

Hitachi-GE Nuclear Energy, Ltd.
UK ABWR GENERIC DESIGN ASSESSMENT
Resolution Plan for RO-ABWR-0066
(Demonstration of suitable and sufficient consideration of chemistry effects in fault analysis)

RO TITLE:	Demonstration of suitable and sufficient consideration of chemistry effects in fault analysis
REVISION :	0
Overall RO Closure Date (Planned):	28 Feb. 2017
REFERENCE DOCUMENTATION RELATED TO REGULATORY OBSERVATION	
Regulatory Queries	RQ-ABWR-0332, RQ-ABWR-0409, RQ-ABWR-0411 RQ-ABWR-0412, RQ-ABWR-0413, RQ-ABWR-0621 RQ-ABWR-0623, RQ-ABWR-0626, RQ-ABWR-0627
Linked ROs	RO-ABWR-0006, RO-ABWR-0011, RO-ABWR-0013 RO-ABWR-0019, , RO-ABWR-0023, RO-ABWR-0043
Other Documentation	RI-ABWR-0001 RI-ABWR-0002 GA91-9201-0001-00023, UE-GD-0219 – UK ABWR GDA – Topic report on Design Basis Analysis, Revision 3, 27 November 2014. GA91-9201-0001-00024, AE-GD-0102 – UK ABWR GDA – Topic report on Severe Accident Phenomena and Severe Accident Analysis, Revision D, 23 December 2014. GA91-9101-0003-00807, WPE-GD-0171– UK ABWR GDA – Demonstration of Adequacy of pH control in the Suppression Pool during Accident Conditions, Revision 1, 8th September 2015. GA91-9101-0003-00451, WPE-GD-0097– UK ABWR GDA – Suppression Pool pH Model during Design Basis Accident and Severe Accident. GA91-9201-0001-00114, AE-GD-0265– UK ABWR GDA – Topic Report on SBO Analysis, Revision 3, 30th October 2015 GA91-9201-0001-00139, AE-GD-0473– UK ABWR GDA – Topic Report on Beyond Design Basis Analysis, Revision 2, 29th January 2016 GA91-9201-0003-00734, WPE-GD-0150– UK ABWR GDA – Support Document Package for UK ABWR Reactor Chemistry Safety Case Strategy, Revision 1, 11th August 2015

Scope of work :
Back ground
<p>This Resolution Plan has been produced in response to Regulatory Observation RO-ABWR-0066 on demonstration of suitable and sufficient consideration of scope of chemistry effects in fault analysis.</p> <p>Throughout the GDA process Hitachi-GE has provided ONR with technical and safety analyses intended to demonstrate that risks to both workers and the public from the UK ABWR will be acceptably low. These analyses</p>

cover both normal operation of the reactor and accident scenarios. Accident scenarios evaluated included both those within the DBA and SA. In considering the progression of reactor accidents, there are numerous stages in the fault analysis where chemistry influences, or has the potential to influence, the transport and release of radiologically-significant nuclides and hence the overall risk. It is necessary for the safety case to clearly and comprehensively present how chemistry has been evaluated within the fault studies. In particular, the safety case should;

- clearly state the nuclear safety significance of the assumptions and/or claims made with respect to chemistry;
- demonstrate an understanding of the uncertainty in those assumptions and/or claims;
- present the sensitivity of the results to those assumptions and/or claims;
- provide appropriate and proportionate evidence to substantiate those assumptions and/or claims; and
- reconcile these aspects in an adequate manner, particularly in the context of the overall safety case for UK ABWR

Scope of work

This Resolution Plan will provide a full demonstration that suitable and sufficient consideration has been given to chemistry effects in fault studies. This demonstration will include all chemistry aspects relevant to Design Basis Analysis, PSA, beyond-DBA and Severe Accident Analysis faults, considered either individually or, where applicable, as generic groups.

The scope of the work undertaken in response to this Regulatory Observation will be constrained to those areas of chemistry that have a direct effect on the radiological consequences of accidents. Where there are chemistry effects that impact the radiological consequences indirectly, such as hydrogen combustion, the responses to this Regulatory Observation will provide comprehensive referencing to those submissions within the UK ABWR safety case to ensure that any interactions are understood and recorded. The work will consider all radiologically-significant nuclides such as, but not necessarily limited to, noble gases, iodine and particulate nuclides.

A detailed programme of work necessary to deliver this Resolution Plan is shown below.

Description of work:

Regulatory Observation RO-ABWR-0066 places a single action on Hitachi—GE as the requesting party;

RO-ABWR-0066.A1 – Hitachi-GE are required to demonstrate that they have given suitable and sufficient consideration to chemistry effects in the fault analysis for UK ABWR

In response to this Action Hitachi-GE should:

- Identify the key chemistry phenomena, assumptions and/or claims which have a nuclear safety significance and impact the radiological consequences analysis evaluated for DBA, PSA, beyond DBA and SAA faults.
- Discuss the sensitivity of the radiological consequences analysis for DBA, PSA, beyond DBA and SAA faults to the key chemistry related assumptions and/or claims identified above.
- Discuss the uncertainty in the key chemistry related assumptions and/or claims identified above, in relation to the radiological consequences analysis for DBA, PSA, beyond DBA and SAA faults.
- Provide appropriate and proportionate evidence to support the assumptions and claims made. The level of evidence will depend on the importance of the parameter, the sensitivity of the results to changes in the parameter, and the level of uncertainty/conservatism/realism that is required in the fault analysis methodology (i.e. DBA, PSA, beyond DBA and SAA).
- Discuss how chemistry considerations of phenomena, assumptions and claims will be reconciled into the overall safety case for the UK ABWR.

