

REGULATORY OBSERVATION	
REGULATOR TO COMPLETE	
RO unique no.:	RO-ABWR-0037
Date sent:	19th January 2015
Acknowledgement required by:	9th February 2015
Agreement of Resolution Plan Required by:	9 th February 2015
Resolution of Regulatory Observation required by:	<i>To Be Determined By Hitachi-GE Resolution Plan</i>
TRIM Ref.:	2015/20684
Related RQ / RO No. and TRIM Ref. (if any):	
Observation title:	Safety Case for Faults not Directly Related to the Reactor
Technical area(s) 5. Fault Studies 4. PSA 15. Radwaste & Decommissioning	Related technical area(s) 1. Internal Hazards 3. External Hazards 10. Radiation Protection & (Level 3 PSA) 13. Human Factors
<i>Regulatory Observation</i>	
Summary	
<p>Safety cases for nuclear power plants rightly consider in detail faults associated with reactor. However, there are additional buildings, systems, processes and activities on a nuclear power plant site which could, in a fault condition, result in a person receiving a significant radiation dose or to a significant quantity of radioactive material escaping from its designated place of residence, despite the reactor core being unaffected.</p> <p>This Regulatory Observation requires Hitachi-GE to demonstrate that it has identified all such buildings, systems, processes and activities on the proposed UK ABWR generic site. Any faults which could occur need to be identified, and if they are not already considered in Hitachi-GE's UK ABWR safety case submissions, provide an appropriate safety case. It needs to be shown that there are adequate safety measures in place for such faults so that both deterministic and probabilistic success criteria are met.</p>	
Background	
<p>Hitachi-GE has developed a design basis safety case for the UK ABWR which demonstrates that various acceptance criteria associated with the fuel in the reactor core and the containment structure are met. Hitachi-GE is also in the process of developing a Probabilistic Safety Analysis (PSA) model which will evaluate the core damage frequencies associated with reactor accidents and the release frequencies associated with all significant sources of radioactivity as indicated in the PSA Strategy Document GA91-9201-0003-00130 Rev 0. There are widely accepted international expectations, practices and norms for performing reactor analysis, which Hitachi-GE has indicated it has or will be following for both its design basis and PSA safety cases.</p> <p>Underlying the regulatory judgements made by ONR inspectors are the principles and guidance contained within the Safety Assessment Principles (SAPs) (http://www.onr.org.uk/saps/saps2006.pdf). The SAPs are technology neutral and focus on the radiological hazards and risks posed by a nuclear site. They do not prescribe specific methodologies, acceptance criteria or design requirements for any particular facility type or technology.</p> <p>The Fault Analysis (FA) series of SAPs set out the expectations which ONR inspectors apply when looking at safety cases for fault conditions.</p> <p>SAP FA.1 sets the expectation that the risks arising from faults on nuclear facilities should be analysed using design basis analysis, probabilistic safety analysis, and, if appropriate, severe accident analysis.</p>	

SAP FA.2 states that fault analysis should identify all initiating faults having the potential to lead to a person receiving a significant dose of radiation, or to a significant quantity of radioactive material escaping from its designated place of residence or confinement. "Significant" is regarded as 0.1 mSv to workers or 0.01 mSv to a hypothetical person outside the site.

SAP FA.3 states that fault sequences should be developed from the initiating faults, and their potential consequences analysed.

These principles are not restricted to the reactor systems. They equally apply to the spent fuel pool, off-gas system, filter systems, transport flasks and waste stores etc. The faults considered should not be limited to plant failures but also chemical and other internal hazards, man-made and natural external hazards, human error, and interactions from other activities on the site.

Expectations for a deterministic safety case

To demonstrate the fault tolerance of the design and the robustness of safety measures which protect people from receiving a significant dose of radiation and to keep radioactive material in its designated place of residence, ONR expects design basis analysis to be undertaken for all initiating events which meet the criteria set out in SAP FA.5 (initiating faults) and numerical target 4 (design basis fault sequences – any person).

Relevant design basis fault sequences need to be identified and analysed, with consideration given to:

- failures consequential upon the initiating fault and failures that would arise because of common cause shared with the initiating event;
- single failures in the safety measures;
- the worst normally permitted configurations of equipment outages for maintenance, test or repair;
- the most onerous permitted operating state within the inherent capacity of the facility;
- the time, information, procedural and compliance requirements for any operator actions.

Ideally, the analysis should demonstrate that no physical barriers preventing escape or relocation of radioactivity are breached, there is no release of radioactivity and no person receives a significant dose of radiation. If releases do occur, then doses to persons should be limited. ONR inspectors will use the numerical Target 4 to inform their judgements on whether the identified safety measures have adequately reduced the radiological consequences of the fault.

It should be clear from the analysis what safety functions have been identified for the systems being considered and what the performance requirements for the safety measures identified to deliver necessary safety functions are. To provide this clarity, it is important that safety functions are appropriately categorised based on their significance with regard to safety, and the safety measures are classified on the basis of the functions they are delivering and their significance to safety.

All design basis faults should appear on "the" fault schedule. However, the format of the extant fault schedule may not lend itself to capturing all the key safety functions required for non-reactor faults. An alternative section or addendum to the main fault schedule could be an effective way to summarise some aspects of the UK ABWR safety case.

Expectations for a probabilistic safety case

Reactor PSAs allow evaluations to be made of core damage frequency, the frequencies of the various release categories and individual and societal risk from reactor accidents. However, SAP FA.12 states that PSA should cover all significant sources of radioactivity and all relevant initiating faults identified at the facility or site. The SAPs also identify additional numerical targets that need to be demonstrated (through probabilistic analyses) for the full range of accidents that could occur on the site, not just the most severe events associated with the reactor core.

