



**New Reactors Division**

**Step 4 Assessment of Conventional Health and Safety for the UK Advanced Boiling  
Water Reactor**

Assessment Report: ONR-NR-AR-17-28  
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## EXECUTIVE SUMMARY

Hitachi-GE Nuclear Energy Ltd (Hitachi-GE) is the designer and Requesting Party (RP) for the United Kingdom Advanced Boiling Water Reactor (UK ABWR). Hitachi-GE commenced GDA in 2013 and completed Step 4 in 2017.

This assessment report is my Step 4 assessment of Hitachi-GE's UK ABWR reactor design in Conventional (non-nuclear) Health and Safety<sup>\*</sup>.

The scope of the Step 4 assessment is to review the safety, security and environmental aspects of the UK ABWR in greater detail, by examining the evidence, supporting the claims and arguments made in the safety documentation and building on the assessments already carried out at Step 3.

My assessment conclusion is:

- I am satisfied that Hitachi-GE has demonstrated sufficient appreciation, understanding and application of GB conventional health and safety requirements in the UK ABWR design.
- Hitachi-GE has demonstrated a good understanding of the Construction (Design and Management) (CDM) Regulations 2015, but has limited its application of designer risk assessment deferring to site specific design development. It is acknowledged that Hitachi-GE is working in parallel with licensee applicant, Horizon Nuclear Power Limited, in regard to the construction of the UK ABWR reactor at Wylfa Newydd, for example in the provision of CDM hazard logs and optioneering reports, as has been evidenced throughout GDA.

My judgement is based upon the following factors:

- Hitachi-GE has provided sufficient information to demonstrate its understanding of GB health and safety legislation.
- Hitachi-GE has demonstrated the application of GB health and safety legislative requirements in the design process.
- Hitachi-GE has provided some relevant examples to demonstrate action, so far as is reasonably practicable, to eliminate, reduce or control foreseeable risks to the health and safety of persons carrying out or liable to be affected by construction work, including decommissioning, maintenance, and operation of the plant as a workplace.
- Hitachi-GE has referenced GB relevant health and safety skills, knowledge and experience in risk assessment, and has acted to develop GB relevant health and safety risk assessment competence in those UK ABWR designers preparing or modifying their designs outside GB.

Overall, based on representative sample assessment, I am satisfied with the claims, arguments and evidence laid down within the Conventional Health and Safety Topic Reports and supporting documentation submitted as part of the GDA process, demonstrate an adequate understanding and response to GB health and safety legislative requirements for the generic UK ABWR design in Conventional Health and Safety. I consider that from a Conventional Health and Safety view point, the Hitachi-GE UK ABWR design is suitable for construction in the UK subject to future permissions and permits being secured..

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<sup>\*</sup> *Conventional health and safety (CHS) refers to workplace risks arising from operations not associated with nuclear material, ionising radiation (the Ionising Radiations Regulations 1999), or nuclear licensed activities (the Nuclear Installations Act 1965 as amended).*

The following matters remain for a future licensee to consider and take forward in their site-specific safety submissions. These matters do not undermine the generic safety submission, but require licensee input/decision at a specific site.

Further to my assessment conclusion above regarding compliance with Regulation 9 designer duties under the CDM Regulations 2015, I designate the following Assessment Finding in regard to the Hitachi-GE proposed GB novel open top construction method:

AF-ABWR-CH-01 As a designer under the CDM Regulations 2015, Hitachi-GE has provided limited information in their UK ABWR generic design to demonstrate the conventional health and safety risks arising from the suggested open top method of construction have been reduced as low as is reasonably practicable. As the open top construction methodology is novel within the context of the GB high hazard construction industry, the licensee shall carry out a site-specific design review using the available Hitachi-GE information as a baseline.

**LIST OF ABBREVIATIONS**

ALARP	As Low As Reasonably Practicable
BSL	Basic Safety Level
BSO	Basic Safety Objective
GDA	Generic Design Assessment
IAEA	The International Atomic Energy Agency
MDEP	Multi-national Design Evaluation Programme
ONR	Office for Nuclear Regulation
PCSR	Pre-construction Safety Report
PSA	Probabilistic Safety Assessment
PSR	Preliminary Safety Report
RGP	Relevant Good Practice
RP	Requesting Party
SAPs	Safety Assessment Principles
SFAIRP	So Far As Is Reasonably Practicable
SSC	System, Structure (and) Component
SSER	Safety, Security and Environmental Report
TAG	Technical Assessment Guide
TSC	Technical Support Contractor
US NRC	United States (of America) Nuclear Regulatory Commission
UK ABWR	United Kingdom Advanced Boiling Water Reactor
WEC	Westinghouse Electric Company
WENRA	Western European Nuclear Regulators' Association

