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| **Rolls-Royce SMR RO Resolution Plan** |

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| RO Unique Number: | RO-RRSMR-005 |
| RO Title: | Internal Hazards Safety Case Scope and Delivery |
| Lead Technical topic: | Internal Hazards |
| Related Technical topic(s): | Civil Engineering  Life Fire Safety  Conventional Health and Safety  Mechanical Engineering  Electrical Engineering  Fault Studies |

## Regulatory Observation

## Background

The Generic Design Assessment (GDA) of the Rolls-Royce SMR Limited’s Small Modular Reactor (SMR) started in April 2022. Rolls-Royce SMR is currently in Step 3 of the GDA.

The RR SMR design continues to mature and is being informed by Environment, Safety, Security and Safeguards (E3S) disciplines. Internal Hazards analysis is being carried out on the design to support the following E3S case claim: “safety analysis has informed the Rolls-Royce SMR design to provide suitable and sufficient levels of defence-in-depth to deliver the Fundamental Safety Functions and reduce nuclear safety risks to workers and the public”.

Information submitted to date has not provided sufficient clarity to the Office of Nuclear Regulation (ONR) regarding the definitive GDA internal hazards scope due to the continuing evolution of the RR SMR design. As a result, the ONR is concerned as to whether the internal hazards case will include sufficient information at the end of GDA Step 3 to deliver the required evidence for the various safety case claims required to demonstrate the risks from internal hazards are ALARP.

The ONR have therefore highlighted a number of areas for improvement, in the form of five actions in Regulatory Observation RO-RRSMR-005. This Resolution Plan sets out how Rolls-Royce SMR Limited intend to respond to these actions. The information provided as part of completion of this resolution plan will be assessed by ONR to determine whether it is sufficient to address these actions and close out the Regulatory Observation (RO).

***Regulatory Observation Actions and Resolution Plan***

## Rolls-Royce SMR Resolution Plan for RO-RRSMR-005.A1

### The following actions have been raised by the ONR to assure that the delivery of the Internal Hazards case is achievable within GDA timescales as the Rolls-Royce SMR design continues to mature, and to demonstrate that the safety case outcomes will be meaningful.

1. *A detailed scope for the IH safety case that the RP expects to produce during GDA, including a clear statement of any exclusions, including aspects that would be completed post-GDA,*
2. *Clarity of safety case structure and content, including the claims, arguments and evidence that the RP intends will form the framework of the safety demonstration. This should cover the full breadth and depth of the case that will be produced during GDA, including all claims on the identified safety measures to mitigate or minimise the impact of internal hazards, relevant activities (such as hazard analysis, optioneering and test results) and the justification of ALARP,*
3. *Definition of the tasks required to be completed during GDA to deliver this scope and provide inputs to the IH case and substantiation evidence (including the tasks already completed or ongoing),*
4. *A detailed work programme including all planned outputs to deliver the tasks detailed above. This should explain how the maturing design (including the plant layout) will be managed as part of the inputs, and how any differences in design baseline will be managed,*
5. *Information on the scope and content of documents that have been agreed to be submitted to ONR during Step 3 (of relevance to IH). This should include any known omissions or further work that will be expected on those documents, such that it is clear what the intended end-point will be during GDA. This includes factors such as the design basis, assumptions and maturity of information that underpins those submissions.*

In response to the ONR actions above, these will be addressed through information provided in the following documents:

1. Interim Hazards Schedule and Requirements for Design Reference Point 2, Issue 1 (new document),
2. Internal Hazards Design Maturity Justification Document, Issue 1 and 2 (new document),
3. Generic E3S Case Scope and Deliverable Document – Internal Hazards, Issue 2 (up-issue),
4. E3S Case, Version 3 (up-issue).

The scope of these documents are outlined below.

Table 4 presents how the ONR actions align with each of the RO-RRSMR-005 Document Submissions.

**Interim Hazards Schedule and Requirements for Design Reference Point 2**

The finalised hazards schedule for GDA Step 3 will be based on DRP3 and presented in the DRP3 Internal Hazards Block Analysis Reports, the analysis reports will be referenced and summarised in Issue 2 of the Internal Hazards Summary Reports [1] [2].

In order to address the concerns raised in this RO, an interim hazards schedule and requirements report will be delivered based on DRP2. The submission of this report will allow Regulators to have early sight on the developments on the hazards case since GDA Step 2 and provide confidence in the case being developed for GDA Step 3 (which will be based on DRP3). This report will include the 7 Reactor Island Layout Blocks: Containment, Interspace, EC&I, Safety Fluids, Fuelling, Auxiliary & Waste.