The response to this action will be provided in two parts. The first part will be presented in a document designated as the Strategy Report. The objective of this report is to identify those areas of chemistry which have safety significance with respect to the radiological consequences analysis for the various accident scenarios considered, and to summarise how these chemistry aspects are incorporated into the safety case. This will be done through systematic breakdown of the fault sequences. The Strategy Report will therefore comprise;

- Flow diagrams to illustrate the transport including key chemical phenomena of each radiologically-significant nuclide or group of nuclides for each relevant accident scenario or generic group of accident scenarios. The flow diagrams will also identify key SSCs relating to the accident scenarios.
- A Claims-Arguments-Evidence tree for the chemistry-related aspects of fault studies based on the output from the flow diagrams.
- An outline of the specific aspects of chemistry shown to significantly influence the results for the fault studies that, as a consequence, will be studied in more detail

- A comprehensive list of all technical study areas relating to fault analysis including a document map highlighting the interactions between the various document submissions that constitute the chemistry aspects of the safety case for the UK ABWR
- The methodologies to be used for detailed evaluation of each area of chemistry identified. These will be selected on a case-by-case basis.
- A schedule of work for each study.

The second part of the response to this Regulatory Observation will be presented in a document designated as the Study Report. The objectives of this report are to provide in detail the evidence identified in the Claims-Arguments-Evidence tree in the Strategy Report, to assess the uncertainties in that evidence and to evaluate the sensitivity of the overall dose analysis to those uncertainties. In this report Hitachi-GE will present a detailed study of those aspects of chemistry identified in the Strategy Report as significantly influencing radiological consequences in the event of accidents. This study will include definition of how the chemistry is assessed in the fault studies, the level of uncertainty associated with the understanding of the chemistry and an assessment of the sensitivity of the overall radiological consequences analysis to that uncertainty. Uncertainties will be assessed in such a way as to ensure that the degree of conservatism included in the analysis is appropriate for its end use.

In a number of instances, ONR have, through issue of Regulatory Queries, formally requested Hitachi-GE to provide additional detail relating to, or clarification of, information provided in the various topic reports to date. To ensure that the comprehensiveness of the safety case the Study Report will incorporate all of the relevant chemistry information already provided to ONR in RQ responses.

Based on the analysis presented in the Study Report and a cross-cutting evaluation of its impact on the overall risk from plant accidents, Hitachi-GE will, if necessary, update the Design Basis Analysis and Severe Accident Analysis Topic Reports.

Deliverables:

(1) Topic Report – A Strategy for Consideration of Chemistry Effects in UK ABWR Fault Studies

Revision 0 : 31th May 2016

Revision 1 : 30th November 2016

(2) Topic Report – A Study of Chemistry Effects in UK ABWR Fault Studies

Revision0 : 4th November 2016

Revision 0 : 4th November 2016

Summary of impact on GDA submissions:

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

<u>Related RO Actions</u>	<u>GDA Submission Document Title</u>	<u>Document ID</u> (Document No.)	<u>Submission Date to the Regulators</u>
ROA1	Topic report on Design Basis Analysis	GA91-9201-0001-00023 (UE-GD-0219)	The assessment of impact on the GDA document is provisional and will be finalized as part of the Study Report. So if revision of document is necessary, these documents will be re-submitted.
	Topic report on Severe Accident Phenomena and Severe Accident Analysis	GA91-9201-0001-00024 (AE-GD-0102)	
	Demonstration of Adequacy of pH control in the Suppression Pool during Accident Conditions	GA91-9101-0003-00807 (WPE-GD-017)	
	Suppression Pool pH Model during Design Basis Accident and Severe Accident	GA91-9201-0003-00451 (WPE-GD-0097)	
	Topic Report on SBO Analysis	GA91-9201-0001-00141 (AE-GD-0265)	
	Topic Report on Beyond Design Basis Analysis	GA91-9201-0001-00139 (AE-GD-0473)	
	Preliminary Evaluation of Radiation Dose to the Workers and the Public in Fault Condition	GA91-9201-0003-00770 (FRE-GD-0073)	
	Topic Report on Design Basis Analysis for SFP and Fuel Route	GA91-9201-0001-00137 (AE-GD-0441)	

Programme Milestones/ Schedule :

See attached Gantt Chart (Table 1).

NB. This programme is provisional and will be finalised upon completion of the Strategy Report

References:

[Ref-1] Hitachi-GE Nuclear Energy, Ltd., “ Demonstration of Adequacy of pH Control in the Suppression Pool during Accident Conditions”, GA91-9201-0003-00807 (WPE-GD-0171) Rev.1, July 2015

[Ref-2] Hitachi-GE Nuclear Energy, Ltd., “ Suppression Pool pH Model during Design Basis Accident and Severe Accident”, GA91-9201-0003-00451 (WPE-GD-0097) Rev.1, July 2015