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## 1 INTRODUCTION

### 1.1 Background

1. Information on the GDA process is provided in a series of documents published on our website (<http://www.onr.org.uk/new-reactors/guidance-assessment.htm>). The outcome from the GDA process sought by Requesting Parties such as Hitachi-GE is a Design Acceptance Confirmation (DAC) for ONR and a Statement of Design Acceptability (SoDA) for the Environment Agency (EA) and Natural Resources Wales (NRW).
2. The GDA Step 3 summary report is published on our website (<http://www.onr.org.uk/new-reactors/uk-abwr/reports/step3/uk-abwr-step-3-summary-report.pdf>). Further information on the GDA process in general is also available on our website (<http://www.onr.org.uk/new-reactors/index.htm>).
3. Hitachi-GE commenced GDA in 2013 and completed Step 4 in 2017. The Step 4 assessment is an in-depth assessment of the safety, security and environmental evidence. Through the review of information provided to ONR, the Step 4 process should confirm that Hitachi-GE:
  - Has properly justified the higher-level claims and arguments.
  - Has progressed the resolution of issues identified during Step 3.
  - Has provided sufficient detailed assessment to allow ONR to come to a judgment of whether a DAC can be issued.
4. During the step 4 assessment I have undertaken a detailed assessment, on a sampling basis of the safety and security case evidence. The full range of items that might form part of the assessment is provided in ONR's GDA Guidance to Requesting Parties (<http://www.onr.org.uk/new-reactors/ngn03.pdf>). These include:
  - Consideration of issues identified in Step 3.
  - Judging the design against the Safety Assessment Principles (SAPs) and whether the proposed design reduces risks to ALARP.
  - Reviewing details of the Hitachi-GE design controls, procurement and quality control arrangements to secure compliance with the design intent.
  - Establishing whether the system performance, safety classification, and reliability requirements are substantiated by the detailed engineering design.
  - Assessing arrangements for ensuring and assuring that safety claims and assumptions are realised in the final as-built design.
  - Resolution of identified nuclear safety issues, or identifying paths for resolution.
5. This is my report from the ONR's Step 4 assessment of the Hitachi-GE UK ABWR design in the area of Conventional Health and Safety

### 1.2 Scope

6. The scope of my assessment is detailed in my Step 4 Assessment Plan for Conventional Health and Safety (TRIM Ref. 2015/418791).
7. The scope of this assessment accords with ONR's risk-based, goal-setting and proportionate approach to conventional health and safety regulation, focussing on controlling significant risks to prevent workplace death, injury or ill health.
8. The scope of work involved more detailed examination of selected subject matter assessed in Step 3, comprising GB health and safety strategic priority and reactor relevant key topics, compliance with CDM Regulations and issues arising.

9. Additional consideration has been given to the open top construction methodology option proposed by Hitachi-GE because this is a GB novel approach.
10. The scope of my assessment is appropriate for GDA because consideration of health and safety at the design stage offers maximum potential for the reduction of conventional health and safety risks as low as is reasonably practicable.

### **1.3 Method**

11. My assessment method involved sampling of aspects of the UK ABWR design which impact on non-nuclear health and safety risks that are most likely to cause harm during construction, operation, maintenance and decommissioning of the plant against GB regulatory expectations.
12. The range of conventional health and safety relevant subjects is too extensive for review and therefore a number of subject areas were selected for sampling assessment across the life cycle of the plant. The topics included Hitachi-GE's response to the Construction (Design and Management) Regulations 2015 (CDM 2015), which came into force on 6 April 2015 (replacing the Construction (Design and Management Regulations 2007). CDM 2015 Regulation 9 duties of designers are of particular relevance in the preparation or modification of a design to be constructed in GB, and apply from design concept. The designer is required to eliminate, reduce or control foreseeable risks that may arise during construction (including decommissioning), use as a workplace, and maintenance, so far as is reasonably practicable.
13. Hitachi-GE submitted Topic Reports to an agreed schedule across a range of subject areas:
  - Evaluation of the construction methodology.
  - Workplace Regulations (Health, Safety and Welfare) Regulations 1992 report.
  - Designing for safety in bespoke equipment.
  - Further development of risk mitigation for Step 3 examples within GDA Step 3, encompassing work at height; work related ill health; lifting operations; and work in confined spaces.
  - CDM 2015 compliance.

These Topic Reports were the subject of review and challenge by ONR in a series of meetings where the content was assessed for compliance against GB regulatory expectations, with focus on how requirements to reduce risk to health and safety, so far as is reasonably practicable, have been or will be met.