The information provided within the submission will include information based on the design maturity at the time of DRP2. A ‘Design Risk’ column is provided in order to identify known design changes that could impact the hazards schedule for DRP3.

Table 1 shows the Interim Hazards Schedule Template that will be produced for this submission.

Table 1: Interim Hazards Schedule Template

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **IH** | **IH Bounding Case** | **Fault Initiation** | **Safety Measures Available** | **Assumed Claim/s** | **Hazard Protection** | **Substantiation** | **Risk Reduction / Additional DiD** | **Design Risks** | **Required Optioneering/ Further assessment** |
| Generic / Column description | | | | | | | | |  |
| Internal Hazard | Hazard Source Safety Case | This column describes the faults that are initiated by the hazard, without protection measures in place, upon duty systems | This column describes the safety measures claimed to prevent/protect against loss of duty function | This column describes the high-level level claim/s made for hazard protection | This column describes the engineering solution proposed to fulfill the claim. This will include preventative and protective measures | This column describes what the Hazard Protection should be substantiated against | This column provides further DiD measures provided to prevent or mitigate the consequences caused by the Internal Hazard | This column provides insight on the design risks that may signify a change in the Hazard Schedule by invalidating the assumptions made or changing the loads substantiated against | This column identifies risks in the layout based on the schedule and requires engineering optioneering or further analysis |

**Generic E3S Case Scope and Deliverable Document – Internal Hazards**

Version 2

The following information will be captured in Version 2 of the Generic E3S Case Scope and Deliverable Document – Internal Hazards:

a) GDA Step 3 Internal Hazards submissions, scope and dates,

b) Any exclusions of RR SMR GDA scope for internal hazards.

**Internal Hazards Design Maturity Justification Document for DRP3**

Issue 1

The following information will be captured in Issue 1 of the Internal Hazards Design Maturity Justification Document based on DRP3:

1. Description of the depth of analysis that can be undertaken for DRP3, which is linked to design maturity,
2. Scope description of the depth of requirements that will be identified in GDA timescales,
3. Design maturity scope for the 7 Reactor Island (RI) Blocks from a layout perspective for internal hazards,
4. Reference to submissions owned by other topic areas of relevance to internal hazards,
5. General approach to substantiation e.g. penetrations, doors, pipe whip restraints.

Issue 2

In addition to the information provided in Issue 1, the following information will be captured in Issue 2 of the Internal Hazards Design Maturity Justification Document based on DRP3:

1. Where information will not be available within GDA timescales due to design maturity, a justification will be provided as to the impact of this on the internal hazards case,
2. The substantiation evidence to be provided by the end of GDA for the internal hazards case,
3. The ‘Golden Thread’ of the Internal Hazards case and the interface with other topic areas,
4. Identify aspects of the design that still need to be completed post GDA of relevance to internal hazards.

**E3S Case, Version 3**

The ‘golden thread’ in the E3S Case is defined as the traceability from the E3S fundamental objective, to ‘protect people and the environment from harm’, through to the detailed underpinning evidence, in a structured manner. A specific example of the ‘golden thread’ for Internal Hazards derived Safety Categorised Functional Requirements is presented in Figure 7 of the E3S Case Development and Management Arrangements [3].

The E3S Case Version 3 will present the Internal Hazards case based on DRP2 to meet the claim that “Design is tolerant to all Internal Hazards (including Combined Hazards)”. This will be presented across various chapters in the case, mainly chapters 3 and 15. Chapter 3 will outline the design basis for internal hazards e.g. Postulated Initiating Events and Safety Categorised Functional Requirements placed onto SSCs. Chapter 15 will present the outputs of the Internal Hazards analysis based on DRP2. The DRP2 internal hazards analysis will have informed DRP3, on which Version 3 of the E3S Case is based.

Version 3 of the E3S Case will provide the ONR with further clarity in the safety case structure and content. In addition, the case will present the claims, arguments and evidence that will form the framework of the safety demonstration and justification of ALARP.

The preview E3S Case, Version 3 will be submitted following the technical check governance step, but prior to the IPR governance step (as defined in Reference [3]). This proposal would mean the preview will not be formally signed off and hence the purpose for submission is to give the ONR early sight of their content ahead of final issue.

