Office for Nuclear Regulation

**New Reactors Division – Generic Design Assessment**

# Step 4 Assessment of Conventional Health and Safety for the UK HPR1000 Reactor

Assessment Report ONR-NR-AR-21-009
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## EXECUTIVE SUMMARY

This report presents the findings of my assessment of the Conventional Health and Safety aspects of the UK HPR1000 reactor design undertaken as part of the Office for Nuclear Regulation (ONR) Generic Design Assessment (GDA). My assessment was carried out using the Pre-Construction Safety Report (PCSR) and supporting documentation submitted by the Requesting Party (RP).

The objective of my assessment was to make a judgement, from a Conventional Health and Safety perspective, on whether the generic UK HPR1000 design could be built and operated in Great Britain in a way that is acceptably safe and secure (subject to site specific assessment and licensing), as an input into ONR's overall decision on whether to grant a Design Acceptance Confirmation (DAC).

The scope of my GDA assessment was to review the safety aspects of the generic UK HPR1000 design by examining the claims, arguments and supporting evidence in the safety case. My GDA Step 4 assessment built upon the work undertaken in GDA Steps 2 and 3 and enabled a judgement to be made on the adequacy of the Conventional Health and Safety information contained within the PCSR and supporting documentation.

My assessment focussed on the following aspects of the generic UK HPR1000 safety case:

- Whether the RP is developing the generic UK HPR1000 design using a robust design process which demonstrates sufficient understanding and appreciation of GB conventional health and safety legal requirements and the principles of As Low As Reasonably Practicable (ALARP).
- Whether the RP is developing the generic UK HPR1000 design using a robust design process which identifies and incorporates Relevant Good Practice (RGP).
- Identifying as to whether the RP is applying the General Principles of Prevention (GPP) and Eliminate, Reduce, Isolate, Control (ERIC) Principles when preparing or modifying the generic UK HPR1000 GDA design.
- Whether the generic UK HPR1000 design is being designed to eliminate, reduce, isolate or control the conventional health and safety risks to workers and the public that may arise during the construction, commissioning, operation, maintenance, and decommissioning of the nuclear power plant to ALARP.

The conclusions from my assessment are:

- I am satisfied that the RP has demonstrated sufficient appreciation, understanding and application of GB conventional health and safety legal requirements to meet relevant GB statutory expectations whilst undertaking the UK HPR1000 design.
- The RP has developed a Construction Design Management Strategy and procedure which requires the application of the GPP and ERIC principles during the design of the UK HPR1000.
- The evidence supplied by the RP has demonstrated the application of the GPP and ERIC Principles during design work.
- Where possible within the generic UK HPR1000 design conventional health and safety risks have been reduced to ALARP.
- Where residual hazards and risks remain, which cannot be fully addressed within the generic GDA design, they have been systematically recorded to ensure they can be effectively communicated and considered during future design work.

These conclusions are based upon the following factors:

- A detailed and in-depth technical assessment, on a sampling basis, of the full scope of safety submissions at all levels of the hierarchy of the generic safety case documentation.
- Detailed technical interactions on many occasions with the RP, alongside the assessment of the responses to the substantial number of Regulatory Queries (RQs) and Regulatory Observations (ROs) raised during the GDA.

Overall, based on my assessment undertaken in accordance with ONR's procedures, the claims, arguments, and evidence laid down within the PCSR and supporting documentation submitted as part of the GDA process present an adequate safety case for the generic UK HPR1000 design. I can recommend that from a Conventional Health and Safety perspective a DAC may be granted for the generic UK HPR1000 design.