## 2 ASSESSMENT STRATEGY

### 2.1 Standards and criteria

14. The standards and criteria adopted within this assessment are principally GB health and safety legislative requirements, and authoritative documented sources of good practice including Health and Safety Executive (HSE) Approved Codes of Practice (ACOPs), and HSE Guidance on legal standards, available at [www.hse.gov.uk](http://www.hse.gov.uk). HSE set the strategy, policy and legal framework for conventional health and safety in GB.

#### 2.1.1 Relevant legislation

15. The key pieces of GB health and safety legislation which have been referenced and which have relevance to the assessment are included within Part 6, References. Of principal significance are
- **The Health and Safety at Work etc. Act 1974**, as the primary piece of legislation covering occupational health and safety in GB, sets out general duties, qualified by the term '*so far as is reasonably practicable*'.
  - **Management of Health and Safety at Work Regulations 1999 (as amended)** makes more explicit the actions required to manage health and safety risk for every work activity, requiring, among other things, a suitable and sufficient risk assessment. It is essential that due regard be given in design to the 'General Principles of Prevention' referenced at Regulation 4 and Schedule 1 when deciding which preventive and protective measures to take.
  - **Construction (Design and Management) Regulations 2015**. The Regulations provide essential guidance on the role of the designer (from initial design concept) to eliminate, reduce or control foreseeable risks that may arise during construction work (including decommissioning), or in the use and maintenance of the building once built. It is incumbent upon the designer to ensure that their design reduces risks as low as is reasonably practicable.

#### 2.1.2 Good practice

16. Published HSE guidance is available on a wide range of health and safety subjects. This guidance assists in interpreting health and safety legal requirements, legal compliance, and offers technical advice. Following HSE guidance will normally be sufficient to achieve legal compliance, however guidance is not compulsory and duty-holders are free to take other, equivalent action.
17. Approved Codes of Practice offer practical examples of relevant good practice. They give advice on how to comply with the law by, for example, providing a guide to what is 'reasonably practicable'. For example, if regulations use words like 'suitable and sufficient', an Approved Code of Practice can illustrate what this requires in particular circumstances. Approved Codes of Practice have a special legal status.

### 2.2 Integration with other assessment topics

18. GDA requires the submission of an adequate, coherent and holistic general safety case. Regulatory assessment cannot therefore be carried out in isolation as there are often safety issues of a multi-topic or cross-cutting nature. The following cross-cutting issues have been considered within this assessment.

#### 19. Civil Engineering

A sample of civil engineering aspects of conventional health and safety during construction have been assessed in support of the assessment of conventional health

safety, with particular consideration of Hitachi-GE’s suggested open top construction methodology in the context of CDM Regulations designer responsibilities.

20. Mechanical Engineering

The assessment of mechanical engineering has included consideration of aspects of conventional health and safety. The Assessor participated in the review of the open-top construction methodology, with particular consideration to lifting operations.

21. Radiation Protection

The assessment of radiation protection has included consideration of aspects of conventional health and safety.

22. Design for Decommissioning

The assessment of design for decommissioning has included reference to integral aspects of conventional health and safety risk control measures. This topic area has not been widely explored by the conventional health and safety assessor during Step 4, however I have been consulted on key issues arising and agree with Assessment Findings AF-ABWR-D-03 and AF-ABWR-D-04.

**2.3 Sampling strategy**

23. It is seldom possible, or necessary, to assess all conventional health and safety aspects of a design, therefore sampling is used to limit the areas scrutinised, and to improve the overall efficiency of the assessment process. This assessment has been focused upon sampling of targeted topic areas of the UK ABWR design with a view to revealing any topic-specific, or generic, weaknesses in non-nuclear health and safety risk control measures.

24. The sampling strategy for this assessment was determined so as to enable targeted, structured focus on Hitachi-GE’s understanding of conventional health and safety risks arising from their UK ABWR design, and to seek assurance of their effective management within GB’s legal framework. Table 1 below sets out the items agreed with Hitachi-GE as being outside the scope of GDA.

25. Reference has been made to a selected range of relevant topics reflecting GB national strategic priority subjects (as determined by HSE as national health safety policy lead), and topics of relevance to reactor construction, operation and decommissioning.

26. Consideration has been given to Hitachi-GE’s response to design requirements of the Construction (Design and Management) Regulations 2015 (CDM) associated with the construction, use as a workplace, and decommissioning of buildings within the generic site envelope

**2.4 Out of scope items**

27. Table 1 below sets out the items agreed with Hitachi-GE as being outside GDA scope.

1.	Structures outside the generic site envelope	
2.	Site specific design	Whilst site specific design issues are referenced by Hitachi-GE, being work undertaken in parallel with Horizon Nuclear Power Limited, it is recorded that such detail is outside the scope of GDA.

