

Hitachi-GE Nuclear Energy, Ltd.
UK ABWR GENERIC DESIGN ASSESSMENT
Resolution Plan for RO-ABWR-0078
(Presentation of Safety Justification for Exceptions to Segregation)

RO TITLE:	Presentation of Safety Justification for Exceptions to Segregation	
REVISION :	0	
Overall RO Closure Date (Planned):	31 March 2017	
REFERENCE DOCUMENTATION RELATED TO REGULATORY OBSERVATION		
Regulatory Queries	RQ-ABWR-1060	
Linked ROs	-	
Other Documentation	See Related Deliverables in Description of Work and References	

Scope of work :
<p>Background</p> <p>The ONR have raised concerns regarding the inclusion of “Exceptions to Segregation” in the UK ABWR safety case and design. This is reported in RO-ABWR-0078, and previously in RQ-ABWR-1060. The concern relates to the compliance of the UK ABWR safety case to the ONR SAPs, notably EDR.2: Redundancy, Diversity and Segregation. The safety case is presented in Hitachi-GE’s Topic Report on Exceptions to Segregation [Ref-1].</p> <p>As part of GDA, there is a requirement to demonstrate that the risks associated with Internal Hazards are reduced As Low As Reasonably Practicable (ALARP). The UK ABWR design implements the nuclear safety principles of redundancy, diversity and segregation in order to reduce risks ALARP. However, in some instances strict adherence to these principles may not reduce risks ALARP. In particular, it may be justifiable and ALARP to have A-1 SSCs from more than one division or both A-1 and A-2 SSCs in the same hazard compartment; such A-1 or A-2 SSCs are referred to as exceptions to segregation SSCs.</p> <p>There are two main reasons why there are SSCs posing exceptions to segregation in the UK ABWR design. Firstly, if a system or parameter to be measured is located in a single division (e.g. neutron flux), then an exception to segregation is unavoidable if redundancy is to be provided to reduce risks ALARP. Secondly, where an exception to segregation is not strictly required by the plant layout but, if included in the design it will result in significant risk reduction, then it is therefore considered necessary in order to reduce risks ALARP.</p> <p>This Resolution Plan summarises the ONR’s Regulatory Expectations and Actions raised via RO-ABWR-0078, and sets out Hitachi-GE’s proposed programme and milestones to meet these expectations and address the identified actions.</p>

Description of work:

RO Actions

RO-ABWR-0078.A1 - Provide a document with the design philosophy and rule sets which ensure that a systematic process is followed in the determination of segregation requirements for all C&I, electrical and mechanical SSCs.

Hitachi-GE's Actions

Hitachi-GE will perform updates to design philosophies and rules sets in the high-level documentation to be updated under Task 1 below. The documents listed cover safety requirements for all SSCs, as well as specific requirements (including those relating to segregation of redundant systems) and design philosophies for mechanical, electrical and C&I SSCs. The Topic Report on Exceptions to Segregation to be updated as part of Task 2 will then assess A-1 and A-2 exceptions to segregation SSCs against these design philosophies and rule sets.

RO-ABWR-0078.A2 – Provide an internal hazards assessment in the 'Exceptions to Segregation' report.

Hitachi-GE's Actions

Based on the high-level philosophies defined in the documents updated as part of Task 1, Hitachi-GE will perform a deterministic assessment of all SSCs posing exceptions to segregation as outlined under Task 2. This will be incorporated into an update to the Topic Report on Exceptions to Segregation [Ref-1].

RO-ABWR-0078.A3 - Provide the claims, arguments and evidence in support of the suitability and sufficiency of segregation, redundancy and diversity for SSCs identified and studied according to A-1 and A-2.

Hitachi-GE's Actions

Hitachi-GE will make amendments to the claims and arguments within the high-level safety case documents identified in Task 1 below. General and mechanical engineering safety claims and requirements for SSCs are set out in the Topic Report on Safety Requirements for Mechanical SSCs [Ref-2]. For C&I, updates to safety claims will be made where appropriate to the Basis of Safety Cases on C&I Architecture [Ref-4]. For Electrical SSCs, updates to safety claims will be made where appropriate to the Basis of Safety Case on Electrical System [Ref-5]. For Internal Hazards, there are already safety claims for exceptions to segregation SSCs made in the Topic Report on Approach to Internal Hazards [Ref-3], however the link between this document and above high-level safety case documents will be improved.

RO-ABWR-0078.A4 – Provide an ALARP justification.

Hitachi-GE's Actions

Hitachi-GE will provide an ALARP justification for A-1 and A-2 exceptions to segregation SSCs within the Topic Report for Exceptions to Segregation [Ref-1], which will be updated as described in Task 2 below.

Task Breakdown

Hitachi-GE understand that updates are required to clarify the high-level philosophy for redundancy, diversity and segregation in the UK ABWR design. This will be carried out as part of Task 1. In Task 2, the exceptions to segregation SSCs will be assessed against the high-level philosophies developed in Task 1 and ALARP justifications for their design will be provided, where appropriate including optioneering. A more detailed description of the tasks which Hitachi-GE will carry out to address this RO is provided below:

Task 1 – Clarification of High-Level Philosophy for Redundancy, Diversity and Segregation

Completion of this task is anticipated to address RO-ABWR-0078 Actions 1.1 and 1.3.