## LIST OF ABBREVIATIONS

| | |
|---|---|
| ALARP | As Low As Reasonably Practicable |
| ACoP | Approved Code of Practice |
| BIM | Building Information Modelling |
| BRB | Bradwell B |
| BSI | British Standards Institution |
| CAE | Claims-Arguments-Evidence |
| CDM 2015 | Construction (Design and Management) Regulations 2015 |
| DAC | Design Acceptance Confirmation |
| DSEAR | Dangerous Substances and Explosive Atmospheres Regulations 2002 |
| DMGL | Delivery Management Group Lead |
| DRR | Design Risk Register |
| EMIT | Examination. Maintenance, Inspection and Testing |
| ERIC | Eliminate, Reduce, Isolate, Control |
| GDA | Generic Design Assessment |
| GPP | General Principles of Prevention |
| GNSL | General Nuclear System Ltd. |
| HOW2 | (ONR) Business Management System |
| HSE | Health and Safety Executive |
| iDAC | Interim Design Acceptance Confirmation |
| JPO | (Regulators') Joint Programme Office |
| MHL | Master Hazard Log |
| NPP | Nuclear Power Plant |
| ONR | Office for Nuclear Regulation |
| PCSR | Pre-construction Safety Report |
| RCP | Reactor Coolant Pumps |
| RPV | Reactor Pressure Vessel |
| RGP | Relevant Good Practice |
| RO | Regulatory Observation |
| RP | Requesting Party |
| RSP | Relevant Statutory Provisions |
| RQ | Regulatory Query |
| SAP(s) | Safety Assessment Principle(s) |
| SFAIRP | So Far As Is Reasonably Practicable |
| SoDA | (Environment Agency's) Statement of Design Acceptability |
| SQEP | Suitably Qualified and Experienced Personnel |
| SG | Steam Generator |

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|---|---|
| TAG | Technical Assessment Guide(s) |
| TSC | Technical Support Contractor |
| WAHR | Work at Height Regulations 2005 |

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## Annex(es)

# 1 INTRODUCTION

## 1.1 Background

1. This report presents my assessment conducted as part of the Office for Nuclear Regulation (ONR) Generic Design Assessment (GDA) for the generic UK HPR1000 design within the topic of Conventional Health and Safety.

2. The UK HPR1000 is a pressurised water reactor (PWR) design proposed for deployment in the UK. General Nuclear System Ltd (GNSL) is a UK-registered company that was established to implement the GDA on the generic UK HPR1000 design on behalf of three joint requesting parties (RP), i.e. China General Nuclear Power Corporation (CGN), EDF SA and General Nuclear International Ltd (GNI).

3. GDA is a process undertaken jointly by the ONR and the Environment Agency. Information on the GDA process is provided in a series of documents published on the joint regulators' website (www.onr.org.uk/new-reactors/index.htm). The outcome from the GDA process sought by the RP is a Design Acceptance Confirmation (DAC) for ONR and a Statement of Design Acceptability (SoDA) from the Environment Agency.

4. The GDA for the generic UK HPR1000 design followed a step-wise approach in a claims-argument-evidence hierarchy which commenced in 2017. Major technical interactions started in Step 2 of GDA which focussed on an examination of the main claims made by the RP for the generic UK HPR1000 design. In Step 3 of GDA, the arguments which underpin those claims were examined. The GDA Step 2 reports for individual technical areas, and the summary reports for Steps 2 and 3 of GDA are published on the joint regulators' website. The objective of Step 4 of GDA was to complete an in-depth assessment of the evidence presented by the RP to support and form the basis of the safety and security cases.

5. The full range of items that form part of my assessment is provided in ONR's GDA Guidance to Requesting Parties (Ref. 1). These include:

   - Consideration of issues identified during the earlier Step 2 and 3 of GDA assessments.
   - Judging as to whether the proposed design ensures risks are As Low As Reasonably Practicable (ALARP).
   - Reviewing details of the RP's design controls and quality control arrangements to secure compliance with the design intent.
   - Assessing arrangements for ensuring and assuring that safety claims and assumptions will be realised in the final as-built design.
   - Resolution of identified nuclear safety and security issues, or identifying paths for resolution

6. The purpose of this report is therefore to summarise my assessment of the Conventional Health and Safety topic which provides an input to the ONR decision on whether to grant a DAC, or otherwise. This assessment was focused on the submissions made by the RP throughout GDA, including those provided in response to the Regulatory Queries (RQs) and Regulatory Observations (ROs) I raised or was involved in assessing. Any Regulatory Issues and Regulatory Observations issued to the RP are published on the GDA's joint regulators' website, together with the corresponding resolution plans.