### 3 REQUESTING PARTY'S SAFETY CASE

28. Conventional health and safety is not regulated as a permissioning regime; a safety case is not applicable to this assessment topic. Conventional health and safety is generally dealt with in the wider GDA, rather than within the PCSR. It is acknowledged that Hitachi-GE has made reference to conventional health and safety within selected chapters of the PCSR, for example Chapters 4; 10; and 31, however I do not propose to comment on these minor entries within this Assessment Report.
29. The Hitachi-GE conventional health and safety Step 4 submissions are detailed within the following documents:
- 29.1 UK ABWR GDA, CDM Regulations 2015 Compliance Plan for Generic Design Activities (Ref. 1.)
- 29.2 Topic Report 1: Topic Report on Option Evaluation of Construction Method (Ref.2)
- 29.3 Topic Report 2: Topic Report on Workplace Regulations (Ref. 3)
- 29.4 Topic Report 3: Topic report on Designing for Safety in Bespoke Equipment (Ref.4)
- 29.5 Topic Report 4: Topic Report on Further Development of Risk Mitigation for Step 3 Report Examples (Ref.5)
- 29.6 Topic Report 5: Topic Report on CDM 2015 Compliance (Response to RQ-ABWR-1184) (Ref.6)
- 29.7 Topic Report 6: Topic Report on CDM 2015 Compliance (Response to RQ-ABWR-1184 and 1413) (Ref.7)

### 4 ONR 4 STEP ASSESSMENT

30. This assessment has been carried out in accordance with ONR's risk-based, goal-setting and proportionate approach to conventional health and safety regulation, focussing on controlling significant risks.

#### 4.1 Scope of Assessment Undertaken

31. The sampling approach pursued evidence to test and validate compliance across selected topic areas of the following
- A clear understanding of GB health and safety regulatory requirements; of health and safety design principles contained in appropriate published national standards; and of current relevant developed standards of industry good practice for health and safety.
  - The application of the knowledge of GB health and safety regulatory requirements in the design process.
  - An understanding and application of the concept of a 'risk hierarchy' reducing risk as low as is reasonably practicable.
  - The elimination, so far as is reasonably practicable, of foreseeable risks to the health and safety of any person carrying out or liable to be affected by construction work (including decommissioning); maintaining or cleaning the UK ABWR structures; or using the said structures as a workplace.
  - The reduction of hazards and, so far as is reasonably practicable, either the elimination or the effective control of risks so as to protect the health and safety of persons.

- Competence by those persons involved in the application of health and safety skills and knowledge.

## 4.2 Assessment

32. The core of my assessment has focussed on the series of Topic Reports (Ref. 2 to Ref. 7), submitted, in accordance with planned subject sampling; close reference to the Hitachi-GE CDM Compliance Plan (Ref.1); and consideration of CDM Regulations matters arising.

### 4.2.1 Construction (Design and Management) Regulations 2015

33. The CDM Regulations confirm the role of the designer (from initial design concept) to eliminate, reduce or control foreseeable risks that may arise during construction work (including decommissioning), or in the use and maintenance of the building as a workplace once built. It is incumbent upon the designer to ensure that their design reduces risks as low as is reasonably practicable.
34. Hitachi-GE outlined their response to CDM 2015 in their CDM Compliance Plan (Ref. 1), accepting their role as designer, and in Revision 2 their role as CDM Client for the project of generic design of a UK ABWR power station for possible construction in the UK. Hitachi-GE confirmed their commitment to ensure the generic design complies with the CDM Regulations.
35. Hitachi-GE committed to the use of CDM hazard logs to record designer risk information, principally via hazard workshops to identify and review significant risks and pursue design mitigation. Hitachi-GE has provided examples to demonstrate this evidence based approach to determine and prioritise risks, where appropriate with multi-disciplinary participation (including invitations to external third party designers), with understanding of how risks are created and how they should be managed. The Plan states that designers are required to provide information to demonstrate hazard identification, elimination or reduction.
36. Hitachi-GE reference at paragraph 7.3(3) in the Compliance Plan 'insignificant risks', including risks where 'previous experience has proven that adequate controls are in place in the reference design', and risks that may be controlled by applying international and/ or British standards, however they commit to subject these areas to a documented review to ensure CDM Regulations and GB health and safety statutory compliance.
37. The hierarchy of measures to mitigate design concept risk outlined in the Compliance Plan accords with CDM 2015.
38. Hitachi-GE commit within the Compliance Plan to delivery of a programme of 'CDM Requirements for Designers' training through the design process.
39. Hitachi-GE has communicated design risk review outcomes to licensee applicant, Horizon Nuclear Power Limited, for parallel site specific work.
40. Hitachi-GE has demonstrated an awareness and understanding of the requirements of the CDM Regulations. Hitachi-GE, as CDM designer, has responsibility for justification of the appropriate assessment of foreseeable significant risks arising from both the reference design as applied to the UK ABWR design, and for any new or revised design elements, as submitted for generic design assessment. Guidance to the CDM Regulations (Ref. 9) states at paragraph 88: 'When addressing risks, a designer is expected to do as much as is reasonable at the time the design is prepared'. I consider there have been limitations on the extent of Hitachi-GE CDM design risk assessment