Hitachi-GE will review, clarify and update their high-level philosophy for Redundancy, Diversity and Segregation across a suite of documents. This will include clarification of the safety requirements for N+1/N+2 safety systems, the segregation philosophy employed by the UK ABWR design to meet the redundancy requirements, and consideration of single failure, unavailability due to maintenance, and Common Cause Failures (CCF).

The following documents will be updated as part of this task:

- *Topic Report on Safety Requirements for Mechanical SSCs [Ref-2].*
This document sets out the safety requirements for all A-1 and A-2 SSCs (not just “mechanical” SSCs). Although already covered to some extent in the current revision, the next revision will discuss in greater depth SSC redundancy, diversity and segregation requirements with respect to Internal Hazards. It will specifically cover how Internal Hazards are a source of CCF. The document will demonstrate that the UK ABWR design follows the principles set out in the UK ABWR Nuclear Safety and Environmental Design Principles (NSEDPs) [Ref-6].
- *Topic Report on Approach to Internal Hazards [Ref-3].*
This document sets out the assessment approach for Internal Hazards for the UK ABWR, and will be updated to reference the existing and proposed new discussion of SSC safety requirements in the Topic Report on Safety Requirements for Mechanical SSCs. The update will focus in particular on internal hazards as a source of Common Cause Failure (CCF).
- *Basis of Safety Case on C&I Architecture [Ref-4].*
This document describes the high-level design for the UK ABWR C&I systems following a ‘Claims, Arguments, Evidence’ (CAE) approach. This document will be updated, and the CAE amended where required, to make better reference to Hitachi-GE’s design philosophy for exceptions to segregation described in [Ref-2] and [Ref-3]. In particular, it will set out the design philosophy for C&I exceptions to segregation SSCs.
- *Basis of Safety Case on Electrical System [Ref-5].*
This document provides the safety justification for the Electrical Power System (EPS) using a CAE approach. This will be updated, and the CAE amended where required, to provide a safety justification consistent with the updated philosophy which will be included in [Ref-2] and [Ref-3]. In particular, it will set out the design philosophy for EPS exceptions to segregation SSCs.

Task 2 – ALARP Assessment and Update to Topic Report on Exceptions to Segregation

Completion of this task is anticipated to address RO-ABWR-0078 Actions 1.2 and 1.4.

Hitachi-GE shall update the Topic Report on Exceptions to Segregation [Ref-1]. The update shall include an assessment of all A-1 and A-2 exceptions to segregation SSCs against the following deterministic assessment methodology:

- Identify all exceptions to segregation which involve A-1 and A-2 SSCs.
- Assess against the high-level philosophies updated as part of Task 1 and/or relevant design justifications within Basis of Safety Cases (e.g. the BSC on Containment Isolation System [Ref-7] for PCV isolation valves). In particular, check against the safety requirements for N+2/N+1 safety systems including consideration for single failure, equipment unavailability due to maintenance and CCF.
- Identify hazards within the same room or hazard compartment that could damage the exceptions to segregation SSCs.
- Demonstrate that, following an internal hazard in areas with an identified SSC, there remain SSCs of the appropriate safety category and class to deliver the relevant FSFs.
- An ALARP justification will be provided based on deterministic, probabilistic, and design basis arguments. Where the risk from the existing design cannot be shown to be ALARP, further assessment or optioneering will be undertaken and will be informed by probabilistic insights.

Summary of impact on GDA submissions:

<u>GDA Submission Document</u>	<u>Submission Data to ONR</u>
Topic Report on Exceptions to Segregation [Ref-1]	31 st March 2017
Topic Report on Safety Requirements for Mechanical SSCs [Ref-2]	28 th February 2017
Topic Report on Approach to Internal Hazards [Ref-3]	28 th February 2017
Basic of Safety Case on C&I Architecture [Ref-4]	16 th December 2016
Basis of Safety Case on Electrical System [Ref-5]	31 st March 2017

Programme Milestones / Schedule:

Refer to the attached Gantt-chart for the programmed activities and the schedule for the resolution of the RO.
Detail Gantt-Chart is not provided separately since full activity is shown in the Table1.

References:

<u>Ref.</u>	<u>Document Title</u>	<u>Document ID</u>	<u>Rev.</u>
[Ref-1]	Topic Report on Exceptions to Segregation	GA91-9201-0001-00084 (BKE-GD-0021)	2
[Ref-2]	Topic Report on Safety Requirements for Mechanical SSCs	GA91-9201-0001-00117 (SE-GD-0308)	1
[Ref-3]	Topic Report on Approach to Internal Hazards	GA91-9201-0001-00085 (SE-GD-0192)	1
[Ref-4]	Basic of Safety Case on C&I Architecture	GA91-9201-0002-00022 (3D-GD-A0001)	2
[Ref-5]	Basis of Safety Case on Electrical System	GA91-9201-0002-00033 (EE-GDA-180)	1
[Ref-6]	UK ABWR Nuclear Safety and Environmental Design Principles (NSEDPs)	GA10-0511-0011-00001 (XD-GD-0046)	0
[Ref-7]	Basis of Safety Cases on Containment Isolation System	GA91-9201-0002-00076 (SE-GD-0166)	0

