

Hitachi-GE Nuclear Energy, Ltd.
UK ABWR GENERIC DESIGN ASSESSMENT
Resolution Plan for RI-ABWR-0002
UK ABWR Probabilistic Safety Analysis: Project Plan and Delivery

RI TITLE:	UK ABWR Probabilistic Safety Analysis: Project Plan and Delivery	
REVISION :	1	
Overall RI Closure Date (Planned):	1 st October 2016	
REFERENCE DOCUMENTATION RELATED TO REGULATORY ISSUE		
Regulatory Queries	RQ-ABWR-0559, RQ-ABWR-0560	
Regulatory Observations	RO-ABWR-0037, RO-ABWR-0040, RO-ABWR-0040, RO-ABWR-0041, RO-ABWR-0042, RO-ABWR-0046, RO-ABWR-0048, RO-ABWR-0053	
Linked RIs	-	
Other Documentation	-	

1. Scope of work for this resolution plan:

This Resolution Plan provides Hitachi-GE's response to RI-ABWR-0002: UK ABWR Probabilistic Safety Analysis: Project Plan and Delivery.

The Japanese ABWR Reference Plant upon which the UK ABWR is based has been designed, constructed and operated in accordance with some of the highest Safety and Environmental standards. The reference plant is the culmination of some 50 years of continuous design-evolution in Boiling Water Reactor technology; and has a strong track record in safety and environmental protection, since the first ABWR plant began operation in 1996.

Hitachi-GE acknowledge that the PSA submissions made in December 2014 did not meet UK Regulatory expectations and as a consequence Hitachi-GE must develop a revised approach in line with UK good practice, in order to build UK Regulator's confidence in our ability to deliver a suitable and sufficient full scope, modern standards, PSA by June 2016 as committed in GDA Step 2. However the design process used in the development of the Japanese Reference Plant is rigorous and Hitachi-GE is confident that when we implement the revised PSA modelling approach this will demonstrate the proposed UK ABWR generic design is safe and will meet appropriate UK environmental and safety standards.

In view of the challenges we have faced meeting the UK Regulator's expectations Hitachi-GE has enhanced our PSA team including securing the support of internationally recognised PSA experts to ensure our PSA submissions meets UK Regulatory expectations. Our delivery plans have been staged to enable a phased assessment by the regulators to help ensure the deliverables meet their expectations.

Hitachi-GE has reviewed the Regulatory Issue (RI-ABWR-0002), the associated Regulatory Observation (RO-ABWR-0037, 0040, 0041, 0042, 0046, 0048 and 0053), the associated Regulatory Queries (RQ-ABWR-0559 and 0560) and other Regulatory feedback and has formulated an approach, scope and programme of work in response to this Regulatory Issue (RI).

Through responses to this RI, Hitachi-GE will submit the following items to provide confidence that we can prepare a suitable and sufficient design assessment stage PSA in GDA:

- **Project plan:** A project plan that ensures that the PSA's purpose and objectives and hence its scope are clearly understood at the outset of the project. It should also identify the requisite level of QA, and the various reports and procedures which will be produced during the course of the development of the PSA. It is essential to identify the required documentation at the beginning of the project, and develop it throughout the course of the work, as much more effort would be required to generate the technical documents after the models have been developed.
- **Resources:** The allocation of sufficient Suitably Qualified and Experienced PSA resources required to complete each of the PSA tasks identified in the project plan. These will be sourced both internally within Hitachi-GE and its sister company GE-Hitachi but also from internationally recognised PSA Consultants
- **Quality Assurance:** The development of the PSA must be based on a secure and traceable process in which all details of the PSA, including explicit and implicit assumptions, modelling techniques, etc., are fully checked, documented and recorded. The purpose of the Quality Assurance (QA) plan and procedures is to ensure that the necessary documentation is developed and the review process for all work products is clearly specified. The QA practices and procedures in use in the development of the plant design should be considered when QA is planned for the development of the PSA.
- **PSA model and technical documentation:** Comprising the UK ABWR PSA model and all the technical documentation covering the development of each of the tasks and the recording and reporting of the work performed. This will be delivered by June 2016 as committed in GDA Step 2.

The project plan includes UK ABWR PSA update to address the shortfalls identified in Step 3 and the expectations in the relevant sections of the SAPs and the PSA TAG.

2. Background:

The Japanese ABWR Reference Plant, upon which the UK ABWR is based, has been designed, constructed and operated in accordance with some of the highest Safety and Environmental standards in the world.

