REGULATORY OBSERVATION

REGULATOR TO COMPLETE

RO unique no.:	RO-ABWR-0023
Date sent:	21st October 2014
Acknowledgement required by:	11th November 2014
Agreement of Resolution Plan Required by:	*To be determined by the Hitachi-GE Resolution Plan*
Resolution of Regulatory Observation required by:	*To be determined by the Hitachi-GE Resolution Plan*
TRIM Ref.:	2014/314434
Related RQ / RO No. and TRIM Ref. (if any)**:**	
Observation title:	Severe Accident Safety Case
Technical area(s) 18. Severe Accident Analysis	**Related technical area(s)** 4. PSA 9. Reactor Chemistry

Regulatory Observation

Summary

ONR requires that severe accident analysis is undertaken to ensure that risks from a nuclear facility are reduced as low as reasonably practicable (ALARP). From ONR's assessment of Hitachi-GE's severe accident safety documentation provided to date it is considered that further information on the safety justification is required to demonstrate that regulatory expectations in the area of severe accident can be met. As such this Regulatory Observation has been drafted in order to ensure that the responses to the shortfalls identified in the Hitachi-GE severe accident documentation are managed appropriately. The aim of this Regulatory Observation is to ensure that Hitachi-GE's severe accident safety case strategy is appropriately defined, the scope of their severe accident safety case is complete; severe accident phenomena are appropriately considered, the severe accident analysis is suitable, engineered features, strategies & procedures are appropriate, and the release paths and behaviour of radionuclides are understood.

Background

ONR's guidance (Safety Assessment Principles (SAPs)) requires that suitable and sufficient severe accident analysis is undertaken to ensure that risks are as low as reasonably practicable (ALARP). Therefore, fault sequences beyond the design basis that have the potential to lead to a severe accident should be analysed. The severe accident analysis should provide information: to assist in the identification of any further reasonably practicable preventative or mitigating measures beyond those derived from the design basis; to form a suitable basis for accident management strategies; to support the preparation of emergency plans for the protection of people; to determine the magnitude and characteristics of radiological consequences, and to support the probabilistic safety analyses (PSA) of the facility's design and operation. One of the key purposes of the severe accident analysis is to demonstrate that the severe accident safety measures reduce the level of risk ALARP. The UK regulatory framework requires Hitachi-GE to demonstrate that their operations are, or will be, conducted in such a way that the risks from their operations are ALARP. ONR will be considering national and international relevant good practise and guidance, such as WENRA reference levels (statement on safety objectives for new nuclear power plants and report on the safety of new NPP designs) and IAEA guidance to ensure that the ALARP principle is complied with. ONR requires a structured and systematic safety case for the UK ABWR in the area of severe accidents to demonstrate that these requirements and the ALARP principle are met.

ONR have assessed Hitachi-GE's preliminary safety report (PSR) and further submission in the area of severe accidents. ONR, supported by GRS, have also considered the further information supplied in Hitachi-GE's draft PCSR documentation in preparation for Step 3 (note: this documentation has not formally been assessed). Information on the assessment work that was undertaken and the shortfalls that were identified is

detailed in ONR's Step 2 PSA and severe accident assessment report and GRS's technical review. From ONR's assessment it was considered that further information from Hitachi-GE will be required to demonstrate that regulatory expectations in the severe accident area can be met. The actions to address this Regulatory Observation have been broken down into 5 key areas below, these are:

- severe accident safety case strategy;
- completeness of the severe accident safety case;
- severe accident phenomena and analysis;
- engineered features, strategies and procedures; and
- release paths and behaviour of radionuclides.

ONR will assess the severe accident safety case, and the response to this Regulatory Observation, in accordance with their Safety Assessment Principles (SAPs), notably SAPs FA.1 (suitable and sufficient severe accident analysis), FA.15 (fault sequences that can lead to a severe accident should be analysed) and FA.16 (further risk reduction measures should be identified). Further, ONR will also consider our guidance on the demonstration of ALARP (NS-TAST-GD-005 Revision 6) and international guidance in the area of severe accidents, the relevant international guidance has been described within GRS's report (Requirements on Severe Accident Analyses) and ONR's severe accident Step 3 plan.

Regulatory Observation Actions

Action # 1

RO-ABWR-0023.A1: Severe accident safety case strategy
Hitachi-GE are required to clearly identify its severe accident safety case strategy for GDA, in terms of:
· Hitachi-GE needs to define its objectives for the severe accident analyses and to provide information on how it plans to demonstrate compliance with the UK regulatory principles. This should include how Hitachi-GE plans to show that the severe accident analysis has been used to:
o identify any further reasonably practicable preventative or mitigating measures;
o form a suitable basis for accident management strategies;
o support the preparation of emergency plans for the protection of people;
o determine the magnitude and characteristics of radiological consequences;
o support the PSA of the facility's design and operation; and
o demonstrate adequate understanding of the severe accident phenomena and accident progression.
· Hitachi-GE to provide information on its strategies for their severe accident safety case and to explain how the severe accident analysis, strategies, planned engineered features and procedures will form a coherent safety argument for the UK ABWR that meets UK regulatory guidance.
· Hitachi-GE needs to define the scope and objectives of the radiological consequence analysis i.e. how is Hitachi-GE identifying the scenarios to be considered, how will this support the preparation of emergency plans for the protection of the people.
· Hitachi-GE to explain the criteria for the selection of postulated initiating events and the different sets of multiple failures leading to a severe accident, for example, how have Hitachi-GE identified the severe accident scenarios that it has considered within its analysis to date?
· Hitachi-GE to identify the criteria used for severe accident analysis against which the performance of the engineered features, strategies and procedures can be judged, for example, how will Hitachi-GE show that their proposed severe accident engineered measures are suitable?
· Hitachi-GE to define the scope of the severe accident safety case for GDA, for example, what extent is it envisaged that the emergency procedures are going to be considered within GDA. If assumptions are going to be made on the future Licensee's emergency capabilities or procedures these should be clearly stated.
This information should be provided in the severe accident topic report. Links and interfaces with other aspects of the UK ABWR safety case need to be identified.
Resolution required by: To be determined by Hitachi-GE's Resolution Plan.