## 1.2 Scope of this Report

7. This report presents the findings of my assessment of the Conventional Health and Safety of the generic UK HPR1000 design undertaken as part of GDA. I carried out my assessment using the Pre-construction Safety Report (PCSR) (Ref. 2) and supporting documentation submitted by the RP. My assessment was focussed on considering whether the generic safety case provides an adequate justification for the generic UK HPR1000 design, in line with the objectives for GDA.

## 1.3 Methodology

8. The methodology for my assessment follows ONR's guidance on the mechanics of assessment, NS-TAST-GD-096 (Ref. 3).

9. My assessment was undertaken in accordance with the requirements of ONR's How2 Business Management System (BMS). The outputs from my assessment are consistent with ONR's GDA Guidance to RPs (Ref. 1).

10. I assessed the generic UK HPR1000 design by sampling several topics which feature within the design. These topic areas were the subject of review and challenge by ONR. The response of the RP in respect of each topic was compared against compliance with Great Britain (GB) regulatory expectations.

11. I assessed the safety case against relevant GB health and safety legislation. This included the Health and Safety at Work etc. Act 1974 (HSWA) (Ref. 4) and other Relevant Statutory Provisions (RSPs) made under the HSWA. Where applicable I also considered Approved Codes of Practice (ACoPs), Relevant Good Practice (RGP) and other relevant guidance which are referenced throughout this assessment report.

# 2 ASSESSMENT STRATEGY

12. The strategy for my assessment of the Conventional Health and Safety aspects of the generic UK HPR1000 design and safety case is set out in this section. This identifies the scope of the assessment and the standards and criteria that have been applied.

## 2.1 Assessment Scope

13. A detailed description of my approach to this assessment can be found in my GDA Step 4 assessment plan (Ref. 5).

14. I considered all the main submissions within the remit of my assessment scope, to various degrees of breadth and depth. I chose to concentrate my assessment on those aspects that I judged to have the greatest safety significance, or where the hazards appeared least well controlled. My assessment was also influenced by the claims made by the RP, my previous experience of similar systems for reactors and other nuclear facilities, and any identified gaps in the original submissions made by the RP. A particular focus of my assessment has been the RQs I raised as a result of my on-going assessment, and the resolution thereof.

## 2.2 Sampling Strategy

15. In line with ONR's GDA Guidance to Requesting Parties, I chose a sample of the RP's submissions to undertake my assessment. The GDA Step 4 assessment plan of conventional health and safety (Ref. 5) outlines the main themes considered which are as follows:

- I assessed the RP's compliance with the requirements of the Work at Height Regulations 2005 (Ref. 6) in the development of the generic UK HPR1000 design, with reference to UK HPR1000 GDA Ladder / Access Strategy (Ref. 7).
- I assessed the RP's design methodology approach to risk management during design, including risk reduction through the implementation and development of design risk registers (DRRs). I examined appropriate reference to RGP to support hazard elimination, reduction, and control; DRR outcome development in accordance with UK statutory requirements; DRR visibility in a multi-disciplinary / cross cutting context, and; preparation of DRR output for future integration into the UK HPR1000 3D model. I also focussed my assessment on the monitoring and assurance review function of the CDM Principal Designer.
- I assessed the consideration of constructability in the development of the generic UK HPR1000 design via assessment of two construction-orientated examples. I reviewed the RP's integration of existing construction knowledge into the design and assessed how risk elimination, reduction or control had been undertaken to comply with UK relevant statutory provisions (RSPs).
- I assessed the RP's consideration and application of the requirements of the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (Ref. 8) in the generic design of the UK HPR1000, to ensure the protection of workers from fire and explosion risks relating to dangerous substances and potentially explosive atmospheres which it is known will be or are liable to be present in the workplace.

## 2.3 Out of Scope Items

16. The following were outside the scope of my assessment.

- Any issues relating to a potential construction site location which require additional design work bespoke to that location following the completion of GDA.

## 2.4 Standards and Criteria

17. The relevant standards and criteria adopted within this assessment are principally GB health and safety legislation, relevant national and international standards, and RGP informed from existing practices adopted on nuclear licensed sites in GB. The key GB health and safety legislation, national and international standards and guidance are detailed within this section. RGP, where applicable, is cited within the body of the assessment.