PSA techniques have been used from the earliest stages in the design of the ABWR Reference Plant. The plant is the culmination of some 50 years of continuous design evolution in Boiling Water Reactor technology and has a strong track record in safety and environmental performance since the first plant began operation in 1996.

The ABWR design has received Regulatory approvals in three countries, has been designed in accordance with rigorous standards and Hitachi-GE is confident that when it implements the revised PSA modelling approach this will demonstrate the proposed UK ABWR generic design is safe and will meet appropriate UK environmental and safety standards.

Hitachi-GE acknowledge that the PSA submissions made in December 2014 did not meet UK Regulatory expectations and as a consequence Hitachi-GE must develop a revised approach in line with UK good practice, in order to build UK Regulatory confidence in our ability to deliver a suitable and sufficient full scope, modern standards, PSA by June 2016 as committed in GDA Step 2.

Following submission of the PSA, Hitachi-GE has met with the Regulators on a number of occasions and

welcomes the close engagement and efforts made by the Regulators to ensure the reasons why the PSA submissions did not meet expectations has been understood and to ensure that Hitachi-GE has a good understanding of relevant good practice for the UK approach to PSA.

Hitachi-GE's revised approach includes:

- **Increased Team Capability:** *Hitachi-GE significantly enhanced its team in the Japan, UK and USA to ensure it has access to internationally recognised PSA experts.*
- **A revised approach:** *Hitachi-GE undertook a thorough review of its approach, including taking advice from internationally recognised PSA experts resulting a revised approach which is summarised in the Resolution Plan.*
- **Phased Delivery Programme:** *Hitachi-GE has developed a staged approach to programme delivery to help support a phased Regulatory assessment programme and to ensure the PSA programme of work produces an acceptable output which meets UK Regulatory expectations.*

Following confirmation from the regulators that the revised approach set out in this Resolution Plan is credible, by the end of GDA Step 3, Hitachi-GE will have fully mobilized its enhanced PSA team and submitted the following key documents to the Regulators:

- PSA Project Plan
- PSA Document Map
- PSA Quality Assurance Plan and Procedures
- Revised Level 1 PSA at power prepared in accordance with these documents

The first documents to be submitted as part of the staged delivery will be the Project Plan, Document Map and Quality Assurance Plan and Procedures, and the L1 PSA at power. These documents will provide the Regulators with a comprehensive understanding of the revised approach to the PSA. This should provide the Regulators with confidence that the revised approach is appropriate to meet UK Regulatory requirements and that the work programmed for completion in Step 4 GDA, will meet their expectations.

3. Description of work:

Hitachi-GE will deliver the following actions in order to make its Hitachi-GE UK ABWR PSA meet the regulators' expectation and to assure its delivery in GDA timeframe.

ACTION 1 – UK ABWR PSA Project Plan

Hitachi-GE will provide the UK ABWR PSA Project Plan, which includes:

- PSA objectives, applications and definition of the requirements of the PSA to fulfil these.
- The identification and justification of the computer code(s) that will be used for UK ABWR PSA (model and database).
- Definition of the PSA tasks required to be completed during GDA (including the tasks already completed and on-going).
- Identification of the procedures and reports which will be produced or updated during the development of the UK ABWR PSA, for all the PSA tasks and PSA applications.
- A detailed work programme including all planned deliverables for the UK ABWR PSA and documentation.

The project plan will reflect a revised approach to present a modern, full scope design assessment PSA to support the GDA. The PSA will address the complete range of initiating events including internal initiators, fire, flood, seismic, other external initiators and credible combinations of these events. Each initiator will be applied to all plant operating modes and to all potential sources of radiation including the reactor, the spent fuel pool and the entire fuel route at the plant.

Each aspect of the PSA noted above can be considered as a separate task in the development of the full scope PSA. The planning of individual PSA tasks may be conducted in parallel with the performance of PSA activities in the other tasks. Therefore, to develop the full scope design assessment PSA, the following cycle will be applied to develop the deliverables for all PSA tasks.

