

REGULATORY OBSERVATION	
REGULATOR TO COMPLETE	
RO unique no.:	RO-ABWR-0011
Date sent:	5th June 2014
Acknowledgement required by:	26th June 2014
Agreement of Resolution Plan Required by:	<i>To be determined by the Hitachi-GE Resolution Plan</i>
Resolution of Regulatory Observation required by:	<i>To be determined by the Hitachi-GE Resolution Plan</i>
TRIM Ref.:	2014/138774 (Rev 0) 2015/234422 (Rev 1)
Related RQ / RO No. and TRIM Ref. (if any):	RO-ABWR-0037
Observation title:	Safety Case for Spent Fuel Pool and Fuel Route
Technical area(s) 5. Fault Studies	Related technical area(s) 2. Civil Engineering 4. PSA 8. Fuel Design 9. Reactor Chemistry 11. Mechanical Engineering 15. Radwaste & Decommissioning 21. Generic Environmental Permitting
<i>Regulatory Observation</i>	
Summary	
<p>Hitachi-GE's Step 2 Preliminary Safety Report (PSR) submission provides extensive details on how it plans to develop a robust safety case for faults associated with the UK ABWR reactor. However, the details provided for faults associated with the spent fuel pool and wider aspects of the UK ABWR fuel route are less well developed. A Regulatory Observation has been raised requiring Hitachi-GE to define the scope of its spent fuel pool and fuel route safety case to be incorporated into future revisions on the Pre-Construction Safety Report (PCSR). The purpose of this Regulatory Observation is to consider the fuel route up to export of the spent fuel from the reactor building. However, the fuel route beyond this point will still need to consider similar issues to those raised in this Regulatory Observation as part of the GDA process.</p>	
Background	
<p>Hitachi-GE's Step 2 Preliminary Safety Report (PSR) submission of the UK ABWR ("Fault Studies to Discuss Deterministic Analysis, PSA and Fault Schedule Development", GA91-9901-0009-00001 Rev B) is mainly concerned with the "traditional" faults directly associated with the reactor. Details are given on initiating events, single failure assumptions, acceptance criteria and proposed transient analyses for the reactor faults. However, an equivalent level of detail is not provided for faults associated with the spent fuel pool or the wider fuel route. The "Initial Safety Case Report on Spent Fuel Pool" (GA91-9901-0003-0001 Rev B) introduces some of these items but it needs to be developed further.</p>	
<p>ONR requires a safety case for operations associated with the spent fuel pool and fuel route to be produced for the UK ABWR. ONR will assess this safety case in accordance with the Safety Assessment Principles (SAPs), notably SAPs FA.1 to FA.16. Appropriate design basis analysis (DBA), probabilistic safety analysis (PSA) and severe accident analysis (SAA) will need to be included within such a safety case.</p>	
<p>Hitachi-GE's methodology for safety function categorisation needs to be rigorously applied to all spent fuel and fuel route operations. Structures, systems and components (SSCs) delivering safety functions need to be clearly identified and classified appropriately. Hitachi-GE's safety case needs to demonstrate that SSC design, procurement, reliability, operation and maintenance are consistent with the designated classification.</p>	
<p>Criteria need to be identified for DBA, PSA and SAA, against which the performance of the SSCs with a safety</p>	

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role can be assessed against. Appropriate transient analysis or design work will need to be provided as evidence to support any claims made on SSC performance.

The safety case for the spent fuel pool and fuel route needs to consider all modes of operation, including periods during reactor operation when the spent fuel pool is isolated, and during refuelling outages when the open reactor vessel and the spent fuel pool will be effectively a single system.

The scope of the safety case for GDA needs to be clearly defined. Hitachi GE should be able to specify the minimum and maximum duration of the storage period in the spent fuel from a safety perspective including any longer term degradation effects that impact on the safety for future options for spent fuel storage and transportation. The safety case will need to accommodate, or at least not preclude, likely future options. Assumptions on spent fuel inventories will need to be consistent with likely strategies and any faults associated with operations clearly identified and considered (e.g. cask import, fill, drain, export, etc.).

Hitachi-GE has stated to ONR that a full scope, modern and well documented spent fuel pool PSA for the UK ABWR, including evaluation of the fuel damage, radioactive releases and consequences will be submitted to ONR before mid-2015. ONR has raised a Regulatory Query to request Hitachi-GE to provide a detailed programme for the development of this PSA by June 2014. Therefore, ONR has not included a specific action in this Regulatory Observation to require Hitachi-GE to develop a spent fuel pool and fuel route PSA, beyond the generic actions define the scope of the spent fuel pool safety case, identify applicable faults and the specification of suitable assessment criteria.

