Hitachi-GE Nuclear Energy, Ltd.
UK ABWR GENERIC DESIGN ASSESSMENT
Resolution Plan for RO-ABWR-0048
UK ABWR Probabilistic Safety Analysis: Level 2 PSA methodology

RO TITLE:	UK ABWR Probabilistic Safety Analysis: Level 2 PSA methodology	
REVISION :	3	
Overall RO Closure Date (Planned):		31 May 2016
REFERENCE DOCUMENTATION RELATED TO REGULATORY OBSERVATION		
Regulatory Queries	RQ-ABWR-0515, RQ-ABWR-0559, RQ-ABWR-0560	
Linked ROs	RO-ABWR-0042, RO-ABWR-0046, RO-ABWR-0053, RO-ABWR-0023	
Other Documentation	-	

Scope of work :

Background

Hitachi-GE has developed an internal event Level 2 PSA at power for the UK ABWR. Typical international guideline (IAEA SSG-4) and Japanese standard (published by Atomic Energy Society of Japan) have been mainly followed as well as specific methods/data, e.g. NUREG/CR-4700, NUREG/CR-5960, NUREG-1150. ONR has identified shortfalls related to the completeness of the Level 2 PSA Plant Damage States (PDS), Containment Event Trees (CETs), Release Categories and documentation and raised RO-ABWR-0048 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 current plan for performing the actions required in the RO-ABWR-0048 for meeting the regulatory expectation. The actions cover review 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.

Hitachi-GE will address the specific findings identified in RQ-ABWR-0515 as part of response to this RO. Hitachi-GE will consider the relevant regulatory expectations in RQ-ABWR-0559/0560 when this action will be performed.

Attached Gantt Chart (Table 1) describes not only timescales for actions related to this RO but also that for Level 1 PSA update.

Description of work:

ACTION 1 – Level 1/Level 2 interface PSA documentation
After the initial quantification in December 2015, Hitachi-GE has been improving the Level 2 PSA quantification method to automatically calculate overall risk point estimates, importance measures, and parametric uncertainties and provide a merged list of cutsets. That method will be applied to the updated Level 2 PSA.
Based on that, Hitachi-GE will update the Level 2 PSA documentation so that it includes a clear explanation of how the model logic and dependencies from the Level 1 (functional, common cause, human, spatial) are transferred into the Level 2 model and are properly treated.
The results of this action will be described in the revised "Topic Report on Internal Event Level 2 PSA" chapter 3 "Interface between Level 1 and Level 2".

ACTION 2 – Plant Damage States
ACTION 2.1 – Expansion of Plant Damage States
Hitachi-GE will expand the number of Plant Damage States (PDSs). Specifically, all Level 1 accident sequences that involve core damage should be assigned to a PDS that adequately represents the key characteristics of the accident sequence.
The results of this action will be described in the revised "Topic Report on Internal Event Level 2 PSA" chapter 3 "Interface between Level 1 and Level 2".
ACTION 2.2 – Development of Containment Event Tree
Hitachi-GE will develop a CET for each PDS.
The results of this action will be described in the revised "Topic Report on Internal Event Level 2 PSA" chapter 6 "Accident Progression Analysis and Containment Event Tree".

ACTION 3 – Severe accident phenomena and other aspects of the severe accident progression
Hitachi-GE will review and appropriately expand the severe accident phenomena and other aspects of severe accident progression treated in the CETs.
The results of this action will be described in the revised "Topic Report on Internal Event Level 2 PSA" chapter 6 "Accident Progression Analysis and Containment Event Tree".

ACTION 4 – Accident Progression Analyses
ACTION 4.1 – Extension of severe accident analyses
Hitachi-GE will extend the severe accident analyses, including mitigating systems analyses to cover key accident sequences in the Level 2 PSA.
The results of this action will be described in the revised "Topic Report on Internal Event Level 2 PSA" chapter 6 "Accident Progression Analysis and Containment Event Tree".

ACTION 4.2 – Demonstration of stable release
Hitachi-GE will demonstrate that the radionuclide release calculations used to support the Level 2 PSA are performed for sufficient time to reach a stable release.
The results of this action will be described in the revised "Topic Report on Internal Event Level 2 PSA" chapter 6 "Accident Progression Analysis and Containment Event Tree".