- (1) Planning of Task is performed by the PSA core team and supporting TSCs under the guidance of the UK ABWR Technical lead. Planning includes detailed review of PSA TAG and ONR's feedback as well as a review of relevant SAP and IAEA safety standards. An approach to the resolution of the findings from the review will be included in the plan.
- (2) Methodology development/definition will be performed by the responsible performer for the task and will include the identification of appropriate supplementary standards.
- (3) Design input/Data/Fragility parameter/Hazard assessment collection will be performed by the responsible parties.
- (4) Model development/Quantification will be performed by the responsible parties.
- (5) Documentation will be developed by the responsible parties who will also perform and document a self-assessment against SAP/PSA TAG.
- (6) Peer Review of output from sub-task by international PSA experts assigned to each task.
- (7) Resolution of comments and submission of document to the UK ABWR project team will be performed by the responsible performer.
- (8) Final approval of the document and transmission of documents to the ONR is the responsibility of the UK ABWR project team and will be performed in accordance with project procedures.

The full scope design assessment PSA is substantiated through a process of identification, grouping of, initiating faults and operational modes and, when relevant prioritisation of source of radioactivity and type of hazard. This prioritisation approach ensures that the depth of detail in the PSA is appropriate for the assessment of risk at design assessment.

The basic principles for depth are that

1. the PSA cannot have greater depth of detail than the design of the UK ABWR SSCs during GDA which will be at the level of specification of requirements prior to detailed design in the site specific phase of the project;
2. The PSA will reflect the Design Reference.

When the level of plant requirements specification limits the detail of the PSA, then appropriate assumptions will be developed to allow completion of the PSA. These assumptions will be tracked in accordance with requirements of the PSA TAG. Additionally, risk insights from the PSA will be shared with the appropriate design teams in accordance with Hitachi-GE's design process. The PSA and its insights will be used to support the ALARP assessment.

Hitachi-GE has undertaken its own assessment of the level of PSA analysis to be undertaken within GDA using its hazards prioritization methodology and used this to estimate the scope of PSA work to be undertaken within GDA. As an early activity in the delivery of the RI Resolution Plan Hitachi-GE will submit its Prioritisation of Hazards for Internal and External Events Report to the Regulators as part of its response to UK-ABWR-RI-0002 Action 4.

Documents will be developed to maximize organizational consistency between PSA tasks. To ensure the acceptability of the documentation including the level of detail required to support regulatory review, Hitachi-GE will submit example documentation to ONR by the end of July.

A detailed work programme will be provided in advance of delivery of each major task within the PSA work programme. This includes a full review of PSA related ROs the PSA TAG, and other regulatory feedback to

ensure all necessary activities are included to resolve the regulatory feedback. The following documents will be revised in accordance with our phased planning strategy.

- PSA Strategy Document, GA91-9201-0003-00130 (AE-GD-0156) Rev.2
- PSA Programme, GA91-9201-0003-00121 (AE-GD-0150) Rev.3

The PSA programme will be updated and submitted to ONR at regular intervals throughout GDA as new information become available and in advance of the next phase of work. The plan and strategic PSA programme cover both Steps 3 and 4 of GDA.

ACTION 2 – Allocation of Suitably Qualified and Experienced PSA Resources to Develop the UK ABWR PSA

Hitachi-GE will provide information on the resources allocated to develop the UK ABWR PSA in terms of manpower and qualifications and experience required to complete each of the PSA tasks identified in Action 1. The PSA team will be considerably enhanced in order to ensure the delivery of the planned workscope. Based on the enhanced team and considering the ONR's expectations in this RI, the document on "Allocation of Suitably Qualified and Experienced PSA Resources to Develop the UK ABWR PSA" will be further developed based on the following document.

- Allocation of Suitably Qualified and Experienced PSA Resources to Develop the UK ABWR PSA (Response to RO-ABWR-0013 Action 2), GA91-9201-0003-00737 (AE-GD-0430) Rev.0

This information covers Hitachi-GE PSA team, the GE-Hitachi team, other engineering teams supporting PSA activities, external support contractors, etc.

ACTION 3 – PSA Quality Assurance Plan and Quality Assurance Procedures

Hitachi-GE will update the Quality Assurance documents and procedures, applied to UK ABWR PSA to reflect the international nature of the enhanced PSA team. This information includes the relationship between each task and involvement parties both within Hitachi-GE and its wider team. Key enhancements include :

- Input from the UK ABWR Technical Lead
- Enhanced internal peer review of PSA documentation by internationally recognised PSA experts
- A dedicated PSA QA team to support and coordinate activities across the team
- Third party reviews of a sample of key submission by Horizon Nuclear Power the prospective Licensee for the UK ABWR

The output from internal Quality Assurance processes is available for inspection by the Regulators in line with Hitachi-GE's wider GDA assurance arrangements.

