Hitachi-GE Nuclear Energy, Ltd.
UK ABWR GENERIC DESIGN ASSESSMENT
Resolution Plan for RO-ABWR-0054
(UK ABWR – Chemical/Process Engineering Design Approach)

RO TITLE:	UK ABWR – Chemical/Process Engineering Design Approach	
REVISION :	0	
Overall RO Closure Date (Planned):	April 2017	
REFERENCE DOCUMENTATION RELATED TO REGULATORY OBSERVATION		
Regulatory Queries	RQ-ABWR-0522 RQ-ABWR-0841	
Linked ROs	RO-ABWR-0006 RO-ABWR-0009 RO-ABWR-0010 RO-ABWR-0011 RO-ABWR-0015 RO-ABWR-0016 RO-ABWR-0017 RO-ABWR-0018 RO-ABWR-0020 RO-ABWR-0021 RO-ABWR-0022 RO-ABWR-0023 RO-ABWR-0025 RO-ABWR-0027 RO-ABWR-0034	RO-ABWR-0035 RO-ABWR-0036 RO-ABWR-0037 RO-ABWR-0040 RO-ABWR-0043 RO-ABWR-0044 RO-ABWR-0045 RO-ABWR-0046 RO-ABWR-0051 RO-ABWR-0056 RO-ABWR-0058 RO-ABWR-0064 RO-ABWR-0065 RO-ABWR-0073
Other Documentation	-	

Scope of work :

Background

Hitachi-GE understands that through the review of the use of the embedded pipework and the hazard identification process for the liquid radioactive waste systems of the UK ABWR, ONR highlighted that there were shortfalls regarding the clarity of the Chemical/Process Engineering Design Approach in terms of demonstrating ALARP for the UK ABWR design. Hitachi-GE is therefore required to demonstrate how the Chemical/Process Engineering Design Approach is adopted in its design process and the UK ABWR design can be substantiated to meet the legal requirements and ONR's expectations.

The objective of the Regulatory Observation (RO) RO-ABWR-0054 [Ref-1] 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 to show how Hitachi-GE will implement a design approach that meets ONR expectations for the design of the UK ABWR.

In the RO, the Chemical/Process Engineering Design Approach means the principle, rules, considerations and selection criteria used by Hitachi-GE in the design process for the whole UK ABWR facility. The standards and criteria against which the UK ABWR 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 Relegations 1999 approved code of practice, ONR's technical assessment & inspection guides and relevant good practice. It is understood that other legislation will be taken into account when judging specific aspects.

Scope of Work

In order to meet the Regulator's expectation and the GDA timeline, Hitachi-GE would like to take immediate actions to incorporate UK Chemical/Process Engineering Design Approach into its design process appropriately and reflect them to the design of the UK ABWR.

This Resolution Plan describes Hitachi-GE's current plan to address the RO. It contains the information to show how the RO will be resolved; this includes the planned activities, deliverables, and timescales. This Resolution Plan is multidisciplinary as it relates to a number of technical areas, as outlined in the Regulator's RO. As the work develops, Hitachi-GE may choose to optimise the means to address the RO and the regulator will be notified in such circumstances.

Description of work:

Under the RO-ABWR-0054, the following 5 actions have been requested from ONR:

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

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

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

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

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

Following the review of the above actions, Hitachi-GE have put together a resolution plan that enables Hitachi-GE experts to demonstrate to ONR that the Chemical/Process Engineering Design Approach generally adopted in the UK nuclear industry has been understood and implemented. This will be carried out through a systematic method with the aim to facilitate knowledge transfer from UK experts to Hitachi-GE experts, and will allow Hitachi-GE to implement such principles effectively to the UK ABWR design.

There are strong interactions between all the Actions raised by the Regulators. For this reason, Actions will be resolved in conjunction and it is anticipated for a Regulators' inspection to be carried out for Hitachi-GE to

demonstrate adequate implementation of the Chemical/Process Engineering Design Approach.

