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REGULATORY OBSERVATION Resolution Plan

RO Unique No.:	RO-UKHPR1000-0005
RO Title:	Demonstration that the UK HPR1000 Design reduces the risks associated with radioactive waste management, so far as is reasonably practicable
Technical Area(s)	RadWaste, Decommissioning & Spent Fuel Management
Revision:	Rev 0
Overall RO Closure Date (Planned):	
Linked RQ(s)	RQ-UKHPR1000-0044 RQ-UKHPR1000-0046 RQ-UKHPR1000-0107
Linked RO(s)	-
Related Technical Area(s)	1. Chemistry 5. Conventional Health & Safety 6. Cross Cutting 11. Human Factors 13. Management of Safety Quality Assurance 14. Mechanical Engineering 16. Radiological Protection 20. Structural Integrity 21. Environmental
Other Related Documentation	-


Scope of Work

Background

ONR issued Regulatory Observation (RO)-UKHPR1000-0005 “Demonstration that the UK HPR 1000 design reduces the risks associated with Radioactive waste management, so far as is reasonably practicable”.

RO-UKHPR1000-0005 placed the following actions:

- **A1:** Evaluation of gaps/difference between UK practices and the HPR1000 (FCG3) design/Chinese practices in radioactive waste management
- **A2:** Evaluation and identification of options to address gaps/differences between UK practices and the HPR 1000 (FCG) design/Chinese practices in radioactive waste management

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- **A3:** Production of a radioactive waste management strategy
- **A4:** List of UK HPR 1000 SSCs modified and/or affected by addressing gaps/differences between UK practice and the HPR1000 (FCG3) generic design/Chinese practices in radioactive waste management
- **A5:** ALARP justification for radioactive waste management for the UK HPR1000

Scope of work

General Nuclear System Limited (GNS) has reviewed RO-UKHPR1000-0005 and produced the resolution plan presented hereafter to address the regulatory expectations identified in each of the actions above.

The resolution plan has been developed in accordance with the UK HPR1000 GDA project procedures and processes. A simplified diagram of the overall approach is presented in Figure 1 and refers to the relevant procedures involved in this RO, all of which have already been submitted to ONR.

