Hitachi-GE Nuclear Energy, Ltd.
UK ABWR GENERIC DESIGN ASSESSMENT
Resolution Plan for RO-ABWR-0053
UK ABWR Probabilistic Safety Analysis (PSA) – level 1 and level 2 PSA for internal events during operation at power - System Analyses

RO TITLE:	UK ABWR Probabilistic Safety Analysis (PSA) – level 1 and level 2 PSA for internal events during operation at power - System Analyses	
REVISION :	1	
Overall RO Closure Date (Planned):		30 April, 2016
REFERENCE DOCUMENTATION RELATED TO REGULATORY OBSERVATION		
Regulatory Queries	-	
Linked ROs	RO-ABWR-0042, RO-ABWR-0048	
Other Documentation	-	

Scope of work :

Background

Hitachi-GE has developed an internal event Level 1 PSA and Level 2 PSA at power for the UK ABWR and associated system analysis. For the system 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-6268. ONR has identified shortfalls related to modelling and documentation and raised RO-ABWR-0053 to state ONR's expectations and request Hitachi-GE to address 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-0053. The actions cover modelling improvements, justification and 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 – Completeness and scope of systems analyses

ACTION 1.1 - System operation during accident conditions

Hitachi-GE will improve the PSA model and documentation to include

- System operation modes and alignments;
- Justification of any operator intervention given adverse environmental effects (if relevant);
- Operability given the trip set-points limits;
- Survivability of all system components;
- Operability given adverse environmental effects impacting equipment survivability.
- Any other relevant aspect of the system operation during accident conditions

This Action will include assumption development and/or supporting analyses for justification as needed.

ACTION 1.2 - Relevant system components and system connections

Hitachi-GE will improve the documentation to include the relevant system components and system connections that are to be modelled. When relevant and justified, documentation of any component in the system diagrams that is not modelled and the reason why will be provided.

ACTION 1.3 - Pre-initiator HEPs

Hitachi-GE will systematically identify pre-initiator Human Failure Events (HFEs) and perform Human Reliability Analysis (HRA) for inclusion in the system fault trees.

ACTION 1.4 – Inter and intra system CCF

Hitachi-GE will improve the PSA model and documentation to include a complete list of inter and intra system CCF and supporting analyses. The documentation will also include a justification for the CCFs groups. When similar components of different systems are not included in the same CCF group a justification will be provided.

ACTION 1.5 – Structural failures of components

Hitachi-GE will review potential structural failures of components when subjected to unusual accident conditions. Then, inclusion or non-inclusion (with justification) of these structural failures in the PSA will be judged and documented. The PSA model will be updated to include the structural failures that are judged to be included in the PSA.

ACTION 1.6 – Failure modes for each component

Hitachi-GE will improve the PSA model and documentation to include a complete and justified list of failure modes for each component.

ACTION 1.7 – System functions for each system

Hitachi-GE will improve the PSA model and documentation to include a complete and justified list of system functions for each system.

ACTION 1.8 – Review of UK ABWR PSA

Hitachi-GE will review UK ABWR PSA to address the specific shortfalls identified in “Topical Report on UK ABWR GDA System Analysis (internal Events At-Power)”, ABWR-02-STEP3.

ACTION 1.9 – Hardware failures that contribute to human failure events

Hitachi-GE will assess the characteristics (e.g. redundancy, alternatives, separation for hazard specific issue) of cues for the credited operator actions. Then, Hitachi-GE will address the impact of the hardware failures on the HFEs, including potential misleading indications resulting from the impact of fault and SA conditions on instrument.

If failures of some alarms/indicators are judged to result in overall failure of specific operator action(s), these alarms/indicators will be added to the system fault trees. In that case, international good practice will be surveyed to adjust the depth of modelling.

ACTION 1.10 – Additional systems

Hitachi-GE will investigate the systems of UK ABWR and identify additional systems for inclusion in the PSA.

ACTION 1.11 – Additional post-initiator operator actions

Hitachi-GE will identify additional post-initiator operator actions for inclusion in PSA, considering the emergency procedures and international good practices. For the additional operator actions judged to be credible and to bring significant risk reduction (criteria to be documented), the HFEs associated with these actions will be newly credited and Human Reliability Analysis (HRA) will be performed.

ACTION 1.12 – Portable equipment

Hitachi-GE will review the accident sequences for Level 1 PSA and Level 2 PSA. If portable equipment is judged to be credible and to bring significant risk reduction (criteria to be documented), system fault tree(s) and associated HFEs will be developed and included in the PSA.

ACTION 2 – Dependencies

ACTION 2.1 – Review of dependencies

Hitachi-GE will review the dependency modelling, identify and include additional dependencies for PSA model update, considering international good practices. Justification for non-inclusion of specific dependencies will be performed in Action 2.2.

ACTION 2.2 – Justification to demonstrate no inclusion of support system dependencies

Hitachi-GE will justify no inclusion of some support system dependencies specifically for room cooling. The justification will include the supporting analysis and/or providing related design specifications.

ACTION 2.3 – Documentation

Hitachi-GE will prepare a Dependency Notebook which addresses all of the PSA dependencies.