### 2.4.1 Safety Assessment Principles

18. The Safety Assessment Principles (Ref. 9) are used to guide the assessment of proposed new nuclear facility designs. They constitute the regulatory principles against which ONR judges the adequacy of the design. The SAPs listed below have been considered during the Conventional Health and Safety assessment where applicable:

- FP: Fundamental principles
- SC: Safety cases

### 2.4.2 Technical Assessment Guides

19. The following Technical Assessment Guides were used as part of this assessment:

- NS-TAST-GD-051, The Purpose, Scope and Content of Nuclear Safety Cases (Ref. 10)
- NS-TAST-GD-005, ONR Guidance on the Demonstration of ALARP (Ref. 11)

### 2.4.3 National and International Standards and Guidance

20. The standards that I have used to judge the adequacy of the RP's submission in Conventional Health and Safety have consisted of GB legal requirements, European Regulation, Approved Codes of Practice, Health and Safety Executive (HSE) guidance and relevant British Standards.

21. The following RSPs, ACoPs and RGP were used as part of this assessment:

- Health and Safety at Work (etc.) Act 1974 (Ref. 4)
- Management of Health and Safety at Work Regulations 1999 (Ref. 12)
- Construction (Design and Management) Regulations 2015 (Ref. 13)
- Work at Height Regulations 2005 (Ref. 6)
- Dangerous Substances and Explosive Atmospheres Regulation 2002 (Ref. 8)
- The Confined Spaces Regulations 1997 (Ref. 14)
- The Pressure Systems Safety Regulations 2000 (Ref. 15)
- Lifting Operations and Lifting Equipment Regulations 1998 (Ref. 16)
- Provision and Use of Work Equipment Regulations 1998 (Ref. 17)
- European Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances (Ref. 18)
- Safe use of lifting equipment. Lifting Operations and Lifting Equipment Regulations 1998. Approved Code of Practice and guidance. L113 (Ref. 19)
- Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance. L138 (Second edition) (Ref. 20)
- Managing health and safety in construction: Construction (Design and Management) Regulations 2015: Guidance on Regulations. L153 (Ref. 21)
- Safe work in confined spaces. Confined Spaces Regulations1997. Approved Code of Practice and guidance. L101 (Ref. 22)
- BS 5975:2019 Code of practice for temporary works procedures and the permissible stress design of falsework. (Ref. 23)

- BS 7121-1:2016 Code of practice for safe use of cranes – Part 1: General (Ref. 24)
- BS 7121-2-7:2012+A1:2015 Code of practice for the safe use of cranes – Part 2-7: Inspection, maintenance and thorough examination – Overhead travelling cranes, including portal and semi-portal cranes, hoists, and their supporting structures' (Ref. 25)

## 2.5 Use of Technical Support Contractors

22. I did not utilise any Technical Support Contractors to assist with my assessment.

## 2.6 Integration with Other Assessment Topics

23. GDA requires the submission of an adequate, coherent, and holistic generic safety case. Regulatory assessment cannot be carried out in isolation as there are often issues that span multiple disciplines. I have therefore worked closely with a number of other ONR Specialisms to inform my assessment. The key interactions were:

- The Mechanical Engineering inspector took the lead regarding the RP's approach to the design of nuclear lifting operations in the spent fuel building. I worked closely with them when considering access strategies to enable Examination, Maintenance, Inspection, and Testing (EMIT) of cranes and repair following breakdown.
- The Civil Engineering inspector considered health and safety and construction aspects relating to the civil engineering design during interactions with the RP. I provided support relating to Conventional Health and Safety during this aspect of their assessment.

# 3 REQUESTING PARTY'S SAFETY CASE

## 3.1 Introduction to the Generic UK HPR1000 Design

24. The generic UK HPR1000 design is described in detail in the PCSR. It is a three-loop PWR designed by CGN using Chinese Hualong technology. The generic UK HPR1000 design has evolved from reactors which have been constructed and operated in China since the late 1980s, including the M310 design used at Daya Bay and Ling'ao (Units 1 and 2), the CPR1000, the CPR1000$^{+}$ and the more recent ACPR1000. The first two units of CGN's HPR1000, Fangchenggang Nuclear Power Plant (NPP) Units 3 and 4, are under construction in China and Unit 3 is the reference plant for the generic UK HPR1000 design. The design is claimed to have a lifetime of at least 60 years and has a nominal electric output of 1,180 MW.