A robust safety case which reflects modern safety standards and demonstrates that all DBA, PSA and SAA criteria and targets have been met should ensure that a new nuclear facility meets the Basic Safety Objectives (BSO) set out in ONR's SAPs. ONR uses the BSOs to define the point at which further consideration of the safety case would not be a reasonable use of ONR resources, compared with the benefit of applying these resources to areas of higher risk. However, Hitachi-GE as the designer intending to build in the UK is not given the option of stopping at this level. ONR expects Hitachi-GE to demonstrate that it has reduced risks as low as reasonably practicable (ALARP). In some cases, ALARP considerations may be such that Hitachi-GE is justified in stopping before reaching the BSO, but if it is reasonably practicable to provide a higher standard of safety, then this must be done.

There are several important aspects to be considered when demonstrating that the design is ALARP, including:

- meeting or exceeding relevant good practice,
- consideration of all practicable design options and combinations of options,
- relevant operational experience,
- balancing of risks.

Further guidance can be found in ONR's Technical Assessment Guide "Guidance on the Demonstration of ALARP", NS-TAST-GD-005, Revision 6, ONR, September 2013.

ALARP considerations need to be made (and demonstrated) across all the fuel route and all aspects of the safety case, for example:

- the means of preventing faults and failures by design,
- controls on abnormal operations and detecting faults,
- control of faults within the design basis to protect against escalation,
- control of severe plant conditions and protecting against severe accidents,
- mitigation of the radiological consequences of significant releases of radioactive material.

The purpose of this Regulatory Observation is to consider the fuel route up to export of the spent fuel from the reactor building. However, the fuel route beyond this point will still need to consider similar issues to those raised in this Regulatory Observation as part of the GDA process.

Regulatory Observation Actions**RO-ABWR-0011.A1: Scope of spent fuel pool/fuel route safety case**

Hitachi-GE is required to clearly identify the scope of the spent fuel pool and fuel route safety case for GDA, in terms of:

- Operational states,
- System boundaries,
- Refuelling and outage operations,
- Import and export of fresh and irradiated fuel.

Links and interfaces with other aspects of the UK ABWR safety case need to be identified.

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RO-ABWR-0011.A2: Identification of initiating events

A comprehensive list of initiating events within the scope of spent fuel pool and fuel route safety case is required for consideration in the DBA and PSA methods (and SAA if appropriate).

This list is expected to include but not necessarily be limited to:

- Loss of cooling faults,
- Loss of water inventory faults,
- Loss of power faults,
- Criticality faults,
- Dropped loads and collisions,
- Over-raise faults,
- Internal and external hazards.

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RO-ABWR-0011.A3: Specification of suitable criteria for spent fuel pool accident analysis

Suitable criteria for demonstrating the success of safety measures and SSCs need to be identified for spent fuel pool and fuel route faults.

These criteria could include:

- On and off-site radiological doses,
- K-eff limits,
- Maximum permitted water temperatures,
- Avoidance of boiling,
- Avoidance of fuel uncovering,
- Avoidance of fuel damage,
- Avoidance of damage to crucial SSCs.

Different criteria could apply in DBA, PSA and SAA.

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RO-ABWR-0011.A4: DBA Safety Case for the spent fuel pool and fuel route

A DBA safety case is required for all qualifying initiating events. Appropriate deterministic rules should be applied such as the requirements for diversity, tolerance to single failures and the amount of conservatism to include within decay heat assumptions. SSCs claimed to protect against DBA faults need to be clearly identified and classified. The effective operation of these SSCs needs to be demonstrated through appropriate analysis, with the identified criteria met.

It should be shown that the faults considered are either successfully terminated and/or a sustainable safe state has been achieved.

All faults identified as being within the design basis need to appear on the UK ABWR fault schedule, along with the SSCs (including any operator actions) which protect against those faults.

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RO-ABWR-0011.A5: SAA Safety Case for the spent fuel pool

Severe accidents associated with the spent fuel pool need to be considered as appropriate. This is anticipated to be as part of a wider SAA development programme for the UK ABWR. A response is required stating:

- How will the spent fuel pool and fuel route be considered as part of the wider SAA work?
- What sequences will be considered (if any)?
- What type of analysis will be undertaken?
- Where and when claims on SSCs to protect against spent fuel pool severe accidents will be identified within the UK ABWR safety case?

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RO-ABWR-0011.A6: Demonstration of ALARP

It needs to be demonstrated in the safety case that in addition to meeting all identified deterministic and probabilistic criteria, the UK ABWR spent fuel pool and fuel route design is ALARP.

A response is required which summarises the appropriateness of the proposed UK ABWR design and why alternative designs or modifications could not provide a higher level of safety.

Resolution required by: To be determined by the Hitachi-GE Resolution Plan

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Actual Acknowledgement date:	
RP stated Resolution Plan agreement date:	