# REGULATORY OBSERVATION

## REGULATOR TO COMPLETE

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| **RO unique no.:** | RO-ABWR-0033 |
| **Date sent:** | 5th December 2014 |
| **Acknowledgement required by:** | 30th December 2014 |
| **Agreement of Resolution Plan Required by:** | *To be determined by Hitachi-GE Resolution Plan* |
| **Resolution of Regulatory Observation required by:** | 31st August 2015 |
| **TRIM Ref.:** | 2014/448194 |
| **Related RQ / RO No. and TRIM Ref**. (if any)**:** | RQ-ABWR-0168, 0171 |
| **Observation title:** | Hitachi-GE Nuclear Energy Ltd. Baseline HF Assessment |
| **Technical area(s)**<br>13. Human Factors | **Related technical area(s)**<br>5. Fault Studies<br>4. PSA |

## *Regulatory Observation*

Summary

As part of the UK ABWR safety case, Hitachi-GE claims that consideration of human factors (HF) has improved and evolved over the course of the history of the reactor and has been integral to design requirements across all areas of plant. The UK ABWR is therefore already starting from a position of having widespread integrated consideration of HF during the original design. In support of this, the RP conducted a Baseline HF Assessment [Ref. 1] which attempts to capture the nature and outcome of the inclusion of HF activity in the existing ABWR design. The UK ABWR Pre-Construction Safety Report (PCSR) [Ref. 2] states that the baseline HF assessment and its referenced documents provide the main source of evidence for the Level 1 Human-Based Safety Claims. Hence the baseline HF assessment and its conclusions constitute an integral part of the UK ABWR safety case.

ONR is unable to verify the adequacy and validity of the baseline HF claims / conclusions and corresponding aspects of the PCSR based on the information provided by RP. The baseline HF assessment fails to evidence its claims and conclusions, which falls short of modern standards safety case expectations. Given that such evidence is based on the existing ABWR design and operations, this should be readily available and presented in coherent and cogent format as a part of the PCSR supporting documentation.

Hitachi-GE needs to assemble (or generate) and compile its baseline HF evidence in a coherent format and submit it as part of the PCSR as detailed in the actions to this RO. This is judged to be necessary in order for both the RP and ONR to be confident that the baseline HF position on which subsequent HFI activities for the UK ABWR are based is as claimed, valid and adequately substantiated.

Background and Discussion

ONR's Step 2 review of the RP's baseline HF assessment concluded that a wide-scoping HF review was conducted and that the baseline HF assessment reflects arguments for the existence HF adequacy, rather than a specific evidence base. ONR has since conducted a detailed assessment of the RP's baseline HF report, which further validates ONR's Step 2 conclusions. The baseline HF assessment makes many claims relating to the efficacy of the HFI processes applied to the ABWR which have some face validity. However, it is rare to find the claims supported by cogent arguments and underpinned by substantive evidence. This lack of substantive evidence is a key weakness of the RP's submission and potentially undermines some HF aspects of the PCSR.

In addition, it seems that many aspects of the plant lifecycle (e. decommissioning, consideration of mis-diagnosis, spent fuel pond, radioactive waste management, and severe accident response) were not included in the J-ABWR design and safety case.

If Hitachi-GE wishes to maintain the claims in the PCSR and baseline HF assessment that the UK ABWR is already starting from a position of having had integrated consideration of HF during the original design, and

HF has been extended to all stages of the plant lifecycle, convincing and substantive arguments and evidence need to be provided.

During Step 2 regulatory queries (RQs) were raised for the following matters [Ref. 3]:

1. The RP to explain what and why certain ABWR design features had been selected, changed and others rejected to ensure human reliability, and why the RP considers these to be appropriate.
2. The RP's HF reports, specifications, tests and assessments results on which the baseline HF is predicated to be submitted as part of PCSR Rev 0.

Hitachi-GE stated that it does not intend the conclusions of the baseline HF assessment to be human-based safety claims. Hitachi-GE has also indicated that the baseline HF assessment will not form part of their safety case moving forward. However, the baseline HF assessment and its conclusions form an explicit part of the PCSR. The PCSR states that the baseline HF assessment and its referenced documents provide the main source of evidence for the Level 1 Human-Based Safety Claim: "*The ABWR plant has a long operating history which includes widespread consideration of HF and human error in the genesis from BWR to ABWR, and regular design improvement through a well-managed programme of making use of operational experience and risk-based design philosophy to identify and reduce opportunity for human error"*.

The key conclusions of the baseline HF assessment in relation to this are: "*there is abundant and fully-integrated consideration of HF within the current processes at Hitachi-GE and within the J-ABWR design. Much of this assessment has been formally done and some of it captured in reports, specifications and tests or assessment results;… consideration of HF extends to all stages of the ABWR plant lifecycle and exists throughout the entirety of the design;……all of this is underpinned by a rigorous programme of quality assurance (QA), verification and validation (V & V), continuous improvement through customer feedback and use of national and international operating experience*'.

However, there is a lack of substantive evidence provided in support of the above claims. If the RP is confident in its baseline HF position, ONR considers that the material evidence that gives rise to that confidence should be relatively straightforward to assemble.