information available within GDA because of the aligned Hitachi-GE and licensee applicant, Horizon Nuclear Power Limited, approach of simultaneous site specific design risk assessment review. Responsibility under the CDM Regulations for the conduct of the risk review and any associated design changes arising to either eliminate, so far as is reasonably practicable, or where this is not possible to reduce or control risks pertaining to the UK ABWR generic design, and to this design's future GB application, remains with Hitachi-GE as designer.

#### 4.2.2 Option Evaluation of Construction Method

41. Topic report 1 'Topic Report on Option Evaluation of Construction Method', Ref.2, is focused upon conventional health and safety considerations with regard to construction methods, with particular reference to the novel to GB open top construction methodology, which Hitachi-GE suggest may be used as the construction method for a significant element of the facility. Open top construction allows modules fabricated off-site and construction materials to be lifted into place via an opening in a temporary roof before completing the ceiling slabs; plant installation works may then continue in parallel with adjacent construction work and building and civil works above.
42. The open top construction methodology raises questions for GB implementation including: structural stability; temporary structures; considerable significant and standard lifting operations to transfer and place modular and other loads; lifting operations including suspended loads and working arrangements in their vicinity; multiple trade contractors working in parallel in potentially restricted areas. Topic Report 1 seeks to demonstrate consideration of conventional safety issues during the planning of construction methods. The approach includes comparative assessment, with consideration of example locations, selected to represent the life cycle of the buildings, and incorporating adaptations for GB construction, including some risk mitigation measures, for example fall from height, and avoidance of work under suspended loads. The Topic Report summarised the option evaluation exercise, demonstrated awareness of relevant conventional health and safety issues, and provided examples of actions to review and reduce risk.
43. An ONR Civil Engineering Assessor participated in the Topic Report review and submitted RQ-ABWR-0898 seeking information to demonstrate the stability of the Reactor Building in temporary construction states. Hitachi-GE referenced this information as arising at site-specific design, further to site specific construction methodology determination. Explanatory drawings and calculations to demonstrate the stability of the Reactor Building in temporary construction states was not forthcoming: Section 4.2.6 below details further exploration of this subject matter.
44. An ONR Mechanical Engineering Assessor reviewed lifting operations associated with open top construction and submitted RQ-ABWR-0879, Lifting arrangements during open top construction, Ref. 17. The Hitachi-GE response, Ref. 18, largely referenced site specific resolution.
45. The open top construction method is referenced within generic design by Hitachi-GE as a construction option, presented as a construction approach with significant Japanese build experience. As a non-routine construction approach novel to GB proportionate risk information about the construction method was anticipated. The Hitachi-GE response focussed upon the approach to be adopted at the GDA stage only, as anticipated. Significant work remains to be taken forward to address hazard review and risk reduction in the detailed site specific design.
46. ONR recognises there is considerable detail to be addressed at site level in the selection of an appropriate construction method. A potential licensee in considering the open top construction approach will require considered design review to ensure CDM 2015 compliance: an Assessment Finding is raised to this effect.

### 4.2.3 Workplace Regulations

47. Hitachi-GE demonstrated appreciation of the Workplace (Health Safety and Welfare) Regulations 1992 in the design of the structure and layout of the ABWR buildings within GDA scope as they will affect workers, and in regard to the facilities provided for workers when in use as a place of work. Topic Report 2 on Workplace Regulations (Ref. 3) illustrated design reference to the Regulations in selected buildings, with examples of general standard specification, for example for walkways and work area traffic routes.