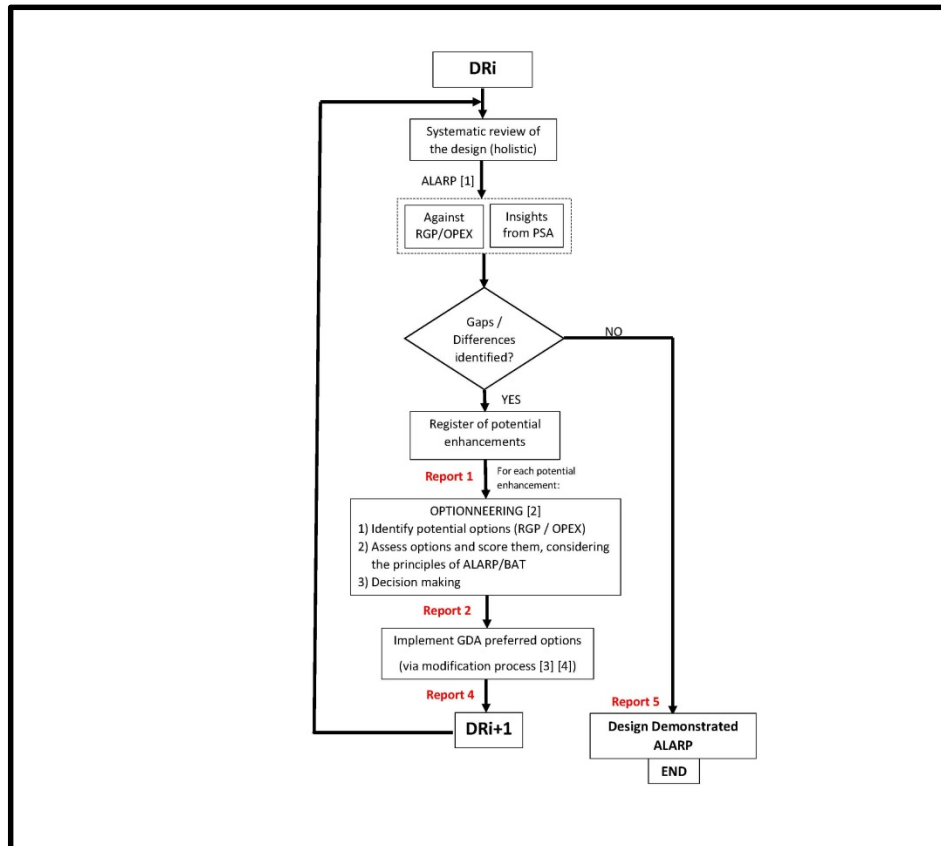



Figure 1: The Simplified Diagram of Overall Approach

The main steps of above overall approach are listed below:

- Holistic Process to identify potential enhancements
 - 1) Step 1: A review of the evolution of the UK HPR1000 design shall be carried out to demonstrate that safety/environmental improvements have been incorporated as the design has developed, and that relevant worldwide OPEX have been considered.

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2) Step 2: GNS will systematically and comprehensively identify the gaps/differences through a holistic analysis of the design against RGP (or OPEX where relevant) according to the ALARP methodology (Ref.1) during this step.

3) Step 3: The identified gaps/differences will be categorised according to their safety/environment significance, and collected into a register of potential enhancement.

Deliverable: At this point of the process, a register of potential enhancement is produced together with gap analysis reports (one per technical area) [Report 1 in Figure 1].

- Specific review of potential enhancements

1) Step 4: For the identified gaps/differences, an options identification and review (based on RGP or, where relevant, OPEX) is undertaken in accordance with the project optioneering process (Ref.2) and GDA preferred options is selected (if relevant to do so during GDA) through decision-making process (Ref.2).

Deliverable: At this point of the process, an optioneering report is produced (one per gap/difference or one per area or one grouping several related gaps/differences) [Report 2 in Figure 1].

2) Step 5: The preferred options from step 4 are introduced into the design modification process (Ref.3&4) and then implemented in the design. During this step, the list of impacted SSCs and documentation will be identified (commensurately to GDA stage and scope) and subsequently modified (if needed and relevant to the UK HPR1000 GDA stage) and then implemented into the design to make a new Design Reference (DR_{i+1}).

Deliverable: At this point of the process, the modification forms are produced as appropriate. For the specific purpose of this RO, a report listing the SSCs potentially impacted by the radwaste management related modifications is produced [Report 4 in Figure 1].


- Holistic Evaluation and Iteration

1) Step 6: The new Design Reference from step 5 shall be subject to a further holistic evaluation to identify any additional potential enhancement. During this step, the potential enhancements may be identified from notably insights from PSA as showed in holistic ALARP assessment process (Ref. 1). This process (step 1 to 6) is continually iterated until the assessment yield no further potential enhancements.

2) Step 7: Where there are no further reasonably practicable options to implement, and no further identified areas for potential enhancement, the design is considered as holistically optimised, reflecting UK expectations, and the nuclear safety risks from the generic UK HPR1000 design are considered reduced to ALARP.

Deliverable: At this point of the process, a holistic ALARP assessment report (one per technical area) [Report 5 in Figure 1] is produced.

Additionally and in parallel to the above work, GNS will produce a radioactive waste strategy that complies with SAP RW.1 (Ref.5) and incorporates the outcomes of the work undertaken under ROA A1 and ROA A2. The output of this work is Report 3.

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A series of reports will therefore be produced in response to RO-UK HPR1000-0005 to demonstrate that the risks relevant to radioactive waste management in UK HPR1000 are reduced to ALARP. The five main reports are:

- Report 1: Gap Analysis Report for Radioactive Waste Management
- Report 2: Optimal Options Study for Identified Gaps in Radioactive Waste Management
- Report 3: Integrated Waste Strategy and/or its relevant supporting report
- Report 4: The List of SSCs Affected by the Optimal Options
- Report 5: ALARP Demonstration Report for Radioactive Waste Management


Radioactive waste management includes the management of liquid, gaseous and solid radioactive waste during the operation of the plant, and covers radioactive waste generation and minimisation, collection, characterisation and segregation, treatment, conditioning and onsite storage.