Hitachi-GE will carry out the following tasks to address the RO:

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

Hitachi-GE's scope:

The following tasks will be carried out for the development and implementation of the Chemical/ Process Engineering Design Approach (CPEDA):

i) Production of Topic Report (TR) on "Generic Chemical/Process Engineering Design Approach (CPEDA) for UK ABWR", with appropriate input from the suitably qualified and experienced UK experts
ii) Implementation of the process set out in the above TR into Hitachi-GE QA process

It is intended for the above TR to capture CPEDA to be utilised for UK ABWR design, setting out the approach to be taken for the near term as well as the plan for the longer term, and the phased strategy for the implementation of CPEDA. In summary, CPEDA will consider the followings (but not limited to):

- Training of Hitachi-GE experts to familiarise with the UK's nuclear safety management method, with the aim to provide introductory overview of the general approach adopted in the UK, particularly for nuclear chemical/process engineering design
- Production of reference document that will provide an overview of the common chemical/process engineering design approach taken in an engineering project in the UK nuclear industry, to raise awareness and understandings of the design approach generally taken in the UK to Hitachi-GE experts
- Review of the UK ABWR design, with the appropriate support from UK experts, where the design of the systems will be openly challenged by both Hitachi-GE and UK experts as necessary in a workshop setting, to test the design against CPEDA generally adopted in the UK
- Systematic hazard identification process (such as HAZOP, FMEA, or Hazard Checklist etc.) of a selected number of UK ABWR systems to test the design further against CPEDA generally adopted in the UK, via appropriate attendance and contributions from the UK experts
- Prioritisation and categorisation of the systems, including selection of the systems to be reviewed during GDA and those that would be reviewed post-GDA, with the aim to carry out a strategic phased review of the UK ABWR systems
- Set up of the appropriate support structure to allow Hitachi-GE experts to call on UK experts, when and as necessary, for the implementation of CPEDA
- Approach to be taken for the resolution of any findings from the above review process, with the appropriate support from UK experts. This will include considerations for consolidating findings of similar theme from the review process for further investigation

- Putting together a long term strategy, looking into (but not limited to):
    - Training requirements of Hitachi-GE experts
    - Building internal Hitachi-GE suitably qualified and experienced CPEDA experts
    - Consideration of design approval process for UK ABWR

Note that the above TR will also cover scope from *A2*, *A3*, *A4*, and *A5*. Please see below for further details.

Deliverables:

(1) TR on "Generic Chemical/Process Engineering Design Approach (CPEDA) for UK ABWR"
(2) Training records of Hitachi-GE experts
(3) TR on "System Selection", where method, its reasoning and the outcome of the selection of systems to be considered during GDA steps and beyond GDA stage will be made clear
(4) Design review reports of the selected systems, including any close out record of action(s)
(5) Hazard identification study reports of the chosen number of systems, including any close out record of action(s)

A2: Chemical/Process Engineering Design Approach and Design Process for the UK ABWR

Hitachi-GE's scope:

Hitachi-GE recognises that CPEDA to be developed and implemented will need to align with the UK ABWR general design process. TR given above in *A1* will clarify how CPEDA will interact and support the overall design process adopted in the UK ABWR design, taking particular considerations to:

- Integration with General Design Process Approach for Mechanical Engineering SSCs [Ref.2] (developed for the resolution of RO-ABWR-0016)
- Integration with GDA Safety Case Development Manual [Ref.3]
- Integration with UK ABWR Nuclear Safety and Environmental Design Principles (NSEDPs) [Ref.4]
- Integration with Hitachi-GE's internal design change process [Ref.5]
- Integration with Fault Studies work

Hitachi-GE recognises the potential impact of this RO and its multi-disciplinary nature, and its links with other ROs raised in the UK ABWR GDA process. As a result, Hitachi-GE will follow a systematic process to cascade any findings from the review process to the relevant technical areas, as captured in the response to *A1*.

Any findings that may require modification(s) to the design will be managed in accordance with the Hitachi-GE's internal design change process [Ref.5] and will be centrally managed by the Project team, maintaining the overseeing role of the potential impact any modifications to the chemical/process engineering design can bring to wider topic areas. To ensure all issues are captured, resolved appropriately and incorporated into the design, an auditable trail will be made available for design decisions. It is anticipated for the Regulators' inspection to confirm management and closure of selected sample of findings from the review process.

Deliverables:

The deliverables (1), (3), (4) and (5) from resolving *A1* will form part of the basis of deliverables to fulfil *A2*.