### 4.2.4 Designing for safety in bespoke equipment

48. Topic report on Designing for Safety in Bespoke Equipment (Ref. 4) demonstrated Hitachi-GE understanding of the Supply of Machinery (Safety) Regulations 2008 (as amended by the Supply of Machinery (Safety) (Amendment) Regulations 2011) and the Provision and Use of Work Equipment Regulations 1998, and provided examples of the review process pursued as a designer of bespoke work equipment to ensure hazards associated with the equipment are considered and mitigation measures incorporated, where reasonably practicable. Hitachi-GE confirmed items of work equipment are being designed and manufactured to UK/European standards with relevant CE marking.

### 4.2.5 Further development of risk mitigation for Step 3 report examples

49. Topic Report 4 (Ref. 5) confirms further refinement and development of Step 3 risk mitigation examples, with evidence of more detailed effective assessment of design health and safety risk reduction having been progressed across a range of equipment and work locations with relevance for all stages of the life cycle of the plant.
50. Design hazard data has been recorded (CDM Compliance Plan – Ref. 1), for reference in ongoing mitigation.
51. The presented examples illustrate an appreciation of the concept of reducing risk as low as is reasonably practicable, in that the nature of the hazard arising has been identified; measures taken to explore the extent of the risk; and consideration of potential control measures to be adopted presented. Reference to relevant GB health and safety legislation is evident, for example in matters arising from manual handling, work at height, occupational health, and confined spaces. The concept of reasonably foreseeable risk as a cause of harm is understood, encompassing reasonably foreseeable events and behaviours, and has been applied to the risk review. There is indication of effort to undertake an integrated overview, within the constraints of a generic design concept, lacking final (and site specific) design and procurement detail – and this is acknowledged. Control measures vary from the relatively straightforward, for example using maximum lengths of piping spool and adaptations to wide and small bore pipe support design to reduce on-site welding within tunnels, to access arrangements within the fuel handling machine, in the ongoing exploration of design solutions to address significant hazards. I make these observations in regard to the wider approach to risk assessment. There is considerable further work to be undertaken to refine design and risk control measures.

### 4.2.6 CDM 2015 Compliance: Response to RQ-ABWR-1184 and to RQ-ABWR-1413

52. RQ-ABWR-1184 Construction (Design and Management) Regulations 2015 Regulation 9 Designer duties, (Ref. 15), was issued to Hitachi-GE to seek further CDM designer compliance assurance in that the response received to RQ-ABWR-0898 (Ref. 14), did not provide explanatory drawings and calculations to demonstrate the stability of the Reactor Building in temporary construction states, and further to cross-cutting civil engineering and decommissioning topic discussion.



53. Hitachi-GE produced Topic Report 5: Topic Report on CDM 2015 Compliance (Response to RQ-ABWR-1184) (Ref. 6). This Report provided evidence to demonstrate that CDM compliance is embedded within the design process. It references the CDM Compliance Plan (Ref. 1) and use of hazard logs to document design review for significant or unusual hazardous construction, operation, maintenance and decommissioning work activities, arising from hazard or optioneering workshops.
54. Hitachi-GE state the CDM Compliance Plan was developed in consultation with licensee applicant, Horizon Nuclear Power Limited, to provide continuity with site specific design risk management. A distinction is drawn between GDA hazard log documentation and site specific risk management which does not relate to the generic design.
55. Expanded examples are provided to illustrate the range of work undertaken and the hazard log outputs. Particular reference was made to example 6.3 'Reactor Building Construction' in the Topic Report (Ref. 6). Hitachi-GE reference a hazard workshop to review an assumed general construction sequence with hazard log output in Appendix B.7. Item 16 references structural stability of the 'Wall construction above operating floor level, external walls'. This item was selected for closer review with consideration to RQ-ABWR-1413.
56. RQ-ABWR-1413, 'UK ABWR - Construction (Design and Management) Regulations 2015 – structural stability - wall construction above operating floor level', (Ref. 16) was issued requesting evidence that stability of the external walls above operating floor level during the construction phase had been considered and that designer information on the construction method was available. The RQ was intent on seeking confirmation that adequate designer information be available where a suggested construction method is cited, for example open top construction, to control associated significant build risks, such as reactor wall stability.
57. Topic Report on CDM 2015 Compliance (Response to RQ-ABWR-1184 and 1413), Rev.1, (Ref.7), Appendices A5 and A8, contained sufficient information to address temporary stability during construction of the Reactor Building walls as detailed in RQ-ABWR-1413 (Ref.16). It is acknowledged this information is included with advice to future constructors in the associated hazard log.
58. Overall the submissions contained relevant and adequate detail.

#### **4.3 Comparison with standards, guidance and relevant good practice**

59. Hitachi-GE has demonstrated an awareness of and reference to GB relevant statutory health and safety provisions, guidance and relevant good practice, as referenced within this report and across the multiple Topic Report submissions.