The work carried out to complete RO-UKHPR1000-0005 resolution plan may impact on or be impacted by other technical areas. Preliminary assessment has identified these as being mainly:

- Chemistry
- Conventional Safety
- Cross Cutting
- Human Factors
- Management Safety Quality Assurance
- Mechanical Engineering
- Radiation Protection
- Civil Engineering
- Structural Integrity
- Environment

For waste generation and minimisation for instance, reactor chemistry regime and material selection are key aspects that influence the nature and amount of waste produced that will require to be processed by the radioactive waste management systems. The chemistry regime and material selection of components in primary circuit are presented in PCSR Chapter 21 “Reactor chemistry”. In order to avoid repeating the same information in different areas, especially for the risk assessment, the holistic ALARP demonstration for Radwaste management which will be presented in PCSR Chapter 23, will summarize and refer out to Report 5 above and will refer out to all relevant technical areas’ ALARP demonstrations.

Throughout the process of addressing RO-UKHPR1000-0005 the radioactive waste technical team will therefore engage with these technical areas’ leading teams to notably ensure radwaste management related expectations are adequately considered and that any proposed changes to the design are considered holistically.

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This Resolution Plan describes the plan to respond to each of the Actions and provides the schedule for their delivery. However, as the work develops, the reports to address *ROA A1 ~A5* may be updated and new reports may need to be produced to reflect GDA progress and regulators requirements.

Deliverable Description

RO-UKHPR1000-0005.A1 – Evaluation of gaps/differences between UK practices and the HPR1000 (FCG3) design/Chinese practices in radioactive waste management

In response to this ROA, GNS should provide:

A suitable and sufficient evaluation of the gaps/differences between UK practices/radioactive waste management infrastructure and the HPR1000 (FCG3) reference plant/Chinese radioactive waste management practices. ONR would expect GNS to:

- *Identify Relevant Good Practice (RGP) and Operational Experience and Feedback (OEF) used to identify gaps and differences between UK practices/infrastructure (for gaseous, liquid and solid radioactive wastes) and the HPR1000 (FCG3) design/Chinese practices relating to radioactive waste management;*
- *Identify all relevant gaps and differences between UK practices/infrastructure and the HPR1000 (FCG3) design/Chinese practices relating to the management of gaseous, liquid and solid radioactive wastes.*

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


Resolution Plan

A systematic and comprehensive gaps analysis will be undertaken to identify the gaps/differences between Chinese and UK waste management regulation, practices and infrastructure, including RGP.

A number of planned workshops have been or will be scheduled to collect UK waste management practices. These workshops will notably be used to identify RGP or OPEX and to help identify and understand the differences between HPR1000 (FCG3) and UK regulations, practices and infrastructure.

Based on the above work, a report titled *Gap Analysis Report for Radioactive Waste Management* [corresponding to Report 1 in Figure 1] will be produced in response to ROA A1, and be submitted on February 28th 2019. The main aspects to be covered in this report include:

- Presenting the scope of radioactive waste management to be analysed;
- Presenting the process used to undertake the gap analysis;
- Holistically reviewing the key steps of radioactive waste management and related systems design;
- Identifying RGP (or OPEX where relevant) relating to radioactive waste management;
- Identifying the gaps/differences for each radioactive waste stream notably against the identified RGP or OPEX;
- Defining the gaps that need to be addressed for UK HPR1000 generic design.

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RO-UKHPR1000-0005.A2 – Evaluation and identification of options to address gaps/differences between UK practices and the HPR1000 (FCG3) design/Chinese practices in radioactive waste management

In response to this ROA, and based on the outcome of the work to address ROA A1 under this RO, the Requesting Party should provide a suitable and sufficient evaluation of options for addressing each of the gaps/differences identified under Action A and to identify preferred options to address each gap/difference. This evaluation should take into account the ultimate objective of demonstrating that the relevant risks associated with the management of radioactive wastes to be produced as a result of operation of the UK HPR1000 will be reduced to ALARP.

ONR would expect GNS to provide a proportionate evaluation of options and identification of preferred options which takes into account:

- *The response to ROA Action A1 under this RO;*
- *A suitable and sufficient methodology/methodologies for evaluating options to address each identified gap/difference in radioactive waste management and that takes into account the balance of health, safety and environmental factors in an optimised manner;*
- *RGP and OEF in the management of gaseous, liquid and solid radioactive wastes and in the evaluation of options;*
- *The UK requirement to demonstrate that, overall, relevant risks are reduced to ALARP.*


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

Resolution Plan

The RGP or OPEX identified as potential options to address each GDA relevant gap/difference, will be evaluated and scored in line with UK HPR1000 optioneering process (Ref.3) to select the preferred options for UK HRP1000 radioactive waste management.

