REGULATORY OBSERVATION

REGULATOR TO COMPLETE

RO unique no.:	RO-ABWR-0054
Date sent:	15th May 2015
Acknowledgement required by:	8th June 2015
Agreement of Resolution Plan Required by:	*To be determined by Hitachi-GE Resolution Plan*
Resolution of Regulatory Observation required by:	*To be determined by Hitachi-GE Resolution Plan*
TRIM Ref.:	2015/181094
Related RQ / RO No. and TRIM Ref. (if any)**:**	RO-ABWR-0011 RO-ABWR-0016 RO-ABWR-0037 RQ-ABWR-0522
Observation title:	UK ABWR – Chemical/Process Engineering Design Approach
Technical area(s) 11. Mechanical Engineering 15. Radwaste & Decommissioning	**Related technical area(s)** 1. Internal Hazards 2. Civil Engineering 3. External Hazards 5. Fault Studies 10. Radiation Protection & (Level 3 PSA) 12. Structural Integrity 13. Human Factors 16. Conventional Safety & Decommissioning 21. Generic Environmental Permitting

Regulatory Observation

Summary

During Step 3 of GDA, ONR's review has identified shortfalls in the Hitachi-GE proposal for the radioactive waste systems and their ultimate decommissioning relating to the J-ABWR use of embedded pipework (Ref.1) and Hitachi-GE's approach to the implementation of the recommendations arising from the identification of hazards arising from the radioactive liquid waste systems. The objective of this Regulatory Observation (RO) is to:

a) State ONR's expectations related to a Chemical/Process engineering design approach to systems, i.e. the principles, rules, considerations and selection criteria.
b) Request Hitachi-GE shows how it will implement a design approach that meets ONR expectations for the design of the UKABWR.

This RO is cross cutting and multidisciplinary and linked with other ROs raised in the UKABWR GDA process. The response to this RO, in conjunction with the other ROs ultimately needs to show that the design of the UKABWR and associated facilities have reduced risks to As Low As Reasonable Practical (ALARP). Note that the term ALARP is equivalent to SFAIRP (So Far As Is Reasonably Practicable) and will be used interchangeably in this RO. In addition the Chemical/process Engineering design approach will have impacts on many other areas of the UK ABWR safety-case (for example, radiation protection, mechanical engineering and GEP), and submissions already provided or scheduled to be submitted to ONR or EA.

Background and Regulatory Expectations

The proposed design for the UK ABWR incorporates a significant quantity of embedded pipework which is based on the Japanese design. In a cross-cutting meeting on the 18th March 2015, Hitachi-GE provided a presentation that explained the background to the embedded piping system (Ref.1). There were a significant number of embedded floor drains and embedded equipment drains within various buildings in the UK ABWR facility. In the examination of the embedded pipework and the hazard identification process for the liquid radioactive waste systems, ONR highlighted that there were shortfalls regarding the Chemical/Process engineering design approach and the ALARP demonstration.

In this RO the Chemical/Process engineering design approach means the principles, rules, considerations and

selection criteria used by Hitachi-GE in the design process (RO-ABWR-016) for the whole UK ABWR facility. The standards and criteria against which the UKABWR and associated facilities will be judged by ONR for the Chemical/Process engineering design approach is primarily based on the Health and Safety at Work etc. Act, SAPs, the Ionising Radiations Regulations 1999 approved code of practice, ONR'S technical assessment & inspection guides and relevant good practice. Other legislation will be taken into account when judging specific aspects.

Hitachi-GE's proposals need to demonstrate that the design can be substantiated to meet the legal requirements of sections 2 and 3 of the Health and Safety at Work etc. Act 1974 (to ensure, so far as is reasonably practicable, the health and safety of employees and others) and ONR's expectations as set out in regulatory guidance.

The following Safety Assessment Principles (SAPs) judged to be pertinent to this topic:

- EKP.1: The underpinning safety aim for any nuclear facility should be an inherently safe design, consistent with the operational purposes of the facility.
- EKP.2: The sensitivity of the facility to potential faults should be minimised.
- EKP 3: Nuclear facilities should be designed and operated so that defence in depth against potential significant faults or failures is achieved by the provision of multiple independent barriers to fault progression.
- EKP.4: The safety function(s) to be delivered within the facility should be identified by a structured analysis.
- EKP.5: Safety measures should be identified to deliver the required safety function(s).
- DC.1 Facilities should be designed and operated so that they can be safely decommissioned.
- RW.2 The generation of radioactive waste should be prevented or, where this is not reasonably practicable, minimised in terms of quantity and activity.

Ionising Radiations Regulations 1999 Approved Code of Practice (IRR 99 ACOP).

The Ionising Radiations Regulations 1999 and associated Approved Code of Practice and Guidance provide a regulatory framework for application of the Hierarchy of Controls summarised by ERIC PD:

- Eliminate
- Reduce
- Isolate
- Control
- Personal Protective Equipment
- Discipline

This hierarchy is covered under Regulation 8 Restriction of Exposure of the IRRs 99

Provision and Use of Work Equipment Regulations 1998, Regulation 6 is applicable to work equipment (including pipework) exposed to conditions causing deterioration which is liable to result in dangerous situations should be subject to an inspection regime to ensure that health and safety conditions are maintained and that any deterioration can be detected and remedied in good time.

