

| <b>REGULATORY ISSUE</b>   |   |
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| <b>REGULATOR TO COMPLETE</b>  |   |
| <b>RI unique no.:</b>   | RI-ABWR-0001  |
| <b>Date sent:</b>   | 2 June 2015   |
| <b>Acknowledgement required by:</b>   | 8 June 2015   |
| <b>Agreement of Resolution Plan Required by:</b>  | 15 June 2015  |
| <b>Resolution of Regulatory Issue required by:</b>  | <i>To Be Determined By The Hitachi-GE Resolution Plan.</i>  |
| <b>TRIM Ref.:</b>   | 2015/202107   |
| <b>Related RQ / RO No. and TRIM Ref. (if any):</b>  | RO-ABWR-0006 (TRIM Ref. 2014/463098)  |
| <b>Issue title:</b>   | Definition and Justification for the Radioactive Source Terms in UK ABWR during Normal Operations   |
| <b>Technical area(s)</b><br>9. Reactor Chemistry<br>21. Generic Environmental Permitting  | <b>Related technical area(s)</b><br>4. PSA<br>5. Fault Studies<br>8. Fuel Design<br>9. Reactor Chemistry<br>10. Radiation Protection & (Level 3 PSA)<br>12. Structural Integrity<br>13. Human Factors<br>15. Radwaste & Decommissioning |
| <b>Regulatory Issue</b>   |   |
| <b>SUMMARY</b>  |   |
| <p>The objective of this Regulatory Issue (RI) is to state the regulators (ONR and the Environment Agency) expectations with respect to Hitachi-GE providing a suitable and sufficient definition and justification for the radioactive source terms in UK ABWR during normal operations.</p> <p>The definition of the radioactive source term; the nature and amount of radioactivity, is a fundamental part in understanding and therefore being able to control the hazards associated with any nuclear facility. Once defined, it is important that the Requesting Party (RP) is able to demonstrate and justify that this source term is appropriate to be used as the basis for the safety and environmental cases. Failure to adequately define or justify the source term could ultimately mean that the design, operations or controls specified for the UK ABWR may not be soundly based. It is therefore important that Hitachi-GE submit a resolution plan which provides sufficient regulatory confidence that the source terms can be defined and justified.</p> <p>During Step 2 of GDA, the regulators jointly raised RO-ABWR-0006 in April 2014 requesting Hitachi-GE to define and justify the UK ABWR source terms, amongst other related matters. Hitachi-GE responded with their definition and justification in January 2015 in accordance with its schedule as defined in its resolution plan for RO-ABWR-0006. Overall, the regulators judge that the responses do not meet our expectations as they do not provide a complete or suitably robust definition and justification for the source terms expected in UK ABWR during normal operations. This is considered to be a serious regulatory shortfall which the regulators, in line with our Guidance to Requesting Parties and our Process and Information Document, are now escalating to a Regulatory Issue.</p> |   |
| <b>BACKGROUND</b>   |   |
| <p>The definition and appropriate use of the “source term” is important in understanding, and therefore controlling, the hazards posed by any nuclear facility. In this context, the regulators defined source terms as:</p> <p style="text-align: center;"><i>The types, quantities, and physical and chemical forms of the radionuclides present in a nuclear facility that have the potential to give rise to exposure to ionising radiation, radioactive waste or discharges.</i></p> <p>During Step 2 the regulators noted that there was a lack of information on the radiological source terms for the</p>   |   |

UK ABWR. This information would form a key part of justifying the design going forward, both from a safety and environmental perspective. Three main areas were identified where further justification and evidence would be required from Hitachi-GE, namely:

- To define and justify the source terms for UK ABWR, including how these are used;
- To demonstrate the impact of the material choices, operating chemistry and operating practices on radioactivity in the plant and to show that these reduce radioactivity So Far As Is Reasonably Practicable (SFAIRP); and
- To show that the source term information is adequately managed and controlled throughout the safety and environmental cases.

To address these aspects the regulators (ONR and the Environment Agency) jointly raised a Regulatory Observation (RO) related to the source terms in the UK ABWR, RO-ABWR-0006 [1] in April 2014. This RO was associated with all of these aspects, including the definition (Action 1) and supporting evidence that was considered necessary to justify (Action 2) the source terms for the UK ABWR design during “operational states” [2] and “expected events” [3] (see also the glossary for these terms). Other actions under RO-ABWR-0006 deal with management and justification that radioactivity is reduced SFAIRP, but these are not within the scope of this Regulatory Issue. Responses to Actions 1 and 2 were received during January 2015 [4, 5].

The regulators provided detailed feedback to Hitachi-GE on these responses during technical meetings in January and February 2015, and followed this up with letter REG-HGNE-0077R [6]. The regulators also provided additional technical advice to Hitachi-GE during March and April 2015. It is clear that some uncertainty still remains, as insufficient progress has been made to build regulatory confidence in the approach proposed by Hitachi-GE to address the shortfalls identified with RO Actions 1 and 2.