ACTION 4 – PSA Task Analysis Files, Summary Report, Document database and Task Procedures

Hitachi-GE will review the PSA TAG, this RI, related Regulatory Observations (ROs) and other Regulatory feedback and will develop the following information as the deliverables as defined in the PSA task plan:

- Individual reports for each of the UK ABWR PSA task, including PSA assumptions
- UK ABWR PSA summary report
- UK ABWR PSA computer model (including input parameter data bases, result files, etc.)
- The task files, including relevant references, which will be available to ONR upon request
- The updated Document Map as a document database
- Updated Task Procedures in line with the relevant expectations and feedback from ONR

Hitachi-GE will provide a Document Database and a plan of updates during GDA. The documents database consists of the document map and the table of the name and ID of PSA report, Methodology document, Report on each task and other documents used to support the development of each PSA task, including the documents produced by other technical areas supporting the assumptions and models in the PSA or for which the PSA provides an input. The document map shows the graphical relationship among above documents.

The final submittal in this action will be PSA Summary Report.

4. Summary of impact on GDA submissions:

The following planned submissions are considered those most likely to be impacted by the PSA:

GDA Submission Documents	C/U	Related GDA RI Action(s)	Submission Date to ONR/EA
PCSR Ch25: Probabilistic Safety Assessment *	U	*	August 2017
PCSR Ch26: Beyond Design Basis and Severe Accident Analysis *	U	*	August 2017
PSA Strategy Document	U	A1	August 2015
PSA Programme	U	A1	Initial : July 2015 Final : February 2016
Allocation of Suitably Qualified and Experienced PSA Resources to Develop the UK ABWR PSA	U	A2	July 2015
Document on PSA Quality Assurance	C	A3	September 2015
PSA Document map	U	A4	June 2016
Topic Report on Internal Event Level 1 PSA at Power	U	A4	September 2015
Prioritisation of Internal and External Hazards Report	C	A4	October 2015
Topic Report on Internal Event Level 2 PSA at Power	U	A4	December 2015
Topic report on internal event shutdown PSA	C	A4	November 2015
Topic report on internal event SFP PSA	C	A4	November 2015
Topic report on Internal event Level 2 shutdown PSA and SFP PSA	C	A4	December 2015
Topic report on Seismic Margin Analysis	C	A4	April 2016
Topic report on Internal Fire PSA	C	A4	April 2016
Topic report on Internal Flooding PSA	C	A4	April 2016
Topic report on non-reactor fault PSA	C	A4	May 2016
Topic report on fuel route and dropped loads PSA	C	A4	May 2016
Topic report on Level 3 PSA	C	A4	June 2016
Other PSA identified through Prioritisation of Internal and External Hazards Report	C	A4	June 2016 (To be confirmed, see below)
PSA Summary Report	C	A4	June 2016

U = Update C = Create * = Not required for closure of RI Actions

5. Programme Milestone/Schedule:

Please refer to the attached Resolution Plan Programme

Key Planning Assumptions:

- In order to help ensure Hitachi-GE's submissions meet the Regulator's expectations, Hitachi-GE request the Regulators sample through the resolution process and provide feedback and advice to ensure alignment with regulatory expectations at appropriate points through written responses to submissions and regular communications via Level 4 Technical Meetings (in the UK and Japan).
- Hitachi-GE has undertaken its own assessment of the level of PSA analysis to be undertaken within GDA using its hazards prioritization methodology and used this to estimate the scope of PSA work to be undertaken within GDA. As an early activity in the delivery of the RI Resolution Plan Hitachi-GE will submit is Prioritisation of Hazards for Internal and External Events Report. Whilst Hitachi-GE will endeavor to mitigate the impact of any change to the scope of the PSA work it should be noted that if there were a significant change to the planned scope of work following Regulatory assessment this may result in a revision to the overall PSA programme.

