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REGULATORY OBSERVATION Resolution Plan

RO Unique No.:	RO-UKHPR1000-0037
RO Title:	In-Core Instrument Assemblies Radioactive Waste Safety Case
Technical Area(s)	Radwaste, Decommissioning & Spent Fuel Management
Revision:	0
Overall RO Closure Date (Planned):	2021-01-31
Linked RQ(s)	RQ-UKHPR1000-0265;RQ-UKHPR1000-0406
Linked RO(s)	RO-UKHPR1000-0005
Related Technical Area(s)	Mechanical Engineering,Radiological Protection,Fuel & Core,Control & Instrumentation
Other Related Documentation	

Scope of Work


Background

ONR has commenced Step 4 of the Generic Design Assessment (GDA) for the UK HPR1000. During Step 3 of the GDA ONR sought information concerning the Requesting Party's (RP's) demonstration that non-fuel core components (NFCCs) can be managed safely, so that the relevant risks associated with their: retrieval, processing, packaging, transport and storage can be demonstrated to be reduced to as low as reasonably practicable (ALARP).

NFCCs are typically metal components used inside the nuclear reactor core, and are therefore subjected to an intense neutron flux during their operational life, and become activated. NFCC is a collective term for three types of components: Rod Cluster Control Assemblies (RCCA), Stationary Core Component Assemblies (SCCA) and In-Core Instrumentation Assemblies (ICIAs).

ONR's expectation is that the UK HPR1000 generic safety case should provide an adequate demonstration that risks relevant to radioactive waste management are reduced to ALARP. To achieve this, as part of the resolution of the RO, the RP should provide the following:

- Evidence that the inconsistencies in the ICIA management strategy have been resolved within the RP's submissions.
- Evidence to demonstrate that the risks associated with the; retrieval, processing, packaging, transport and storage of the ICIAs, can be demonstrated to be ALARP. This should take into account Relevant Good Practice (RGP) and provide a robust justification for what the RP considers to be RGP, and

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identify any gaps.

- Evidence that the generic safety case demonstrates that ICIA's can be safely managed within the UK HPR1000 facilities throughout the ICIA lifecycle.

The Regulatory Observation Actions (ROAs) given below are structured in such a way to enable provision of this information in a logical and step-wise manner, to facilitate ONR's assessment. More detailed regulatory expectations are also articulated under each ROA.

Early in Step 3 of GDA, ONR raised RO-UKHPR1000-0005 titled *Demonstration that the UK HPR1000 Design Reduces the Risks Associated with Radioactive Waste Management, So Far As is Reasonable Practicable*. ONR would therefore expect the RP to take account of any inter-dependencies between the work being delivered to resolve RO-UKHPR1000-0005 and work to address this RO.

Scope of work

The Resolution Plan presented below describes current plan to address the RO.

It details the actions and timescales for the development of the management strategy and safety analysis related to the spent In-Core Instrumentation Assemblies (ICIA's) for the UK HPR1000, including those relevant to generation, retrieval from reactor core, packaging, handling and transfer within buildings and interim storage in relevant on-site facilities (Spent Fuel Interim Storage Facilities (BQF) and/or ILW Interim Storage Facility (BQZ)).

The resolution plan presents all the work that that provides a response to this RO, including the work that is already planned and any new work required.


Deliverable Description

Action. 1 – Robust Definition of ICIA Lifecycle Characteristics

In response to this ROA, the RP should:

- *Provide information on, and a suitable justification for, the radioactive waste classification (i.e. Low Level Waste (LLW), Intermediate Level Waste (ILW) or High Level Waste (HLW)) of all types and components of ICIA's;*
- *Given the assumption that ILW will be interim stored until the Geological Disposal Facility (GDF) is available, information on whether any of the ICIA's are expected to decay to LLW during the storage period;*
- *Justify the basis for the decay storage period selected for the relevant type of ICIA, including any uncertainty relating to the defined decay period; and*

The response to this ROA may be combined with any other ROA under this RO, if deemed appropriate.

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Resolution Plan

To address this action, the following work will be carried out:

- a) Based on the detailed source term information of the 3 types of ICIAAs:
 - Information and justification of the proposed (at source) classification and segregation into HLW/ILW/LLW will be provided, considering where relevant and possible uncertainties in the source term calculations;
 - Decay analysis will be undertaken to determine the necessary time to decay any HLW to ILW and, where applicable, any ILW to LLW. Relevant information and justification from the analysis will be provided;
- b) Based on the above, proposal for ICIAAs classification/segregation and resulting management (including decay storage proposal as relevant) will be substantiated for UK HPR1000.

The report *Waste Inventory for Operational Solid Radioactive Waste*, and if necessary *Activated Structures Source Term Supporting Report*, will be updated to present information from item a) and will be submitted by 30th June 2020;

The report *Management Proposal of Waste Non-Fuel Core Components*, will be updated to present information from item b) and it will be submitted by 30th August 2020.