A3: Chemical/Process Engineering Design Approach and Hazard Identification interactions

Hitachi-GE's scope:

As described in the scope for resolving *A1* and *A2*, TR on "Generic Chemical/Process Engineering Design Approach (CPEDA) for UK ABWR" will make clear how CPEDA will interact with the overall design process, including the Fault Studies topic area.

As mentioned in response to *A1* as well as *A2*, any findings from the review process (including any hazard identifications studies) will be monitored, providing an auditable trail of the review and closure of any findings. Similar to *A2*, it is anticipated for the Regulators' inspection to confirm management and closure of selected sample of findings from the review process.

Deliverables:

The deliverables (1), (4), and (5) from *A1* will form the basis of deliverables to fulfil *A3*.

A4: Demonstration of Chemical/Process Engineering Design Approach as input to demonstration of risks to SFAIRP

Hitachi-GE's scope:

TR on "Generic Chemical/Process Engineering Design Approach (CPEDA) for UK ABWR" will demonstrate how CPEDA to be implemented for UK ABWR will be one of the holistic input to demonstrating risks are reduced SFAIRP for the UK ABWR design, with the primary aim to facilitate Hitachi-GE experts to understand and become aware of the philosophy and the approach adopted in the UK to demonstrate risk associated with chemical/process engineering design is ALARP.

Outputs from the review processes (such as design review reports, hazard identification study reports) as well as the documents incorporating resolution of the findings from the review process (i.e. any new or revised submissions) will also form the basis of demonstrating that the risks have been reduced SFAIRP.

Deliverables:

The deliverables (1), (4) and (5) from *A1* will form the basis of deliverables to fulfil *A4*.

A5: Hitachi-GE to explain how the lessons learnt from ICL inquiry has affected the design of the UK ABWR

Hitachi-GE's scope:

Learning from operational experience on existing BWRs, ABWRs and any other relevant external reports will be used as inputs into the review process (see resolution plan for RO-ABWR-0045 [Ref.6]). TR on "Generic Chemical/Process Engineering Design Approach (CPEDA) for UK ABWR" will clarify the approach that will be taken for giving due considerations to any Learning From Experiences (LFEs) from relevant operational experiences, as set out in the General Design Process Approach for Mechanical Engineering SSCs [Ref.2], and also capture how CPEDA is to be adopted to ensure that lessons learnt from ICL inquiry are duly considered.

Deliverables:

The deliverables (1), (4) and (5) from *A1* will form the basis of deliverables to fulfil *A5*.

Summary of impact on GDA submissions:

The GDA submissions that will be affected by the actions to resolve this RO are summarised below. These documents will be originated and/or revised in accordance with the corresponding Resolution Plan Actions.

Impacted GDA Submission Documents

	Generic Environmental Permitting
	Conceptual Security Arrangements
PCSR Chapter	General Design Aspects
PCSR Chapter	Internal Hazards
PCSR Chapter	Structural Integrity
PCSR Chapter	Civil Works and Structures
PCSR Chapter	Reactor Coolant Systems, Reactivity Control Systems and Associated Systems
PCSR Chapter	Engineered Safety Features
PCSR Chapter	Control and Instrumentation
PCSR Chapter	Auxiliary Systems
PCSR Chapter	Radioactive Waste Management
PCSR Chapter	Fuel Storage and Handling
PCSR Chapter	Radiation Protection
PCSR Chapter	Human-Machine Interface
PCSR Chapter	Emergency Preparedness
PCSR Chapter	Reactor Chemistry

PCSR Chapter Design Basis Analysis

PCSR Chapter Probabilistic Safety Assessment

PCSR Chapter Beyond Design Basis and Severe Accident Analysis

PCSR Chapter Human Factors

PCSR Chapter Commissioning

PCSR Chapter Decommissioning

PCSR Chapter Spent Fuel Interim Storage

Key GDA submissions identified in related RO Actions are summarised in the table below.