6. References:

RO-ABWR-0037 Regulatory Observation
RO-ABWR-0037 Resolution Plan
RO-ABWR-0040 Regulatory Observation
RO-ABWR-0040 Resolution Plan
RO-ABWR-0041 Regulatory Observation
RO-ABWR-0041 Resolution Plan
RO-ABWR-0042 Regulatory Observation
RO-ABWR-0042 Resolution Plan
RO-ABWR-0046 Regulatory Observation
RO-ABWR-0046 Resolution Plan
RO-ABWR-0048 Regulatory Observation
RO-ABWR-0048 Resolution Plan
RO-ABWR-0053 Regulatory Observation
RO-ABWR-0053 Resolution Plan
RQ-ABWR-0559
RQ-ABWR-0560

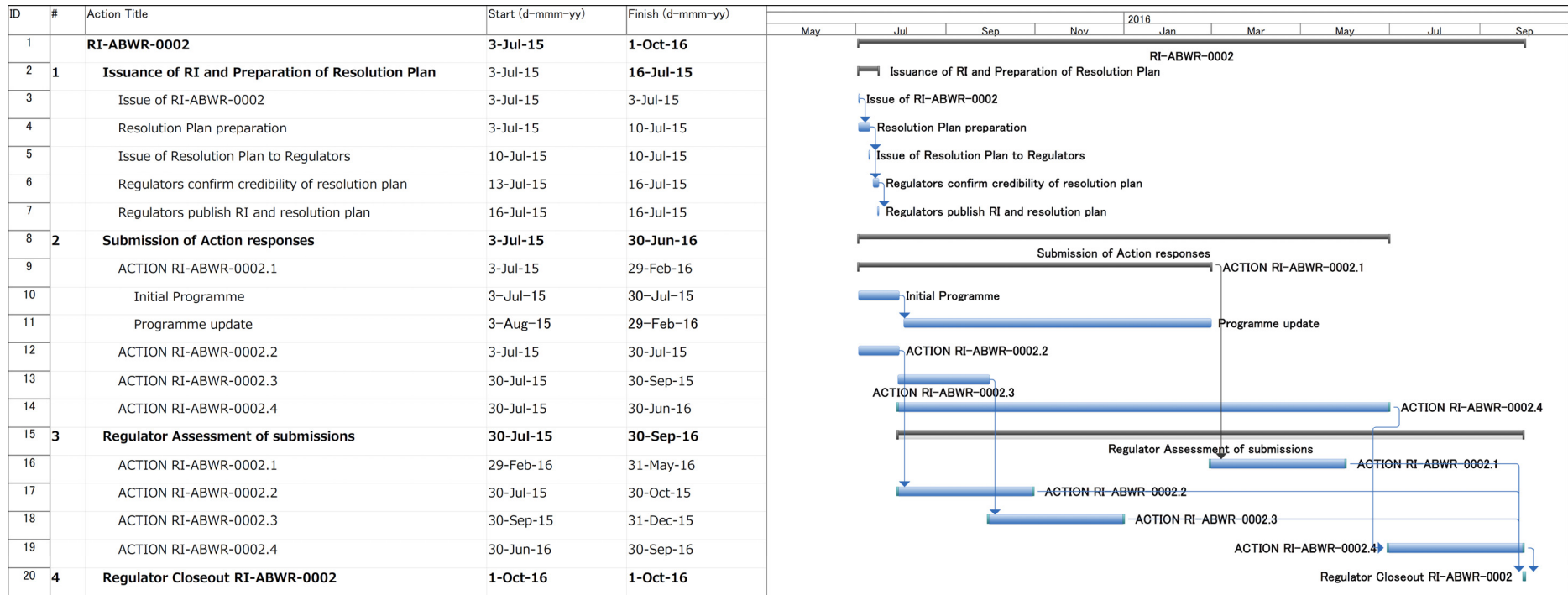


Figure 1– Resolution Plan Programme for RI-ABWR-0002

Glossary

ABWR – *Advanced Boiling Water Reactor*

BAT – *Best Available Techniques*

BWR – *Boiling Water Reactor*

EA – *Environment Agency*

EPRI – *Electric Power Research Institute*

GDA – *Generic Design Assessment*

GEP – *Generic Environmental Permit*

Normal Operation s – *Includes all five operational phases associated with the ABWR. This includes system start-up, hot standby, power operation, system shutdown and refuelling outage.*

ONR – *Office for Nuclear Regulation*

OPEX – *Operating Experience data from operational plants worldwide.*

PCSR – *Pre-construction Safety Report*

PSA – *Probabilistic Safety Analysis*

Radwaste – *Radioactive Waste*

RI – *Regulatory Issue*

RIA – *Regulatory Issue Action*

RO – *Regulatory Observation*

SFAIRP – *So Far As Is Reasonably Practicable*

TR – *Topic Report*

UK ABWR – *UK Advanced Boiling Water Reactor*

NOT PROTECTIVELY MARKED

Level 0 Resolution Plan Strategic Programme