Based on the above work, a report titled *Optimal Options Study for Identified Gaps in Radioactive Waste Management* [corresponding to Report 2 in Figure 1] will be produced in response to ROA A2, and be submitted on May 31st 2019, and updated by March 30th 2020. The main aspects covered in this report include:

- Presenting the identified gaps/differences;
- Presenting the optioneering process;
- Presenting sources of RGP or OPEX for each identified gap/difference;
- Listing the options from RGP or OPEX that suitably plugs each of the identified gaps/differences that fall in the scope of GDA;
- Summarising the options' evaluation and scoring for each GDA relevant gap/difference in accordance with optioneering process;
- Concluding on the preferred options that will form the baseline for the design of radioactive waste management

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systems in the UK HPR1000.

During GDA Step 2, GNS have already identified a number of gaps/differences and are currently working to address these. The output of this work will be summarised in a number of reports already identified in the step 3 work plan; some novel reports may be developed if other gaps/differences are identified. All these reports will be referenced in the ‘summary’ report “*Optimal options study for identified gaps in radioactive waste management systems*”. The following list corresponds to the reports [also corresponding to Report 2 in Figure 1] already planned to be produced to cover the gaps identified at this stage of the GDA and may be completed as work progresses:

1) Optioneering Study for Identified Gaps in Operational Solid Waste Processing Techniques

This report will be submitted on February 28th 2019. The main aspects it will cover are:

- Presenting the optioneering process;
- For each gap/difference, identifying the RGP or international OPEX where no RGP exists;
- For each gap/difference, identifying all relevant options related to operational solid waste processing techniques;
- Defining the optioneering assessment criteria for each waste stream if relevant;
- Evaluating and scoring the options for each waste stream for each assessment criteria;
- Concluding on the chosen options that will form part of the baseline for the UK HPR1000 design for radioactive waste management systems.

2) Management Proposal of Waste Non-fuel Core Components


This report will be submitted on February 28th 2019. The main aspects this report will cover are:

- Presenting the non-fuel core components inventory;
- Identifying the RGP or international OPEX where needed;
- Defining the optioneering assessment criteria for waste stream;
- Evaluating and scoring the options for the management of waste non-fuel core components;
- Concluding on the chosen options proposed for the UK HPR1000 for Waste Non-fuel Core Components management.

3) Selection of Waste Containers for Disposal of ILW

This report will be submitted on March 31st 2019. It will be developed together with optioneering reports on processing techniques (previous reports 1) and 2)) and requirements on the resulting waste package (from RWM). The main aspects it will cover are:

- Defining the process to select the ILW containers;

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- Identifying the types of ILW containers to be used in the UK;
- Evaluating and scoring the options suitable for each ILW waste stream, considering notably the selected treatment/conditioning techniques and the resulting waste packages radiological characteristics;
- Presenting containers proposed to be used for UK HPR1000 ILW.

4) Conceptual Proposal of ILW Interim Storage Facility

This report will be submitted on May 30th, 2019. The main aspects this report will cover are:

- Presenting the design principles of ILW interim storage facility;
- Presenting key assumptions and inputs for the design of the UK HPR1000 ILW interim store, including the scope of wastes to be stored;
- Presenting general arrangements and key features for ILW interim storage facility;
- Presenting preliminary safety and environmental assessment.

RO-UKHPR1000-0005. A3 – Production of a radioactive waste management strategy

In response to this ROA, and based on the outcome of the work to address ROA A1 and A2 under this RO, GNS should provide a suitable and sufficient radioactive waste management strategy that meets the expectations of SAP RW.1 and which incorporates the outcome of options evaluation undertaken in ROA A2 to address the identified gaps/differences in radioactive waste management resulting from the work to address ROA A1. ONR would expect GNS to provide an adequate radioactive waste management strategy, taking into account:


- *The responses to ROA A1 and A2 under this RO;*
- *RGP and OEF in the production of radioactive waste management strategies;*
- *The regulatory expectations set out in SAP RW.1.*

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

Resolution Plan

The radioactive waste management strategy will be developed in line with UK government policy and regulatory framework, including the expectation of SAP RW.1. This strategy will demonstrate that the radioactive waste management holistically complies with UK requirements including RW.1 and will integrate outcomes from ROA A1 and ROA A2.