## Schedule 1

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## RO-RRSMR-005 Submissions

Table 2: RO-RRSMR-005 Submissions

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| **Number** | **Submission Title** | **Issue Date** |
| 1 | Generic E3S Case Scope and Deliverable Document – Internal Hazards, Version 2 | 28th February 2025  Issued |
| 2 | Interim Hazards Schedule and Requirements for DRP2 | 9th May 2025 |
| 3 | Internal Hazards Design Maturity Justification Document, Issue 1 | 30th May 2025 |
| 4 | Preview E3S Case, Version 3 | 30th June 2025 |
| 5 | Internal Hazards Design Maturity Justification Document, Issue 2 | 31st July 2025 |
| 6 | E3S Case, Version 3 | 29th August 2025 |

## Impacted Submissions

Table 3: Impacted Submissions

|  |  |
| --- | --- |
| **Existing Submissions** | **Impact** |
| Generic E3S Case Scope and Deliverable Document – Internal Hazards, SMR0011049, Issue 1, April 2024 [4] | Replaced with up-issued version of document. |
| E3S Case, SMR0004294, Version 2, May 2024 [5] | E3S Case Version 3 will reference additional documents produced as part of the RO Resolution Plan. |

## ONR actions aligned with RO-RRSMR-005 Document Submissions

Table 4: ONR actions aligned with RO-RRSMR-005 Document Submissions

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| --- | --- |
| **ONR actions for RO-RRSMR-005.A1** | **Document Submission(s)** |
| *A detailed scope for the IH safety case that the RP expects to produce during GDA, including a clear statement of any exclusions, including aspects that would be completed post-GDA.* | Internal Hazards Design Maturity Justification Document, Issue 1 and 2 |
| E3S Case, Version 3 |
| *Clarity of safety case structure and content, including the claims, arguments and evidence that the RP intends will form the framework of the safety demonstration. This should cover the full breadth and depth of the case that will be produced during GDA, including all claims on the identified safety measures to mitigate or minimise the impact of internal hazards, relevant activities (such as hazard analysis, optioneering and test results) and the justification of ALARP.* | Interim Hazards Schedule and Requirements for DRP2, Issue 1 |
| E3S Case, Version 3 |
| *Definition of the tasks required to be completed during GDA to deliver this scope and provide inputs to the IH case and substantiation evidence (including the tasks already completed or ongoing).* | Internal Hazards Design Maturity Justification Document, Issue 1 and 2 |
| *A detailed work programme including all planned outputs to deliver the tasks detailed above.* | Internal Hazards Design Maturity Justification Document, Issue 1 and 2 |
| *Information on the scope and content of documents that have been agreed to be submitted to ONR during Step 3 (of relevance to IH). This should include any known omissions or further work that will be expected on those documents, such that it is clear what the intended end-point will be during GDA. This includes factors such as the design basis, assumptions and maturity of information that underpins those submissions.* | Internal Hazards Design Maturity Justification Document, Issue 1 and 2 |

## References

[1] Rolls-Royce SMR Limited, Internal Hazards Summary Report - Reactor Island within Hazard Shield, SMR0007172, Issue 1, January 2024,

[2] Rolls-Royce SMR Limited, Internal Hazards Summary Report - Outside Hazard Shield, SMR0008560, Issue 1, January 2024,

[3] Rolls-Royce SMR Limited, E3S Case Development and Management Arrangements, SMR0000627, Issue 3, February 2025,

[4] Rolls-Royce SMR Limited, Generic E3S Case Scope and Deliverable Document – Internal Hazards, SMR0011049, Issue 1, April 2024,

[5] Rolls-Royce SMR Limited, E3S Case, SMR0004294, Version 2, May 2024.

## Record of Change

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| --- | --- | --- |
| **Date** | **Revision Number** | **Reason for Change** |
| 01/04/2025 | 1 | Issue of resolution plan |
| 15/07/2025 | 2 | Format and consistency update and alignment |

## Approvals

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Author | Sign | Print | Role | Date |
| See Teamcenter | {REDACTED} | {REDACTED} | See Teamcenter |
| Reviewer | Sign | Print | Role | Date |
| See Teamcenter | {REDACTED} | {REDACTED} | See Teamcenter |
|  | **Sign** | **Print** | **Role** | **Date** |
| Approver | See Teamcenter | {REDACTED} | {REDACTED} | See Teamcenter |