Action. 2 – Robust Management Strategy for ICIAAs.

In response to this ROA, and based on the outcome of ROA1 above, the RP should:

- *Justify, or otherwise, whether a period of decay storage for any of the three types of ICIAAs is required within the Spent Fuel Pool (SFP) before they are transferred for interim storage.*
- *Review the selected management strategies against RGP and clearly identify any gaps.*
- *Describe and justify the management strategies for the three types of ICIAAs across the lifecycle from: generation to interim storage, pending disposal. The justification should also include reference to any optioneering undertaken.*

The response to this ROA may be combined with any other ROA under this RO, if deemed appropriate.

Resolution Plan

Based on the holistic review of radioactive waste management against RGP (and/or OPEX), a gap related to ICIAAs management has been identified, reference [1]. In order to address this gap, the report *Management Proposal of Waste Non-Fuel Core Components* has been developed in line with the GDA optioneering process, Reference [2]. It is intended to present the optioneering study that has been undertaken for selecting the UK HPR1000 NFCCs management strategies.

To address this RO action, the report *Management Proposal of Waste Non-Fuel Core Components* will be updated to improve the following aspects:

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- a) The presentation of RGP/OPEX relevant to ICIA's management will be improved (as and where possible), and the reason why a specific management strategy/practice has not been selected for UK HPR1000 will be provided, e.g. the reasons why decay storage in the spent fuel pool (SFP) has not been adopted for UK HPR1000 will be explained.
- b) The information on the management of ICIA's from source to disposal, i.e. generation, retrieval from reactor core and processing, packaging, handling and interim storage, will be improved, including:
- For Generation: Information on measures for ICIA's waste arising minimisation, taking account of the safety requirements for reactor core parameters monitoring which determine the quantities of the three types of ICIA's, reference [3], selection of types (including material) and size of ICIA's, and retrieval frequency / design life time considering any relevant available OPEX.
 - For Retrieval from reactor core and processing: the retrieval process, including cutting and winding steps will be described more clearly and high level information about the winding machine will be added in Appendix of the report, including a sketch of the winding machine, shielding provisions, handling/lifting provisions and a flow chart of the retrieving and processing process. The detailed design of winding machine will be provided in site specific stage.
 - For Packaging: The reason for selection of 500 litre robust shielded drum as waste package will be described more clearly, taking the waste property, container performance, OPEX and information on UK standard containers for GDF into consideration.
 - For Handling: Information on handling and in-building transfer route of the packages will be added (cf. response to RQ-UKHPR1000-0265).
 - For Interim storage: The interim storage option presented in reference [2] had been selected through a high level optioneering. The evidence to underpin the optioneering between the three possible interim storage options (1/ SFIS; 2/ SFIS then ILW ISF; 3/ ILW ISF) will be presented in reference [2].

The updated report *Management Proposal of Waste Non-Fuel Core Components* will be submitted on the 30th of August 2020.

Action. 3 – Appropriately Describe and Document, in the UK HPR1000 Generic Safety Case, the Risks and Hazards Associated with the Management of ICIA's.

In response to this ROA, and based on the outcomes of ROAs 1 and 2 above, the RP should:

- *Provide a clear and logical description, supported by appropriate evidence, of the hazards associated with the management of ICIA's.*
- *Provide suitable and sufficient evidence that any faults associated with the management of the ICIA's have been identified, prevented and/or mitigated, together with an explanation of the measures implemented within the UK HPR1000 design.*
- *Clearly identify relevant limits and conditions in the interest of safety required for the management of ICIA's.*

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- Provide an adequate justification (i.e. evidence) that the relevant risks associated with the management of ICIA's will be reduced to ALARP.

The response to this ROA may be combined with any other ROA under this RO, if deemed appropriate.

Resolution Plan

The risks and hazards assessment will be presented for all the management steps of ICIA's, including retrieval from reactor core, packaging, handling, transfer within buildings and interim storage steps. This will include, as relevant, nuclear safety risks, internal/external hazards, and conventional safety risks. Two new reports will be developed that will provide the safety assessment process and results for identified fault sequences associated with any identified risk/hazard. The design measures to prevent or mitigate the identified risks/hazards to reduce risks ALARP will be clearly identified within the safety assessment as and if relevant. Those two reports will demonstrate that risks associated with the management of ICIA's are reduced to ALARP.


The assessment steps include:

- Review the activities associated with management of ICIA's waste;
- Identify potential risks/hazards as well as the qualitative understanding of their probability/consequences;
- Identification of prevention or mitigation measures as relevant;
- Conclude on risk reduction.