The targets are expressed in terms of Basic Safety Levels (BSL) and Basic Safety Objectives (BSO). ONR expects a facility or activity to at least meet the BSLs. However, the more onerous BSOs provide the benchmarks that reflect modern safety standards and expectations.

Target 5 sets out BSL and BSO frequency targets for the individual risk of death to a person on the site, from

on-site accidents that result in exposure to ionising radiation.

Target 6 sets out BSO and BSL targets for the predicted frequency of any single accident in the facility, which could give doses to a person on the site.

Target 7 sets out BSO and BSL frequency targets for the individual risk of death to a person off the site, from on-site accidents that result in exposure to ionising radiation.

Target 8 sets out BSO and BSL targets for the total predicted frequencies of accidents on the facility, which could give doses to a person off the site.

Target 9 sets out BSO and BSL targets for the total risk of 100 or more fatalities, either immediate or eventual, from on-site accidents that result in exposure to ionising radiation.

It is anticipated that the UK ABWR PSA Hitachi-GE is developing will allow evaluations of core damage frequency from reactor and spent fuel pool accidents, release frequencies, and risk figures for comparison against the SAPs numerical targets 7, 8 and 9. There may be buildings and operations not directly related to the reactor which could result in significant doses to a person off the site in fault conditions and it needs to demonstrated that these have been considered in evaluation against target 8 - it is ONR's understanding that Hitachi GE is already considering these in its evaluations against target 8 .

However, there may be buildings and operations not directly related to the reactor which could result in significant doses to workers in fault conditions; Hitachi-GE needs to demonstrate that these have been considered in evaluations against targets 5 and 6.

Regulatory Observation Actions

RO-ABWR-0037.A1 – Identification of initiating events in buildings, systems, processes and activities which could result in a significant dose of radiation

Action 1.1: Hitachi-GE to identify all the buildings, systems, processes and activities on the generic UK ABWR site that have the potential in a fault condition to result in a person receiving a significant dose of radiation, or to a significant quantity of radioactive material escaping from its designated place of residence or confinement.

Action 1.2: Hitachi-GE to provide a complete list of potential initiating events for the identified buildings, systems, processes and activities.

“Significant” is regarded as 0.1 mSv to workers or 0.01 mSv to a hypothetical person outside the site.

Reference can be made to the extant fault schedule, PSA and work on other Regulatory Observations (e.g. RO-ABWR-0011 on the fuel route faults) such that the response to the action is focussed on any new areas requiring safety case attention.

Estimates of inventories (the allowable maximums likely to be seen during the operational life of the site being considered in GDA) will need to be presented, as well as evaluations of the source terms. Consideration should be given to the unmitigated consequences of the accidents.

Resolution required by: To be determined by Hitachi-GE's Resolution Plan

RO-ABWR-0037.A2 - Extension of the Deterministic Safety Case

Hitachi-GE to review the completeness of its extant design basis safety case and fault schedule to identify if there are any additional initiating events (including those resulting from internal and external hazards) associated with buildings, systems, processes and activities that are not directly linked to the UK ABWR reactor, or not already considered within the UK ABWR safety case, but which could result in radiological releases that exceed the design basis threshold (considering both on-site and off-site consequences).

Relevant design basis fault sequences need to be identified and analysed as appropriate to demonstrate that

the mitigated radiological consequences are as low as is reasonably practicable.

The safety functions protecting against any identified faults are to be identified and categorised.

The performance requirements of safety measures are to be identified and classified.

Any safety limits, operator actions, procedural and compliance requirements need to be clearly identified.

Any additions to the extant safety case need to be included in an update to the PCSR, relevant topic reports and the fault schedule.

Resolution required by: To be determined by Hitachi-GE's Resolution Plan

RO-ABWR-0037.A3 – Extension of the Probabilistic Safety Case

Action 3.1: Hitachi-GE to provide a methodology to analyse the risks associated with the initiating events identified in Action 1.2, including sequence progression, calculation of frequencies and radiological consequences.

Action 3.2: Hitachi-GE to provide analysis of the risks associated to the initiating events identified in Action 1.2 (including sequence progression and calculation of frequencies and radiological consequences) and the overall risk associated to the buildings, systems, processes and activities identified in Action 1.1, including:

- the risk of death to a person on the site from on-site accidents that result in exposure to ionising radiation (SAP target 5);
- the predicted frequency for any single accident on the UK ABWR GDA site which could give doses to a person on the site (SAP target 6);
- the individual risk of death to a person off the site, from on-site accidents that result in exposure to ionising radiation (SAP target 7);
- the predicted frequencies of accidents on the UK ABWR GDA site which could give doses to a person off-site (SAP target 8);
- if relevant, the total risk of 100 or more fatalities, either immediate or eventual, from on-site accidents that result in exposure to ionising radiation (SAP target 9).

It is recognised that Hitachi-GE has already undertaken to develop a "full scope" PSA for the reactor, spent fuel pool and fuel route activities during GDA Steps 3 and 4. The response to this action does not need to repeat the work being undertaken elsewhere. However, it should be referenced and interactions or differences in scope clearly identified.

Any additions to the extant safety case need to be included in an update to the PCSR and relevant topic reports.

Resolution required by: To be determined by Hitachi-GE's Resolution Plan

REQUESTING PARTY TO COMPLETE

Actual Acknowledgement date:

RP stated Resolution Plan agreement date: