Oct	30-Nov	31-Dec	31-Jan	28-Feb	31-Mar	30-Apr	31-May
RO Action 1																			
Development and submission of [Fuel Handling Process and Operations]																			
Development and submission of [Fuel Handling Related Operations Hazards]																			
Target ROA1 Close Date								▲											
RO Action 2																			
Development and submission of [Fuel Handling Related Operations Consequence Assessment]																			
Target ROA2 Close Date										▲									
RO Action 3																			
Update and submission of [ALARP Assessment of the PMC [FHSS] SSCs (updated version)]																			
Development and submission of [ALARP Assessment of the BFX Cranes Arrangements]																			
Development and submission of [ALARP Assessment of the Spent Fuel Delivery Process]																			
Target ROA3 Close Date																		▲	
Assessment																			
Regulatory Assessment																			
Target RO Close Date																			▲