For completeness and clarity of the matters surrounding this RO, further key points arising from ONR's assessment of the RP's baseline HF assessment are discussed below.

- The baseline HF assessment claims that RP's risk-reduction approach has focused on design-based HF such as the application of standards, generic rules and guidelines and operating experience feedback. This approach has eliminated various error traps within the design and reduced the risk of many safety critical errors, improving the design in a holistic way. However, nowhere is evidence presented of the 'various human error traps and type of safety critical errors that have been eliminated and how this was achieved.
- The RP claims that operational experience feedback (OEF) has influenced evolution of the ABWR design, which is a reasonable claim. However, little specific evidence is provided linking OEF to demonstrable human performance improvements, and there is no evidence of the claimed OEF review. ONR expects a detailed review of OEF data, which highlights error-prone activities and design weaknesses, and provides an explanation of how these activities / weaknesses have been designed out, or how the design /operational processes have been changed to improve their reliability. Given that the ABWR has many reactor-operational years to draw upon, a large part of this evidence should be readily available. It is important that OEF is included in the safety case in order to be confident that safety case is valid and adequate, that all reasonably foreseeable risks have been identified and reduced as low as reasonably practicable.
- The ABWR concept of operations makes use of significant levels of automation, advanced / complex computerised human-system interfaces (HSI). The baseline assessment provides no substantiation of the adequacy of the design and use of computerised procedures and advanced HSI. Given the prominence of these for the UK ABWR, ONR expected significance evidence to be available to substantiate the design of such features, many of which are likely to remain unchanged for the UK ABWR. ONR's expectation is that HSI important to safety would be validated to adequately function under all reasonably foreseeable operational circumstances, including abnormal operation and postulated fault conditions. The results of the V & V tests should be used to confirm that the design can meet its operational and safety requirements. No substantive evidence of a past rigorous programme of V & V testing, or evidence that such a process had been followed is provided. Given that the J-ABWR can demonstrate a many operational years, ONR expects that the key HSI's would have been through a rigorous V & V process and that evidence of this would be readily available.

References

[1] UK ABWR GDA Baseline Human Factors Assessment Report. GA91-9201-0001-00032. Rev. A. June 2014. Hitachi-GE.
[2] UK ABWR GDA Generic PCSR Chapter 27: Human Factors. GA91-9101-0101-27000. Rev A. August 2014. Hitachi-GE.
[3] *ONR Electronic Document Management System TRIM Folder 5.1.3.9389 ONR – New Nuclear Reactor Build.* GDA 2013 – 2017 (Hitachi-GE) – RQs (Regulatory Queries and Responses)

## *Regulatory Observation Actions*

*Action # 1*

*Action # 1: Following on from RQ-ABWR-0171, Hitachi-GE is required to submit to ONR the report(s) of its HF review of the respective documents, records, reports, specifications, test and assessment results as claimed within the baseline HF assessment to provide "abundant fully-integrated consideration of HF within the H-GE processes and J-ABWR design". Hitachi-GE is required to provide a comprehensive reference list for these claimed information sources.*

*Resolution required by 31/08/2015*

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*Action # 2*

*Action # 2: Hitachi-GE is required to submit to ONR its rigorous programme of QA and V & V as applied to the J-ABWR designs, and in particular for safety important Human System Interfaces (HSI), or provide representative samples and evidence that such a process had been followed.*

*Resolution required by 31/08/2015*

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*Action # 3*

*Action # 3: Following on from RQ-ABWR-0161, Hitach-GE is required to provide a report that demonstrates with logical arguments and evidence, how the design evolution / improvements have reduced the overall dependency on human action to maintain safety.*

*Resolution required by 31/08/2015*

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*Action # 4*

*Action # 4: Hitach-GE is required to provide a report or alternative evidence that demonstrates how consideration of HF extends to all stages of the ABWR plant lifecycle.*

*Resolution required by 31/08/2015*

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*Action # 5*

*Action # 5: Hitachi-GE is required to provide a report of a convincing representational selection of evidence (i.e. sufficient, relevant and accurate) of human performance enhancing design features that have come about through operational experience feedback. This OEF review should be of significant depth and consist of sufficient representative examples and supporting evidence that highlights and reports on:*
*· Examples of key incidents, events and learning that have occurred over the past 10 - 15 years that are relevant to pre and post-fault scenarios referenced in the safety case; identifying information about error-prone activities / human error mechanisms, performance shaping factors (PSF) and any design weaknesses, with explanations of how known problem areas have been (will be) addressed by the UK ABWR design, how any error-prone activities have been designed out, or the design / operational processes changed to improve human reliability.*

*Resolution required by 31/08/2015*

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*Action # 6*

*Action # 6: Hitachi-GE is requested to provide a document route 'route-map' that logically shows how the ABWR baseline HF evidence links to and substantiates the Level 1 human-based safety claims made in the PCSR regarding the widespread integrated consideration of HF during the original design and its evolution, and throughout the plant life-cycle.*

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| *Resolution required by 31/08/2015* |

| **REQUESTING PARTY TO COMPLETE** | |
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| **Actual Acknowledgement date:** | |
| **RP stated Resolution Plan agreement date:** | |