Hitachi-GE Nuclear Energy, Ltd.
UK ABWR GENERIC DESIGN ASSESSMENT
Resolution Plan for RO-ABWR-0042
Probabilistic Safety Analysis (PSA) internal initiating events at power

RO TITLE:	Probabilistic Safety Analysis (PSA) internal initiating events at power	
REVISION :	2	
Overall RO Closure Date (Planned):		30 April, 2016
REFERENCE DOCUMENTATION RELATED TO REGULATORY OBSERVATION		
Regulatory Queries	-	
Linked ROs	RO-ABWR-0048, RO-ABWR-0053	
Other Documentation	-	

Scope of work :

Background

Hitachi-GE has developed an internal event Level 1 PSA at power for the UK ABWR and associated initiating event analysis. For the initiating event analysis, typical international guideline (IAEA-TECDOC-1511) and Japanese standard (published by Atomic Energy Society of Japan) have been mainly followed as well as specific methods/data, e.g. NUREG/CR-5124, NUREG/CR-6890, NUREG-1829, NUREG/CR-6928. ONR has identified shortfalls related to the traceability and completeness of the initiating events and raised RO-ABWR-0042 to state ONR's expectations and request Hitachi-GE to respond to the shortfalls.

Scope of work

The objective of this resolution plan is to introduce Hitachi-GE's plan for performing the actions required in the RO-ABWR-0042. The actions cover review/justification of existing analysis, additional investigation/analysis and revised/additional documentation. The resolution plan is coordinated with those for "Linked ROs" and input preparation activities, e.g. data review, reflection of Design Reference Point.

Description of work:

ACTION 1 – Justification of the list of initiating events

ACTION 1.1 - Impact of each initiator on systems

Hitachi-GE will explain and justify the impact of each initiator on plant normally operating and standby systems and the cause of each initiator. This Action will be included in RO-ABWR-0053 Action 2.3.

ACTION 1.2 - Investigation into every system in the UK ABWR list of systems

Hitachi-GE will investigate every system in the UK ABWR list of systems to determine if they could lead to an initiating event because of the system failure or spurious operation. FMEAs performed for Design Basis Analysis (DBA) as the actions of RO-ABWR-0007, 0008, 0010 (GA91-9201-0001-00022 Rev.2, GA91-9920-0001-00001 Rev.1, GA91-9201-0003-00696 Rev.0) will be reviewed for that purpose, as well as justifying their applicability to address PSA requirements. Further FMEAs may be performed or existing FMEAs for PSA system analysis will be reviewed for the systems that lead to administrative shutdowns so that initiating event fault trees are developed as RO-ABWR-0053 A4 or RO-ABWR-0042 A6.4. Specific initiators indicated in RQ-ABWR-0449 will be addressed.

ACTION 1.3 - Complete list of BOC initiators

Hitachi-GE will provide a complete list of BOC initiators as part of the ACTION 1.2. Specific lines indicated in RQ-ABWR-0449 will be addressed.

ACTION 1.4 – Applicability of identified initiators to low power conditions

Hitachi-GE will explain the applicability of the identified initiators to low power conditions.

ACTION 1.5 – Identification and prioritisation of initiating events unique to low power conditions

Hitachi-GE will identify other potential initiating events that are unique to low power conditions.

ACTION 1.6 – Update of PSA to include a comprehensive list of initiating events

Hitachi-GE will update the PSA to include a comprehensive list of initiating events.

ACTION 2 – ISLOCA Initiating Event

Hitachi-GE will revise the identification and quantification of ISLOCA initiating events considering international practice.

ACTION 3 – Identification of the LOCA initiators by location

ACTION 3.1 – Identification of the LOCA initiators

Hitachi-GE will identify the LOCAs inside containment by reviewing all the Reactor Pressure Vessel (RPV) penetrations and locations as part of the ACTION 1.2. Specific lines indicated in RQ-ABWR-0449 will be addressed.

ACTION 3.2 – Inclusion of location specific LOCA initiators into PSA

Hitachi-GE will update the PSA to include the location specific LOCA initiators as part of Action 1.6. The revised PSA will address the adverse impacts of each initiator on the plant response and mitigation capability.

ACTION 3.3 – Inclusion of all penetrations susceptible to a LOCA

Hitachi-GE will update the PSA to include all penetrations susceptible to a LOCA as part of Action 1.6.

ACTION 4 – Technical analysis to support the definition of the LOCA break size

Hitachi-GE will extend the thermal-hydraulic analyses to support the definitions of Large/Medium/Small LOCAs and associated success criteria for the core cooling systems.

ACTION 5 – Treatment of Conditional LOOP

Hitachi-GE will revise the treatment of conditional LOOP in the initiating event analysis, event sequence analysis and system analysis considering international practice.

ACTION 6 – Process for the grouping of Initiating Events

ACTION 6.1 – Review and update of Initiating Event Grouping

Hitachi-GE will review and as needed revise the initiating event grouping. Grouping of the new initiating events identified or re-defined in other Actions will be performed. Specific IEs that RQ-ABWR-0449 requires explicit/separate quantification will be addressed.

ACTION 6.2 – Master Logic Diagram Structure

Hitachi-GE will develop the Master Logic Diagram structure to visualize the relation among the initiating event groups and list the sources and contributions to the group.

ACTION 6.3 – Update of PSA to reflect initiating event grouping

Hitachi-GE will update the PSA to reflect the updated initiating event grouping as part of ACTION 1.6.

ACTION 6.4 – Review of modelling for unplanned forced manual shutdowns caused by equipment failures

Hitachi-GE will develop fault trees for support system initiators and document them as RO-ABWR-0053 Action 4. Treatment of standby frontline system failures will be reviewed and as needed update the modelling.