To a level of detail commensurate with the expectations for GDA, the parameters/design features for which Operating Limits and Conditions (OLCs) are likely to be necessary, will be identified according to the safe operation and surveillance requirements (the specific limits/conditions or action levels will not be defined during GDA, nor will the actions in case of limit/level being exceeded or condition not being fulfilled). Examples of such parameters/features include waste loading per drum, package surface dose rate requirement, lift loading capacity, etc.

The following reports will be developed to address this action:

- The report, *Process Risks/Hazards Analysis for ICIA's Retrieval and Processing Operations*, will be developed to address the risk/hazard assessment for ICIA's retrieval from reactor core and processing operations as well as the corresponding OLCs identification (as relevant), as well as design requirements and assumptions relevant to winding machine/retrieval process safety consideration. For the winding machine safety assessment, the risk/hazard analysis will be undertaken at the process level (such as the processes of retrieval, of handling, etc.). This new report will be submitted by 30th September 2020;
- The report, *Process Risks/Hazards Analysis for ICIA's Packaging, Handling and Storage Operations*, will be developed to address the risk/hazard assessment for ICIA's packaging, handling transfer within buildings and storage operation as well as the corresponding OLCs identification (as relevant) and design requirements and assumptions. This new report will be submitted by 30th September 2020;
- Conceptual Proposal of ILW Interim Storage Facility and Preliminary Safety Evaluation of Spent Fuel

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Interim Storage will be updated to include a summary of relevant parts of and a link to the report produced under item 2) above, to provide relevant information on the ICIA's package storage safety analysis by 30th September 2020.

The *ALARP Demonstration Report for Radioactive Waste Management* is a deliverable in the Resolution Plan for RO-UKHPR1000-0005 (raised by ONR in Step 2), with the purpose of demonstrating that the risks associated with radioactive waste management are reduced to ALARP. This was intended to include the risks associated with the management of ICIA's. To enable the closure of both RO-UKHPR1000-0005 and RO-UKHPR1000-0037, the ALARP demonstration for ICIA's management will be provided within the deliverables outlined within this Resolution Plan, and is thus excluded from the scope of RO-UKHPR1000-0005.

Impact on the GDA Submissions

The information that form part of the response to this RO will be appropriately incorporated into the reports identified in the resolution plan described above (as per the plan presented in the Gantt chart) as well as in V2 of relevant PCSR and PCER chapters, notably PCSR Chapter 23, PCSR Chapter 29 and PCER Chapter 4.

Timetable and Milestone Programme Leading to the Deliverables

See attached Gantt Chart in Appendix A.

Reference

- [1] CGN, Gap Analysis Report for Radioactive Waste Management, GHX00100059DNFF03GN, Revision B, 2019.
- [2] CGN, Management Proposal of Waste Non-Fuel Core Components, GHX00100064DNFF03GN, Revision D, 2019.
- [3] CGN, Functional Requirement of the RIC [IIS], GHX00600011DRDG03GN, Revision A, 2019.

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APPENDIX A RO-UKHPR1000-0037 Gantt Chart

	May 2020	June 2020	July 2020	August 2020	Sept 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021
RO Action 1									
Development of deliverable-[Activated Structures Source Term Supporting Report, Revision D]	█								
Submission of deliverable-[Activated Structures Source Term Supporting Report, Revision D]		▲							
Development of deliverable-[Waste Inventory for Operational Solid Radioactive Waste, Revision D]	█								
Submission of deliverable-[Waste Inventory for Operational Solid Radioactive Waste, Revision D]		▲							
Development of deliverable-[Management Proposal of Waste Non-Fuel Core Components, Revision E]	█								
Submission of deliverable-[Management Proposal of Waste Non-Fuel Core Components, Revision E]				▲					
Regulators Assessment					█				
Target ROA1 Closure date								▲	
RO Action 2									
Development of deliverable-[Management Proposal of Waste Non-Fuel Core Components, Revision E]	█								
Submission of deliverable-[Management Proposal of Waste Non-Fuel Core Components, Revision E]				▲					
Regulators Assessment					█				
Target ROA2 Closure date								▲	
RO Action 3									
Development of deliverable-[Process Risks/Hazards Analysis for ICIA's Retrieval and processing Operations, Revision A]			█						
Submission of deliverable-[Process Risks/Hazards Analysis for ICIA's Retrieval and processing Operations, Revision A]					▲				

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Development of deliverable-[Process Risks/Hazards Analysis for ICIA's Packaging, Handling and Storage Operations, Revision A]									
Submission of deliverable-[Process Risks/Hazards Analysis for ICIA's Packaging, Handling and Storage Operations, Revision A]									
Submission of deliverable-[Conceptual Proposal of ILW Interim Storage Facility]									
Submission of deliverable-[Preliminary Safety Evaluation of Spent Fuel Interim Storage]									
Regulators Assessment									
Target RO Closure date									