The regulators have judged Hitachi-GE’s responses are not adequate to resolve RO Actions 1 and 2 because:

- The approach taken, of calculation of the source terms, means that there are inherently many assumptions, some of which would appear to impose a significant sensitivity on the results. These have not been appropriately justified;
- The definition of an “average” source term does not cover all potential transients, operational occurrences or operations expected at the plant, as requested in RO-ABWR-0006;
- The amount of fixed radioactivity (contamination) is inadequately defined and substantiated, with no supporting evidence;
- The scope of the defined source terms is incomplete with some significant aspects missing;
- The corrective factor applied when the source terms are used for specific purposes does not appear to be conservative;
- There is no link between the defined source terms and the extant UK ABWR safety and environmental cases; and
- A suitably robust demonstration and justification for the adequacy of the defined source terms has not been provided.

The regulators consider a robust source term to be a crucial aspect of the UK ABWR safety and environmental cases. The impact of the source term is significant for the GDA of UK ABWR, due to the large number of topics and areas which rely on this information. Overall, the responses received do not provide a complete or suitably robust definition and justification for the source terms expected in the UK ABWR during normal operations. This is considered to be a serious regulatory shortfall which the regulators, in line with our Guidance to Requesting Parties [7] (paras. 159 and 160), are now escalating to a Regulatory Issue.

## **REGULATORY EXPECTATIONS**

The regulatory expectations are the same as those defined under RO-ABWR-0006 Actions 1 and 2 [1]. Overall, the regulators expect Hitachi-GE to provide a suitable and sufficient definition and justification for the source terms for the UK ABWR.

The definition should:

- Cover all significant radionuclides;
- Cover all systems which are expected to contain radioactivity;
- Cover all operational states;
- Cover all appropriate sources of radioactivity within the plant, including mobile and fixed sources;

- Consider how the nature and quantity of radioactivity within the plant may change over time;
- Cover all aspects of the safety or environmental case for UK ABWR;
- Be consistent with how the defined source terms are used by, and support, these cases; and
- Be consistent with the design and operations of UK ABWR.

The justification should:

- Provide an appropriate degree of robust supporting evidence for the defined source terms;
- Cover the full scope of the definition, but be targeted towards those radionuclides, systems or operations which have the highest safety or environmental impact; and
- Be demonstrated to be appropriate for the UK ABWR and consistent with the extant safety and environmental cases.

#### References:

- [1] Regulatory Observation – Source Terms, RO-ABWR-0006. [www.onr.org.uk/new-reactors/uk-abwr/reports/ro-abwr-0006.pdf](http://www.onr.org.uk/new-reactors/uk-abwr/reports/ro-abwr-0006.pdf)
- [2] INTERNATIONAL ATOMIC ENERGY AGENCY, IAEA Safety Glossary: Terminology Used in Nuclear Safety and Radiation Protection, 2007 Edition, IAEA, Vienna (2007). [www.iaea.org](http://www.iaea.org)
- [3] Process and Information Document – Generic Design Assessment. Version 2. Environment Agency. March 2013. [http://cdn.environment-agency.gov.uk/LIT\\_7998\\_3e266c.pdf](http://cdn.environment-agency.gov.uk/LIT_7998_3e266c.pdf)
- [4] Topic Report 1: Definition of the UK ABWR Design Source Term, GA91-9201-0001-00107, HE-GD-5088, Revision 0, 15 January 2015.
- [5] Topic Report 2: Demonstration and Justification of the Source Term for the UK ABWR, GA91-9201-0001-00108, HE-GD-5089, Revision 0, 15 January 2015.
- [6] Letter to Hitachi-GE from ONR, REG-HGNE-0077R, 6 March 2015.
- [7] New nuclear reactors: Generic Design Assessment Guidance to Requesting Parties, ONR-GDA-GD-001 Revision 1, August 2014. [www.onr.org.uk/new-reactors/ngn03.pdf](http://www.onr.org.uk/new-reactors/ngn03.pdf)

#### Glossary:

*Expected event – events that are expected to occur over the lifetime of the plant. This does not include events that are inconsistent with the use of best available techniques such as accidents, inadequate maintenance and inadequate operation.*

*Operational States – Including “normal operations” and “anticipated operational occurrences”. For a nuclear power plant, this includes start-up, power operation, shutting down, shutdown, maintenance, testing and refuelling.*

*Source term – The types, quantities, and physical and chemical forms of the radionuclides present in a nuclear facility that have the potential to give rise to exposure to radiation, radioactive waste or discharges.*

#### **Regulatory Issue Actions**

**RI-ABWR-0001.A1 – Hitachi-GE is required to provide a suitable and sufficient definition for the radioactive source terms for UK ABWR during normal operations.**

*The scope of this Action is the same as that defined under RO-ABWR-0006 Action 1.*

*The response to this Action should:*

- Meet the regulatory expectations defined in this RI;
- Address the regulatory expectations of RO-ABWR-0006 Action 1 [1]; and
- Address the feedback given in letter REG-HGNE-0077R [6].

**RESOLUTION REQUIRED BY:** *To Be Determined By The Hitachi-GE Resolution Plan.*

**RI-ABWR-0001.A2 – Hitachi-GE is required to provide a suitable and sufficient justification for the radioactive source terms for UK ABWR during normal operations.**

*The scope of this Action is the same as that defined under RO-ABWR-0006 Action 2.*

*The response to this Action should:*

- Meet the regulatory expectations defined in this RI;

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- *Address the regulatory expectations of RO-ABWR-0006 Action 2 [1]; and*
- *Address the feedback given in letter REG-HGNE-0077R [6].*

**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:**