ACTION 7 – Initiating Event Frequencies

ACTION 7.1 – Causes of LOOP

Hitachi-GE will define and justify the causes of LOOP considered as internal initiating events. Impact from the cause of LOOP on the recovery probability will be considered.

ACTION 7.2 – Justification of LOOP frequency

Hitachi-GE will demonstrate that the LOOP frequency used in the internal event PSA for UK ABWR GDA is bounding in comparison to the causal categories. Impact from the cause of LOOP on the recovery probability will be considered.

ACTION 7.3 – Breaks Outside Containment

Hitachi-GE will revise the calculation to derive the frequencies of Breaks Outside Containment considering international practice.

ACTION 7.4 – Justification of LOCA frequencies inside containment

Hitachi-GE will provide the justification for using the NUREG-1829 for the estimation of LOCA frequencies inside containment in the PSA.

ACTION 7.5 – Unit of initiating event frequencies

Hitachi-GE will provide the calendar year based frequencies for the initiating events.

Summary of impact on GDA submissions:

The GDA submissions that may be affected by the actions to resolve this RO are summarised below. These documents will be originated and/or revised in accordance with the corresponding actions.

Related RO Actions	GDA Submission Document Title	Document ID (Document No.)	Submission Date to the Regulators
ROA1, 2, 3, 4, 5, 6, 7	Topic Report on internal event Level 1 PSA at power	GA91-9210-0001-00102 (AE-GD-0257)	30-Sept-2015
ROA1, 2, 3, 4, 5, 6, 7	Topic Report on internal event Level 2 PSA at power	GA91-9210-0001-00103 (AE-GD-10258)	30-Dec-2015
ROA1, 3, 6, 7	Initiating event analysis for internal event PSA at power	GA91-9201-0003-00148 (AE-GD-0184)	30-Sept-2015
ROA1, 3, 4, 6	Event sequence analysis for internal event PSA at power	GA91-9201-0003-00151 (AE-GD-0187)	30-Sept-2015
ROA5, 6	System analysis for internal event Level 1 PSA at power	GA91-9201-0003-00183 (AE-GD-0194)	30-Sept-2015
ROA2	ISLOCA frequency estimation for internal event PSA at power	GA91-9201-0003-00321 (AE-GD-0223)	30-Sept-2015
ROA5, 7	Assumption on LOOP frequency for UK ABWR internal event PSA at power	GA91-9201-0003-00122 (AE-GD-0087)	30-Sept-2015

Programme Milestones/ Schedule:

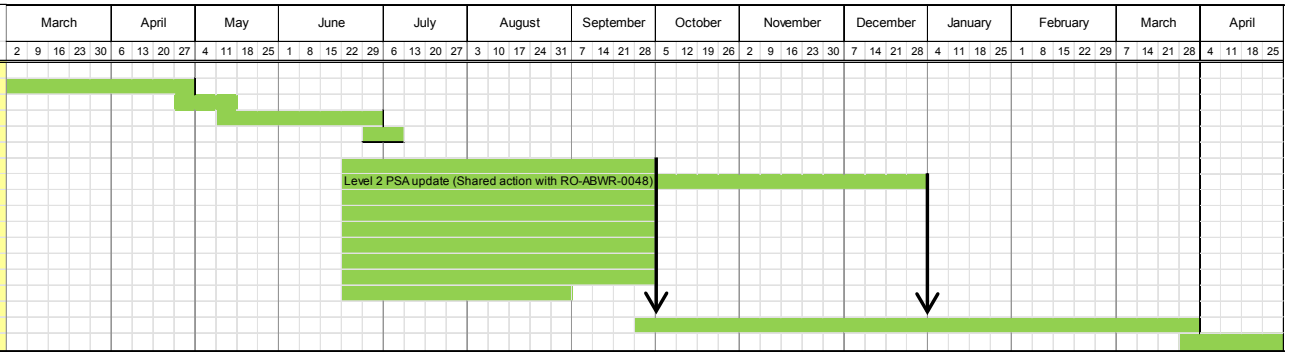
See attached Gantt Chart (Table 1).

Reference:

N/A

Table 1 RO-ABWR-0042 Gantt Chart

Probabilistic Safety Analysis (PSA) internal initiating events at power Resolution Plan for RO-ABWR-0042			
Level	Action Title	Start	Finish
1	Regulator's issue of RO		
1.1	ONR Issue RO	2-Mar-15	30-Apr-15
1.2	Hitachi-GE acknowledge RO & issue Resolution Plan	1-May-15	14-May-15
1.3	Regulator's confirm credibility of Resolution Plan	15-May-15	30-Jun-15
1.4	Regulator's publish RO and Resolution Plan	1-Jul-15	10-Jul-15
2	Preparation of Submissions and Closure of RO Actions		
2.1	RO Action 1	22-Jun-15	30-Sep-15
	Update of Level 2 PSA	22-Jun-15	30-Dec-15
2.2	RO Action 2	22-Jun-15	30-Sep-15
2.3	RO Action 3	22-Jun-15	30-Sep-15
2.4	RO Action 4	22-Jun-15	30-Sep-15
2.5	RO Action 5	22-Jun-15	30-Sep-15
2.6	RO Action 6	22-Jun-15	30-Sep-15
2.7	RO Action 7	22-Jun-15	30-Sep-15
2.8	Input preparation for PSA update (shared action with Linked ROs)	22-Jun-15	28-Aug-15
3	Regulator's Closure of RO		
3.1	Regulators Assessment	1-Oct-15	31-Mar-16
3.2	Regulator's publication of RO closure letter	1-Apr-16	30-Apr-16



NOTE: The resolution plan is coordinated with those for "Linked ROs" (RO-ABWR-0048, RO-ABWR-0053)