REGULATORY OBSERVATION

REGULATOR TO COMPLETE

RO unique no.:	RO-ABWR-0066
Date sent:	1st February 2016
Acknowledgement required by:	22nd February 2016
Agreement of Resolution Plan Required by:	*To be determined by Hitachi-GE Resolution Plan*
Resolution of Regulatory Observation required by:	*To be determined by Hitachi-GE Resolution Plan*
TRIM Ref.:	2016/43718
Related RQ / RO No. and TRIM Ref. (if any)**:**	RO-ABWR-0043 (Trim Ref. 2015/99649) RI-ABWR-0001 (Trim Ref. 2015/202107)
Observation title:	Demonstration of suitable and sufficient consideration of chemistry effects in fault analysis
Technical area(s) 9. Reactor Chemistry	**Related technical area(s)** 4. PSA 5. Fault Studies 10. Radiation Protection & (Level 3 PSA) 18. Severe Accident Analysis

Regulatory Observation

SUMMARY

The objective of this Regulatory Observation (RO) is to state ONR's expectations with respect to Hitachi-GE demonstrating that they have given suitable and sufficient consideration to the chemistry effects important within the fault analysis.

To do this ONR expect that Hitachi-GE will provide proportionate evidence to support the key chemistry related assumptions and/or claims which influence the radiological consequence assessments for the DBA, PSA, beyond DBA and SAA faults. This should include a clear evaluation of their significance, sensitivity and uncertainty and should reconcile this with the overall UK ABWR safety case.

BACKGROUND

The assessment of risk from a nuclear facility needs to consider those arising from fault and accident conditions, in addition to those from normal operations. For UK ABWR this will include DBA, PSA and SAA. Throughout this fault analysis there will be assumptions and/or claims, either explicitly or implicitly, on chemistry related effects, such as chemical behaviour, speciation or reaction rates for example. Depending upon the particular analysis these could be conservative, best-estimate or bounding. As with many other aspects of the analysis there may be significant uncertainties associated with these chemistry related effects, due to knowledge gaps or lack of data. The consideration given to such chemistry effects in the safety case should be proportionate to their nuclear safety significance. It is clear therefore that in order to consider these matters appropriately within the safety case an understanding of their significance, uncertainty and sensitivity is necessary.

ONR have been discussing the consideration given by Hitachi-GE to chemistry related effects during fault analysis for UK ABWR. This topic started in Step 2 and has progressed throughout GDA. The purpose of this assessment has been to consider the adequacy of the claims and/or assumptions made by Hitachi-GE on the chemistry related effects during fault analysis.

The main focus for this topic to date has been the claims made on iodine retention in the suppression pool, due to the safety significance of iodine and the specific chemistry claims made by Hitachi-GE on this aspect of the safety case. This resulted in the issue of RO-ABWR-0043 [1], demonstration of the adequacy of pH control in the suppression pool during accident conditions, which Hitachi-GE are currently responding to. Information to date suggests that this aspect is only relevant during severe accident conditions. An important part of satisfactorily resolving RO-ABWR-0043 will be demonstrating the safety significance of pH control in the

suppression pool, particularly given other means or measures which may be available in UK ABWR to minimise the radiological consequences of such accidents (for example via filtered venting).

In addition, ONR have raised a number of RQs [2] on the chemistry related assumptions used within the DBA [3]. These RQs have been primarily focused on understanding the basis for the assumptions used. While generally responding to the specific query, the responses have themselves led to additional queries.

Throughout GDA Steps 2 and 3 a number of meetings and technical exchanges have taken place on this topic. Hitachi-GE have demonstrated a broad level of understanding of the underlying technical aspects, but have not as yet been able to clearly articulate how these inform the safety case, from the overall claims to the underlying technical evidence to be provided. For example, the response to RO-ABWR-0019 [4] - the chemistry safety case strategy and plan, the chemistry chapter of PCSR Rev. B [5] and the extant step 4 submission plan [6] are inconsistent regarding the claims and approach to making the safety case for the chemistry related aspects of the fault analysis for UK ABWR. Hitachi-GE have suggested and planned to produce a number of reports or documents to address this, but have yet to do so and importantly, have not been able to explain the roles and purposes of many of these in making the safety case.