Related RO Actions	Corresponding Deliverable Title	Document ID (Document No.) [If applicable]	Submission Date to the Regulators
ROA1 ROA2 ROA3 ROA4 ROA5	*Topic Report on " Generic Chemical/Process Engineering Design Approach (CPEDA) for UK ABWR"*	TBD	Feb 2017
ROA1	*Training record of Hitachi-GE experts*	HGNE-ONR-0101R (XL-GD-0333)	25 Jan 2016
ROA1 ROA2	*Topic Report on "System Selection"*	GA91-9201-0003-00927 (XE-GD-0446)	05 Jan 2016
ROA1 ROA2 ROA3 ROA4 ROA5	*Design review reports of the selected systems*	GA91-9201-0003-01114 (XE-GD-0536) GA91-9201-0003-01251 (SE-GD-0405) GA91-9201-0003-01402 (SE-GD-0472) GA91-9910-0003-00001 (GE-GD-0056)	Sep 2016
ROA1 ROA2 ROA3 ROA4 ROA5	*Hazard identification study reports of the chosen number of systems*	GA91-9201-0003-01168 (XE-GD-0554) GA91-9201-0003-01259 (SE-GD-0412) GN62-9910-0001-00001 (GE-GD-0044) GT22-9910-0001-00001 (SE-GD-0389)	Sep 2016

As the work progress other areas affected may be identified and will be updated as required.

Programme Milestones/ Schedule:

Refer to the attached Gantt-chart (Table 1) for the programmed activities and the schedule for the resolution of the RO.

Reference:

1. RO-ABWR-0054, "UK ABWR - Chemical/Process Engineering Design Approach", 15th May 2015, ONR
2. GA91-9201-0003-00854 Rev.0, "General Design Process Approach for Mechanical Engineering SSCs", 21st August 2015, Hitachi-GE
3. GA10-0511-0006-00001 Rev.1, "GDA Safety Case Development Manual", 26th November 2015, Hitachi-GE
4. GA10-0511-0011-00001 Rev.0, "UK ABWR Nuclear Safety and Environmental Design Principles (NSEDPs)", 28th April 2016, Hitachi-GE
5. GA70-1501-0003-00001 Rev.5, "Design Change Control and Documentation", 8th April 2015, Hitachi-GE
6. GA91-9201-0004-00048 Rev.2, "Resolution Plan for RO-ABWR-0045 UK ABWR – Operational Experience (OPEX)", 10th June 2015, Hitachi-GE

Table 1 RO-ABWR-0054 Gantt Chart

UK ABWR Resolution Plan for RO-ABWR-0054
"Chemical / Process Engineering Design Approach"

Level	Action Title	Start	Finish
1	Regulator's Issue of RO		
1.1	ONR Issue RO	15-May-15	15-May-15
1.2	Hitachi-GE acknowledge RO & issue Resolution Plan	15-May-15	12-Jun-15
1.3	Regulator confirm credibility of Resolution Plan	12-Jun-15	19-Jun-15
1.4	Regulator publish RO and Resolution Plan	20-Jun-15	30-Jun-15
1.5	Hitachi-GE issues Revised Resolution Plan	10-Oct-16	26-Oct-16
1.6	Regulator confirm credibility of Revised Resolution Plan	19-Oct-16	26-Oct-16
1.7	Regulator publish Revised Resolution Plan	26-Oct-16	4-Nov-16
2	Preparation of Submissions and Closure of RO Actions		
2.1	A1: Development and Implementation of Chem/Process Eng	15-May-15	24-Feb-17
2.1.1	Production of TR on "CPEDA for UK ABWR"	24-Oct-16	24-Feb-17
2.1.2	Implementation of the process set out in the above TR	18-May-15	24-Feb-17
2.2	A2: Chem/Process Eng Design Appr. & Design Process	19-Jun-15	24-Feb-17
2.3	A3: Chem/Process Eng Design Appr. & Hazard ID interaction	6-Jul-15	24-Feb-17
2.4	A4: Demonstration of Chem/Process Eng Design Approach	6-Jul-15	24-Feb-17
2.5	A5: How Lessons Learnt has affect the design of the UK ABWR	6-Jul-15	24-Feb-17
3	Regulator's Closure of RO		
3.1	Regulator's On-site Audit/Inspection	(TBD)	(TBD)
3.2	Regulators Assessment for Closing RO	21-Dec-16	31-Mar-16
3.3	Regulator's publication of RO closure letter	3-Apr-17	7-Apr-17

NB: Detailed actions in A2 through A5 will be covered by the applicable sub-actions in A1.