Resolution required by

Action # 2

RO-ABWR-0023.A2: Completeness of the severe accident safety case
Hitachi-GE are required to demonstrate the completeness of their severe accident safety case, this should include:
· All operating modes (e.g. low power, shutdown, refuelling, etc.) and all relevant facilities are considered.
· A full analysis of the impact of potential internal and external hazards.
· An explicit description of the severe accident strategies and other outcomes resulting from the learning from the Fukushima accident.
· A full analyses of events taking place over a long timescale until a safe and sustainable position has been

reached inline with the HM Chief Inspector's recommendations following the events at Fukushima (IR-25).
This information should be provided in an update to the PCSR or topic report. Links and interfaces with other aspects of the UK ABWR safety case need to be identified.
Resolution required by: To be determined by Hitachi-GE's Resolution Plan.

Resolution required by

Action # 3

RO-ABWR-0023.A3: Severe accident phenomena and analysis
Hitachi-GE are required to identify and describe the relevant severe accident phenomena for the UK ABWR as well as providing the results severe accident analyses. This should include:
· A comprehensive list and description of all relevant severe accident phenomena for the UK ABWR; including a justification of any known severe accident phenomena that have been excluded from consideration in the UK ABWR analysis.
· The severe accident documentation should include a description of the input data files, description of the boundary conditions of the analyses (including all assumptions) and a detailed explanation of the results. More specifically the results section should contain: information on the key phenomena seen in the analysis, a description of the performance and time to failure of the severe accident measures and the time to enact mitigation measures.
· An analysis of the potential impact of key uncertainties on the results. Sensitivity work should be undertaken to ensure that all uncertainties are dealt with appropriately.
This information should be provided in either an update to the PCSR or topic report, or within appropriate references. Links and interfaces with other aspects of the UK ABWR safety case need to be identified.
Resolution required by: To be determined by Hitachi-GE's Resolution Plan.

Resolution required by

Action # 4

RO-ABWR-0023.A4: Engineered features, strategies and procedures
Hitachi-GE are required to provide a clear description and justification of all the engineered features, strategies and procedures to deal with severe accidents for the UK ABWR. This should:
· Substantiate the severe accident measures through the provision of detailed information on the actual design (for example, number, type, and location of connection points in the reactor building, mobile equipment; ways to provide coolant injection to the containment head, etc.) and their implementation into the severe accident management strategies.
· Demonstrate the effectiveness of the severe accident management measures (see analysis above).
· Describe the system safety classification and withstand capability on all of the proposed severe accident engineered features.
· Describe the Fukushima related improvements (for example, backup building, mobile components, hydrogen management etc.).
· Describe the measures for hydrogen management (and other combustible gases) during a severe accident inside and outside of the primary containment.
· Provide information on the systems and strategies to depressurise the containment following a severe accident (for example, strategy, system design and filter design).
· Provide documentation of the optioneering process which has been, or will be, done to consider what severe accident design measures are reasonably practicable for the UK ABWR. Hitachi-GE should explain why the design of the UK ABWR represents Relevant Good Practice and follows the ALARP principle in relation to severe accidents; this should include a review of international good practice in the severe accident area. The response to this action should include: consideration of methods / technologies for confining a molten core, passive methods of core or containment cooling, methods for further increasing grace / response times, methods of further capturing / reducing fission products inside containment, the design of the containment head flange and other systems to protect from containment leakage, passive methods for flammable gas control, and any other relevant severe accident measures considered elsewhere.
· A description of the overall strategy/ies to deal with severe accidents at a UK ABWR, that will serve as the basis for the development of severe accident management guidelines and which should be underpinned by severe accident analysis.
This information should be provided in an update to the PCSR and/or topic report/s and/or within supporting references. Links and interfaces with other aspects of the UK ABWR safety case need to be identified.
Resolution required by: To be determined by Hitachi-GE's Resolution Plan.

Resolution required by

Action # 5

RO-ABWR-0023.A5: Release paths and behaviour of radionuclides
Hitachi-GE are required to identify and describe the possible release paths and the behaviour of radionuclides for the UK

ABWR. This should include:
· An analysis of releases of radionuclides following a severe accident from the UK ABWR (i.e. severe accident source terms).
· A justification of the amount of fission products to be retained within the containment (e.g. retention of fission products in the suppression pool) and a description of the behaviour of radionuclides (in-vessel and ex-vessel) following a severe accident.
· A description of the primary containment failure mode/s assumed in the analyses, this should include information on conditions inside the reactor building (outside of the primary containment).
· A description of all other possible release paths following a severe accident considered for the UK ABWR.
This information should be provided in the appropriate topic report. Links and interfaces with other aspects of the UK ABWR safety case need to be identified.
Resolution required by: To be determined by Hitachi-GE's Resolution Plan.

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