Overall therefore, through these interactions and responses, ONR have gained some comfort that Hitachi-GE understand what is required in these areas at a technical level. Namely that they understand the fundamental "science", but what is less clear is how this is being used to inform the safety case. This means that ONR judge that, to date, Hitachi-GE has not been able to demonstrate that they have given suitable and sufficient consideration to chemistry effects in their fault analysis, namely that they:

- Understand the nuclear safety significance of their assumptions and/or claims;
- Understand the uncertainty in those assumptions and/or claims;
- Understand the sensitivity of the results to those assumptions and/or claims;
- Will be able to provide appropriate and proportionate evidence to substantiate those assumptions and/or claims; and
- Will produce a safety case that reconciles these aspects in an adequate manner, particularly in the context of the overall safety case for UK ABWR

REGULATORY EXPECTATIONS

In responding to this RO, I expect Hitachi-GE to provide documentation that demonstrates that the UK ABWR safety case will include suitable and sufficient consideration of the chemistry effects in the fault analysis. While iodine chemistry may form an important part of this, I would expect the response to be wider than this.

This RO is concerned with assuring ONR that suitable and sufficient information will be provided in a timely manner during GDA. Therefore the response should concentrate on what will be done, how this will be done, when this will be provided and the links with the overall safety case, in particular in those topics which constitute the fault analysis.

ONR recognise that the scope of this RO could be broad; however the consideration given should be in proportion to the safety significance and be consistent with other aspects of the safety case.

I would expect the response to include an identification of the claims or assumptions, explicit or implicit, related to chemistry effects throughout the fault analysis. This should highlight those which are most significant, uncertain or sensitive and identify what evidence will be provided to substantiate these, including how, when and where it will be provided. Part of the response may well constitute a "road map" to existing or scheduled documentation outside the chemistry topic. For example, aspects related to the definition and justification of the normal operations source term, used as an input to this analysis in some instances, are coved under RI-ABWR-0001 [7].

I recognise that this RO overlaps with the requirements of RO-ABWR-0043. This RO is not intended to replace or change any requirements or expectations given there, rather I would expect the responses to RO-ABWR-0034 to be consistent with any response to this RO.

References:

[1] Demonstration of the adequacy of pH control in the Suppression Pool during accident conditions, RO-

ABWR-0043, TRIM Ref. 2015/99649
[2] RQ-ABWR-0411, 0412, 0413, 0415, 0416, 0621, 0623, 0626 and 0626.
[3] GA91-9201-0001-00023, Topic report on Design Basis Analysis, Rev.3, 28 November 2014. TRIM Ref. 2014/444506.
[4] GA91-9201-0003-00412, UK ABWR Reactor Chemistry Safety Case Strategy, Revision 1, 1 June 2015. TRIM Ref. 2015/205798.
[5] GA91-9101-0101-23000, WPE-GD-0058 – UK ABWR GDA – Generic PCSR Chapter 23: Reactor Chemistry, Revision B, 20 October 2015. TRIM 2015/392485.
[6] GA91-0702-0004-00001, UK ABWR Step 4 Plan, Rev. 1, 16 December 2015. TRIM Ref. 2015/476600.

[7] Definition and Justification for the Radioactive Source Terms in UK ABWR during Normal Operations, RI-ABWR-0001, www.onr.org.uk/new-reactors/uk-abwr/reports/ri-abwr-0001.pdf

Regulatory Observation Actions

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.

RESOLUTION REQUIRED BY: *to be determined by the Hitachi-GE resolution plan.*

REQUESTING PARTY TO COMPLETE

Actual Acknowledgement date:	
RP stated Resolution Plan agreement date:	