It is recognised that this strategy will evolve with any modification to the UK HPR1000 generic design through the GDA process. Therefore, it will be updated to incorporate any modification relating to radioactive waste management in an interval of time between two versions, different versions of this strategy will be submitted on February 28th 2019, July 31st 2019 and May 30th 2020. The final version of the strategy will be consistent with the final holistic radwaste management ALARP assessment (see ROA A5).

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The main aspects about operational radioactive waste to be covered in this strategy include:

- Identifying radioactive waste streams generated by the operation of UK HPR1000;
- Defining the assumptions, constraints and requirements to be complied with from relevant UK Government policies / strategies, legislation, SAPs, TAGs, REPs, etc.;
- Collecting the good practice and lessons notably from previous GDA projects;
- Presenting the strategy that is delivering in accordance with the identified constraints and requirements;
- Describing specific strategy for each waste stream;
- Driving improvement by focusing on key outcomes;
- Showing how the strategy will be implemented.

RO-UKHPR1000-0005.A4 – List of UK HPR1000 Structures, Systems and Components (SSCs) modified and/or affected by addressing gaps/differences between UK practices and the HPR1000 (FCG3) generic design/Chinese practices in radioactive waste management

In response to this ROA, and based on the outcome of the work to respond to ROA A1 and A2 under this RO, GNS should identify all Structures, Systems and Components (SSCs) that will need to be modified and those that may otherwise be affected by implementation of the preferred options for addressing the gaps/differences between UK practices/infrastructure and the HPR1000 (FCG3) generic design as they relate to radioactive waste management. ONR would expect GNS to provide a clear list, based on a proportionate consideration of the SSCs, that takes into account:


- *Any modifications to SSCs and thus to the generic design of the UK HPR1000 needed to implement the preferred options identified as a result of completion of the work under ROA A2;*
- *Identification of those SSCs which do not need to be modified of themselves but which may be affected by modifications to SSCs to implement the preferred options identified under ROA A2, in terms of possible changes to relevant risks as a result of implementation of the modifications;*
- *GNS's strategies, plans and timescales to address modifications to SSCs in the UK HPR1000 generic design during GDA identified as a result of completion of the work under ROA A2.*

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

Resolution Plan

Based on the design modification proposed as part of the outcome of the work to respond to ROA A2, each proposed design change will be managed through application of UK HPR1000 design modification process (Ref.3&4) to holistically review and assess the impact of each radwaste management related design modification on the SSCs (commensurately to GDA stage and scope), and ensure a holistic consideration of risk reduction and ALARP justification. As presented in Figure 1, the process to identify the impacted SSCs until the risks associated with radioactive waste management are reduced to ALARP, is iterative.

A report titled *The List of SSCs Affected by the Optimal Options* [corresponding to Report 4 in Figure 1] will be

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produced to respond to ROA A4, it will be submitted on August 30th 2019, and updated by March 30th 2020 to reflect the iterative nature of the process. This report will present the list of SSCs potentially affected (commensurately to GDA stage and scope) by design changes and identify those that:

- do not need to be modified;
- need to be modified.

For the SSCs which need to be modified, the appropriate strategies and schedule to address change will be presented commensurately to GDA stage and scope.

The main aspects covered in this report include:

- Summarising the SSCs potentially affected (commensurately to GDA scope and stage) based on the holistic review and evaluation of the impact of the radwaste management related design changes on the overall plant;
- Identifying the SSCs requiring modification in the UK HPR1000 generic design during GDA process, and presenting the reasons;
- Identifying the SSCs which do not need to be modified in the UK HPR1000 generic design during GDA process, and presenting the reasons;
- Presenting strategies, plans and timescales to deal with any necessary modifications to SSCs in the UK HPR1000 generic design during GDA process.