#### **4.4 Assessment findings**

60. During my assessment a residual matter was identified for a future licensee to take forward in their site-specific safety submissions. Details of this Assessment Finding are contained in Annex 2.
61. These matters do not undermine the generic safety submission and are primarily concerned with the provision of site specific safety case evidence, which will usually become available as the project progresses through the detailed design, construction and commissioning stages. These items are captured as assessment findings.
62. I have recorded residual matters as assessment findings if one or more of the following apply:

- site specific information is required to resolve this matter;
- resolving this matter depends on licensee design choices
- the matter raised is related to operator specific features / aspects / choices;
- the resolution of this matter requires licensee choices on organisational matters;
- to resolve this matter the plant needs to be at some stage of construction / commissioning.

63. Assessment Findings are residual matters that must be addressed by the Licensee and the progress of this will be monitored by the regulator.

## 5 CONCLUSIONS

64. This report presents the findings of my Step 4 Conventional Health and Safety assessment of the Hitachi-GE UK ABWR.

65. To conclude, I am satisfied with the claims, arguments and evidence laid down within the PCSR and supporting documentation for Conventional Health and Safety. I consider that from a Conventional Health and Safety view point, the Hitachi-GE UK ABWR design is suitable for construction in the UK.

66. An Assessment Finding (Annex 2) was identified; this is for future licensees to consider and take forward in their site-specific safety submissions. These matters do not undermine the generic safety submission and require licensee input/decision.

### 5.1 Key Findings from the Step 4 Assessment

I consider that from a Conventional Health and Safety view point, the UK ABWR design is suitable for construction in the UK at this present time.

## 6 REFERENCES

- Ref. 1 UK ABWR GDA, CDM Regulations 2015 Compliance Plan for Generic Design Activities, XE-GD-0265, Rev. 2, Hitachi-GE Nuclear Energy Ltd., 25 March 2016. TRIM Ref.: 2016/133406
- Ref. 2 Topic Report 1: Topic Report on Option Evaluation of Construction Method, XE-GD-0569, Rev. 0, Hitachi-GE Nuclear Energy Ltd., 30 March 2016. TRIM Ref.: 2016/136787
- Ref. 3 Topic Report 2: Topic Report on Workplace Regulations, XE-GD-0580, Rev. 0, Hitachi-GE Nuclear Energy Ltd., 30 May 2016. TRIM Ref.: 2016/220306
- Ref.4 Topic Report 3: Topic report on Designing for Safety in Bespoke Equipment, XE-GD-0609, Rev.0, Hitachi-GE Nuclear Energy Ltd., 30 August 2016. TRIM Ref.: 2016/343682
- Ref. 5 Topic Report 4: Topic Report on Further Development of Risk Mitigation for Step 3 Report Examples, XE-GD-0661, Rev. 0, Hitachi-GE Nuclear Energy Ltd., 28 October 2016. TRIM Ref.:2016/418942
- Ref. 6 Topic Report 5: Topic Report on CDM 2015 Compliance (Response to RQ-ABWR-1184), Rev.0, XE-GD-0706, Hitachi-GE Nuclear Energy Ltd., 31 May 2017. TRIM Ref.: 2017/83798



- Ref. 7 Topic Report 6: Topic Report on CDM 2015 Compliance (Response to RQ-ABWR-1184 and 1413), Rev.1, XE-GD-0706, Hitachi-GE Nuclear Energy Ltd., 28 Feb. 2017. TRIM Ref.: 2017/211434
- Ref. 8 Construction (Design and Management) Regulations 2015
- Ref. 9 HSE publication L153, published 2015, 'Managing health and safety in construction'
- Ref.10 ONR Step 4 Assessment Plan for Conventional Health and Safety, TRIM Ref.: 2015/418791
- Ref. 11 Health and Safety at Work etc. Act 1974
- Ref. 12 Management of Health and Safety at Work Regulations
- Ref. 13 HSE Publication 'Reducing risks, protecting people: HSE's decision making process' 2001 ISBN 0 7176 2151 0
- Ref. 14 RQ-ABWR-0898, Reactor building construction method statement, TRIM Ref.: 2016/199844
- Ref. 15 RQ-ABWR-1184, Construction (Design and Management) Regulations 2015 Regulation 9 Designer duties, TRIM Ref.: 2016/456460
- Ref. 16 RQ-ABWR-1413, UK ABWR - Construction (Design and Management) Regulations 2015 – structural stability - wall construction above operating floor level, TRIM Ref.: 2017/143227
- Ref. 17 RQ-ABWR-0879, Lifting arrangements during open top construction, TRIM Ref.: 2016/196555
- Ref. 18 Response to RQ-ABWR-0879, Rev.0, KE-GD-0121 (Lifting arrangements during open top construction), Hitachi-GE Nuclear Energy Ltd., 01 August 2016, TRIM Ref.: 2016/305379
- Ref. 19 Relevant GB Health and Safety Legislation includes
- Ref. 19.1 The Health and Safety at Work etc. Act 1974
- Ref. 19.2 Management of Health and Safety at Work Regulations 1999 (as amended)
- Ref. 19.3 Work at Height Regulations 2005
- Ref. 19.4 Control of Substances Hazardous to Health Regulations 2002
- Ref. 19.5 Lifting Operations and Lifting Equipment Regulations 1998
- Ref. 19.6 Workplace (Health, Safety and Welfare) Regulations 1992
- Ref. 19.7 Confined Spaces Regulations 1997
- Ref. 19.8 Provision and Use of Work Equipment Regulations 1998
- Ref. 19.9 Supply of Machinery (Safety) Regulations 2008, as amended by the Supply of Machinery (Safety) (Amendment) Regulations 2011.
- Ref. 19.10 Manual Handling Operations Regulations 1992