ACTION 5 – Radionuclide release path characterisation
Hitachi-GE will explicitly characterise the radionuclide release paths in the Level 2 PSA based on a detailed containment failure analysis (Action 6) from locations and timing affected by the debris location. This action will be performed as extension part of the actions for RO-ABWR-0023. The impact on the Reactor Building systems, instrumentation, access, integrity during the postulated failure mode, including leakage to the Reactor Building will be considered.
The results of this action will be described in the revised "Topic Report on Internal Event Level 2 PSA" chapter 7 "Source Term Analysis". This action is planned by maintaining the consistency to RO-ABWR -0046.

ACTION 6 – Containment performance analyses

Hitachi-GE will perform containment performance analyses to identify the potential radionuclide release paths following a severe accident. This action will be performed as part of the actions for RO-ABWR-0046.
The results of this action will be summarised in the revised "Topic Report on Internal Event Level 2 PSA" chapter 5 "Containment Capacity Analysis".

ACTION 7 – Release category groups
Hitachi-GE will revise the release category groups as needed in line with the outcome of A5 and A6.
The results of this action will be described in the revised "Topic Report on Internal Event Level 2 PSA" chapter 7 "Source Term Analysis".

ACTION 8 – Mitigation measures
ACTION 8.1 – Additional mitigation measures
Hitachi-GE will verify whether there are additional mitigation measures that need to be incorporated into the PSA.
The results of this action will be described in the revised "Topic Report on Internal Event Level 2 PSA" chapter 4 "Engineered Safety Features and Operator Actions".

ACTION 8.2 – Systems response under severely degraded conditions
Hitachi-GE will characterize the systems response under severely degraded conditions of core melt progression.
The results of this action will be described in the revised "Topic Report on Internal Event Level 2 PSA" chapter 4 "Engineered Safety Features and Operator Actions".

ACTION 9 – Key assumptions and sensitivity analyses
Hitachi-GE will identify the key assumptions and uncertainties related to the Level 2 PSA and supporting analyses, provide justification.
Hitachi-GE will undertake sensitivity analyses as needed to understand the impact on the Level 2 PSA results.
The results of this action will be described in "Sensitivity Analysis Report for Internal Event PSA at power".

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, 7,8,9	Topic Report on internal event Level 2 PSA at power Rev.2	GA91-9201-0001-00103	30-December-2015
ROA4, 5, 6, 9	Topic Report on Severe Accident Phenomena and Severe Accident Analysis (Rev. number depends on SAA activity)	GA91-9201-0001-00024	30-December-2015
ROA5, 6	Analysis Report on UK ABWR Containment Performance	-	30-November-2015
ROA9	Sensitivity Analysis Report for Internal Event PSA at power Rev.1	GA91-9201-0003-00627	31-March-2016
ROA1	Human Reliability Analysis Report (Rev. number depends on HF activity)	GA91-9201-0001-00041	31-March-2016

Programme Milestones/ Schedule:

See attached Gantt Chart (Table 1).

Reference:

N/A

Table 1 RO-ABWR-0048 Gantt Chart

UK ABWR Probabilistic Safety Analysis: Level 2 PSA methodology Resolution Plan for RO-ABWR-0048

Level	Action Title	Start	Finish
1	Regulator's issue of RO		
1.1	ONR Issue RO	27-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	31-May-15
1.4	Regulator's publish RO and Resolution Plan	1-Jun-15	14-Jun-15
2	Preparation of Submissions and Closure of RO Actions		
2.1	RO Action 1	10-Aug-15	31-Dec-15
2.2	RO Action 2	10-Aug-15	31-Dec-15
2.3	RO Action 3	10-Aug-15	31-Dec-15
2.4	RO Action 4	10-Aug-15	31-Dec-15
2.5	RO Action 5	10-Aug-15	31-Dec-15
2.6	RO Action 6	4-May-15	30-Nov-15
2.7	RO Action 7	10-Aug-15	31-Dec-15
2.8	RO Action 8	10-Aug-15	31-Dec-15
2.9	RO Action 9	4-Jan-16	31-Mar-16
2.10	Update of Level 1 PSA	6-Jul-15	30-Sep-15
3	Regulator's Closure of RO		
3.1	Regulators Assessment	4-Jan-16	31-Dec-16
3.2	Regulator's publication of RO closure letter	9-May-16	31-Dec-16