ONR Technical Assessment Guide (TAG) & Technical Inspection Guides (TIG) see references 2 – 8.

The standards and criteria above drive a structured robust approach to the Chemical/Process engineering design. The approach affects facility layout and service infrastructure and leads to a consideration of a number of factors.

In the examination of Hitachi-GE's embedded pipework philosophy, shortfalls were identifiedregarding the Chemical/Process engineering design approach and the ALARP demonstration where regulatory expectations were not met.

The justification and benefits for the embedded pipework were not clear. ONR expects Hitachi-GE to have considered alternative piping system arrangements or engineering designs and demonstrate the final to have reduced risks to ALARP specifically for the UK ABWR design.

ONR draws Hitachi-GE's attention to the ICL inquiry. Although the ICL incident involved liquid petroleum gas (LPG) a key message from the ICL inquiry summary (Ref:9) was:

"This was an avoidable disaster. There can be no debate as to its cause:

- **the underground ageing metallic LPG pipe was out of sight and out of mind;**
- **it was inadequately protected when buried, it was subject to corrosion and ultimately it failed……."**

The hierarchy of safety measures set out in the SAPs Engineering Key Principles (EKP. 1-5 and supporting guidance, particularly SAPs paragraph 146) will usually be a key part of the ALARP analysis. ONR expects Hitachi-GE to follow the hierarchal process: avoid the hazard; design to achieve fault tolerance; maintain safe conditions by passive means rather than active systems; initiate protection automatically in preference to manually; and mitigate fault consequences.

It is ONR's expectation that the Chemical/Process engineering design approach will feed into and be informed by the Requesting Party's safety assessment processes, so as to systematically identify the hazards using a suitable methodology, such as a Hazard and Operability Study (HAZOP).

This is a cross cutting regulatory observation led by Radwaste and Decommissioning but is supported by other disciplines as required.

References:

1. Hitachi-GE Presentation, "Optioneering for Selected Piping System," PJ-GD-1024.
2. ONR Technical Assessment Guide (TAG), "Guidance on the Demonstration of ALARP (As Low As Reasonably Practicable)." NS-TAST-GD-005 Revision 6
3. ONR Technical Assessment Guide (TAG), "Containment: Chemical Plants." NS-TAST-GD-021 Revision 2
4. ONR Technical Assessment Guide (TAG), "Control of Processes Involving Nuclear Matter." NS-TAST-GD-023 Revision 3
5. ONR Technical Assessment Guide (TAG), "The Purpose, Scope and Content of Safety Cases." NS-TAST-GD-051 Revision 3.
6. ONR Safety Assessment Principles for Nuclear Facilities (SAPs). 2014 Edition, Revision 0.
7. ONR Technical Assessment Guide (TAG), "Design Safety Assurance." NS-TAST-GD-057 Revision 3.
8. ONR Technical Inspection Guide (TIG), "LC34: Leakage And Escape Of Radioactive Material And Radioactive Waste" NS-INSP-GD-034 Revision 2
9. ICL inquiry summary , http://www.theiclinquiry.org/documents/documents/071609_ICL_INQUIRY_SUMMARY_PUBLIC_RELEASE7.pdf

Further clarification is provided in REG-HGNE-0087N

Regulatory Observation Actions

RO-ABWR-0054.A1: Development and Implementation of the Chemical/Process Engineering Design Approach for the UK ABWR

Hitachi-GE should develop and implement the Chemical/Process engineering design approach for the equipment and pipework to be used in the UK ABWR and associated facility and show how it meets UK regulatory expectations. Items to be addressed (this is not an exhaustive list, but it is for Hitachi-GE to look at the design as a whole and identify other relevant items:) include: Tanks, Vessels, Pipework, fixing brackets, baffles, valves, leak detection, tundish/funnels, bunds, floor drains, sample points, etc.

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

RO-ABWR-0054.A2 : Chemical/Process Engineering Design Approach and Design Process for the UK ABWR

Hitachi-GE to demonstrate how the Chemical/Process engineering design approach developed in Action A1, interacts with the design process, RO-ABWR -016 refers.

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

RO-ABWR-0054.A3 : Chemical/Process Engineering Design Approach and Hazard Identification interactions

Hitachi-GE to demonstrate how the hazard identification process and the Chemical/Process engineering design approach and design process interact.

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

RO-ABWR-0054.A4: Demonstration of Chemical/Process Engineering Design Approach as input to demonstration of risks to SFAIRP.

1. Hitachi-GE is requested to identify which document(s) demonstrate the output of the systematic hazard identification using a suitable methodology, such as a HAZOP (or similar) to cover the full UK ABWR life cycle.
2. Hitachi-GE is requested to identify which document(s) demonstrate the outcome of all the recommendations from the hazard identification process.
3. Hitachi-GE is requested to identify which document(s) demonstrate that the systematic hazard identification process has led to further considerations of how to design out, prevent and mitigate hazards and form the part of the demonstration of how the risks have been reduced to So Far As Is Reasonably Practicable (SFAIRP).

All of the above documents should be made available to ONR on demand.

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

RO-ABWR-0054.A5: Hitachi-GE to explain how the lessons learnt from ICL inquiry have affected the design of the UK ABWR.

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

REQUESTING PARTY TO COMPLETE

Actual Acknowledgement date:	
RP stated Resolution Plan agreement date:	