- Ref. 19.11 Control of Noise at Work Regulations 2005
- Ref. 19.12 Control of Vibration at Work Regulations 2005
- Ref. 19.13 Electricity at Work Regulations 1989
- Ref. 19.14 Dangerous Substances and Explosive Atmospheres Regulations 2002
- Ref. 19.15 Pressure Systems Safety Regulations 2000

## Annex 1

### National and International Standards and Guidance

#### National and International Standards and Guidance

1. *Reducing Risks: Protecting People. HSE's decision-making process. HSE Books 2001 ISBN 0 7176 2151 0*  
[www.hse.gov.uk/risk/theory/r2p2.pdf](http://www.hse.gov.uk/risk/theory/r2p2.pdf)
2. *Workplace health, safety and welfare. Workplace (Health, Safety and Welfare) Regulations 1992. Approved Code of Practice L24 (Second edition) HSE Books 2013 ISBN 978 0 7176 6583 9* [www.hse.gov.uk/pubns/books/l24.htm](http://www.hse.gov.uk/pubns/books/l24.htm)
3. *Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance L22. (Fourth edition) HSE Books 2014 ISBN 978 0 7176 6619 5* [www.hse.gov.uk/pubns/priced/l22.pdf](http://www.hse.gov.uk/pubns/priced/l22.pdf)
4. *Safe use of lifting equipment. Lifting Operations and Lifting Equipment Regulations 1998. Approved Code of Practice and guidance L113* [www.hse.gov.uk/pubns/books/l113.htm](http://www.hse.gov.uk/pubns/books/l113.htm)
5. *Safe work in confined spaces. Confined Spaces Regulations 1997. Approved Code of Practice, Regulations and guidance L101 (Third edition) HSE Books 2014 ISBN 978 0 7176 6622 5* [www.hse.gov.uk/pubns/books/l101.htm](http://www.hse.gov.uk/pubns/books/l101.htm)
6. *Working at height: A brief guide Leaflet INDG401(rev2) HSE Books 2014* [www.hse.gov.uk/pubns/indg401.htm](http://www.hse.gov.uk/pubns/indg401.htm)
7. *Safety of pressure systems: Pressure Systems Safety Regulations 2000. Approved Code of Practice L122 (Second edition) HSE Books 2014 ISBN 978 0 7176 6644 7* <http://www.hse.gov.uk/pubns/books/l122.htm>
8. *Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance L138 (Second edition) HSE Books 2013 ISBN 978 0 7176 6616 4* [www.hse.gov.uk/pubns/priced/l138.pdf](http://www.hse.gov.uk/pubns/priced/l138.pdf)
9. *Control of substances hazardous to health (COSHH). The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Code of Practice and guidance L5 (Sixth edition) HSE Books 2013 ISBN 978 0 7176 6582 2*

[www.hse.gov.uk/pubns/books/l5.htm](http://www.hse.gov.uk/pubns/books/l5.htm)

## Annex 2

### Assessment Findings

Assessment Finding Number	Assessment Finding	Report Section Reference
AF-ABWR-CH-01.	Hitachi-GE as a designer under the Construction (Design and Management) Regulations 2015 has provided limited information in their UK ABWR generic design to demonstrate the conventional health and safety risks arising from the suggested open top method of construction have been reduced as low as is reasonably practicable. As the open top construction methodology is novel within the context of the GB high hazard construction industry the licensee shall carry out a site-specific design review using the available Hitachi-GE information as a baseline.	Executive Summary Assessment para 4.2.2.