ACTION 3 – C&I model and documentation

ACTION 3.1 – C&I system boundaries and components

Hitachi-GE will provide justification for the C&I system boundaries and components modelled in the PSA.

ACTION 3.2 – C&I failure modes

Hitachi-GE will review the C&I FMEA and associated CCF potential map that have been prepared for Design Basis Analysis (DBA). The FMEA and potential map include instrumentation failures. Additional failure modes may be modelled.

ACTION 3.3 – Technical basis for C&I modelling assumptions

Hitachi-GE will provide the technical basis for the C&I modelling assumptions.

ACTION 3.4 – Technical basis for C&I data and associated uncertainty

Hitachi-GE will provide the technical basis for the C&I data and associated uncertainty.

ACTION 3.5 – Impact of C&I data uncertainties and modelling assumptions

Hitachi-GE will provide an evaluation of the impact of C&I data uncertainties and modelling assumptions on the risk. Hitachi-GE will provide a plan to reduce these uncertainties and the effect on the PSA results of key assumptions, when further information on the design becomes available.

ACTION 3.6 – Indicators/alarms

This Action will be performed as part of Action 1.9.

ACTION 4 – Support systems initiators

Hitachi-GE will develop fault trees for support system initiators and document them.

ACTION 5 – Latent failure modes

Hitachi-GE will review the current modelling of standby failures and if needed introduce additional failure modes into the PSA model. Identification and inclusion of additional pre-initiator HEPs will be conducted in Action 1.3.

ACTION 6 – Improvement of system analyses documentation

ACTION 6.1 – Address shortfalls identified in ABWR-02-STEP3

Hitachi-GE will improve the documentation to address the shortfalls identified in ABWR-02-STEP3 and to meet the expectations listed in the Technical Assessment Guideline. Some of the documentation improvement might be duplicated with other Actions.

ACTION 6.2 – Impact of initiating events on systems

This Action will be performed as part of Action 2.3.

ACTION 6.3 – House events, flags and mutually exclusive files

Hitachi-GE will improve the documentation on house events, flags and mutually exclusive files.

ACTION 6.4 – Recovery actions

Hitachi-GE will improve the documentation such that recovery actions credited in the PSA model is complete and clear.

ACTION 6.5 – Model asymmetries

Hitachi-GE will provide an explanation of how model asymmetries will be considered on the evaluation of the results of importance analysis and a commitment date to correct model asymmetries artificially built in the PSA. The commitment date may not be within GDA because Hitachi-GE understand that model asymmetries will not cause problem before the phase of risk monitor development.

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	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	Topic Report on internal event Level 2 PSA at power	GA91-9210-0001-00103 (AE-GD-10258)	30-Dec-2015
ROA2, 4, 6	Initiating event analysis for internal event PSA at power	GA91-9201-0003-00148 (AE-GD-0184)	30-Sept-2015
ROA1, 2, 3, 6	Event sequence analysis for internal event PSA at power	GA91-9201-0003-00151 (AE-GD-0187)	30-Sept-2015
ROA1, 2, 3, 4, 5, 6	System analysis for internal event Level 1 PSA at power	GA91-9201-0003-00183 (AE-GD-0194)	30-Sept-2015
ROA1, 3, 5, 6	Human Reliability Analysis Report	GA91-9201-0003-00321 (AE-GD-0223)	30-Sept-2015

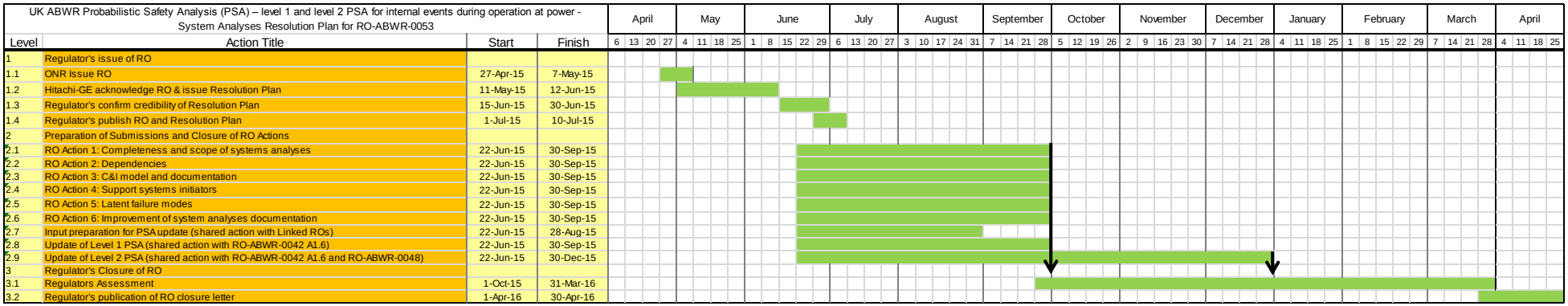
Programme Milestones/ Schedule:

See attached Gantt Chart (Table 1).

Reference:

N/A

Table 1 RO-ABWR-0053 Gantt Chart



NOTE: The resolution plan is coordinated with those for "Linked ROs"