RO-UKHPR1000-0005.A5 – ALARP justification for radioactive waste management for the UK HPR1000

In response to this ROA, and based on the outcome of the work to respond to ROA A1 and A2, GNS should provide:

- *A suitable and sufficient assessment of the impact on the generic safety case of the modifications to the generic design for the UK HPR1000 necessary to address gaps/differences between UK practice/infrastructure and the UK HPR1000 (FCG3) design and Chinese radioactive waste management practices.*
- *A suitable and sufficient substantiation or justification (i.e. evidence) that the relevant risks associated with the management of radioactive wastes that would arise as a result of operation of the generic design of the UK HPR1000 will be reduced to ALARP. The scope of this substantiation should be holistic and address all aspects associated with radioactive waste management relevant to the risks, not just those affected by the modifications necessary to address gaps/differences between UK practice/infrastructure and the UK HPR1000 (FCG3) design and Chinese radioactive waste management practices. The overall justification that relevant risks relating to radioactive waste management are ALARP should balance health, safety and environmental aspects in an optimised manner.*

ONR notes that justification of ALARP for radioactive waste management for the UK HPR1000 will need to consider a range of technical topic areas in addition to the radioactive waste management topic area under which this RO is being raised.

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

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For each version of UK HPR1000 Design Reference, the holistic ALARP assessment of radioactive waste management in the UK HPR1000 will be carried out, any identified potential enhancement shall be fed back to ROA A2 through the overall approach shown in Figure 1. The final ALARP demonstration for radioactive waste management for UK HPR1000 will demonstrate that the relevant risks relating to radioactive waste management are reduced to ALARP.

The report “*ALARP Demonstration Report for Radioactive Waste Management*” [corresponding to Report 5 in Figure 1] will be produced in response to ROA A5, and combined with the outcome of work to address ROA A1, A2 and A4. A first version of this report will be submitted on September 30th 2019 (relevant to DR2), and updated by April 30th 2020 (relevant to DR3).

This report will include the following aspects:

- Presenting the purpose and scope of this report;
- Presenting the UK HPR1000 Design Reference for radioactive waste management;
- Summarising the gaps identified by the systematic review of UK HPR1000 Design reference against UK RGP or OPEX and insight from PSA (link to Report 1 in Figure 1);
- Summarising the outcome of optioneering of identified gaps (link to Report 2 in Figure 1);
- Providing justification that no reasonably practicable measures are available beyond the selected options during GDA process;
- Concluding the relevant risks relating to radioactive waste management are reduced to ALARP.


It is noted that PCSR 23 will present the summary of the holistic ALARP assessment for Radwaste management, summarise detailed information from the report “*ALARP Demonstration Report for Radioactive Waste Management*”, referring out to it as well as to relevant technical areas’ ALARP demonstrations. PCSR Chapter 33 will present the summary of the holistic ALARP assessment of the UK HPR1000 generic design, cross-referencing to the technical areas related holistic ALARP demonstrations.

For the reports outlined in response to RO A1, 2, 3, 4 and 5, the anticipated timescales to submit these documents are given in the Gantt Chart 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.

Reference

- [1] CGN, ALARP Methodology, GHX00100051DOZJ03GN, Rev. B, 2018
- [2] GNS, Requirements on Optioneering and Decision-Marking, HPR/GDA/PROC/0012, Rev. 0, 2018
- [3] GNS, UK HPR1000 Modification Categorisation Procedure, HPR/GDA/PROC/0033, Rev. 000, 2018
- [4] GNS, UK HPR1000 Modification Control Procedure, HPR/GDA/PROC/0053, Rev.000, 2018
- [5] ONR, Safety Assessment Principles for Nuclear Facilities, Rev.0, 2014.

Impact on the GDA Submissions


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The information will be appropriately incorporated into V1 and V2 of relevant PCSR and PCER chapters, notably PCSR Chapter 23 and PCSR 33, PCER Chapter 3 and Chapter 4.

Related PCSR and PCER chapters and their supporting submissions may be impacted too. The full extent of interfacing PCSR/PCER chapters and supporting documents impacted will be determined once the gap analysis and identification of SSCs affected by optimal options is completed.

Timetable and Milestone Programme Leading to the Deliverables

See attached Gantt Chart in APPENDIX A.

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APPENDIX A RO-UKHPR1000-0005 Gantt Chart