25. The reactor core contains zirconium clad uranium dioxide ($UO_2$) fuel assemblies and reactivity is controlled by a combination of control rods, soluble boron in the coolant and burnable poisons within the fuel. The core is contained within a steel Reactor Pressure Vessel (RPV) which is connected to the key primary circuit components, including the Reactor Coolant Pumps (RCP), Steam Generators (SG), pressuriser and associated piping, in the three-loop configuration. The design also includes a number of auxiliary systems that allow normal operation of the plant, as well as active and passive safety systems to provide protection in the case of faults, all contained within a number of dedicated buildings.

26. The reactor building houses the reactor and primary circuit and is based on a double-walled containment with a large free volume. Three separate safeguard buildings surround the reactor building and house key safety systems and the main control room. The fuel building is also adjacent to the reactor and contains the fuel handling and short-term storage facilities. Finally, the nuclear auxiliary building contains a number of systems that support operation of the reactor. In combination with the diesel, personnel access, and equipment access buildings, these constitute the nuclear island for the generic UK HPR1000 design.

## 3.2 The Generic UK HPR1000 Safety Case

27. In this section I provide an overview of the Conventional Health and Safety aspects of the generic UK HPR1000 safety case as provided by the RP during GDA. Details of the technical content of the documentation and my assessment of its adequacy are reported in the subsequent sections of my report.

28. The RP submitted a PCSR and supporting references which outline the nuclear safety case for the generic UK HPR1000 design. Chapter 25 of the document covers conventional health and safety, and it aims to demonstrate how compliance with GB legal requirements will be achieved. This was supplemented by further submissions, including topic reports and responses to my regulatory queries as my assessment continued.

29. The fundamental objective of the generic UK HPR1000 safety case is to demonstrate that:

- The generic UK HPR1000 could be constructed, operated, and decommissioned in the UK on a site bounded by the generic site envelope in a way that is safe, secure and that protects people and the environment.

30. The safety case presented by the RP in respect of Conventional Health and Safety was captured by a series of claims and sub-claims contained in Chapter 25 of the PCSR which underpin the overarching objective:

- "Claim 2: The generic UK HPR1000 design will be developed in an evolutionary manner, using a robust design process, building on relevant good international practice, to achieve a strong safety and environmental performance."
- "Claim 2.4: General Principles of Prevention (GPP) and Eliminate, Reduce, Isolate, Control (ERIC) Principles are in place to ensure the design meets the Environmental Protection, Security and Conventional Safety Objective."
- "Claim 4: The design and intended construction and operation of the UK HPR1000 will be developed to reduce, so far as is reasonably practicable, the health and safety risks to the workers and the public, and the impact on the environment."
- "Claim 4.2: Conventional safety and conventional fire risks are managed to ensure that the conventional health and safety risks, and fire safety risks to workers and the public are reduced so far as is reasonably practicable."

31. To support claims 2.4 and 4.2 a sub-claim along with relevant arguments and supporting evidence has been developed:

- "Sub-claim 4.2.SC25.1: The design of the UK HPR1000 is being developed to eliminate, reduce, isolate or control, so far as is reasonably practicable, the conventional health and safety risks to workers and the public that may arise during the construction, commissioning, operation, maintenance, and decommissioning of the NPP."
- "Argument 4.2.SC25.1-A1: The design teams of this project, including internal designers and external designers, have the skills, knowledge, experience and the organisational capability. The skills, knowledge and experience of project participants are being assessed and recorded. There is a commitment to develop the knowledge of key internal staff to provide conventional health and safety guidance and advice to the design teams when it is required."
- "Argument 4.2.SC25.1-A2: Suitable design management arrangements with regards to conventional health and safety for this project are in place and have been communicated to all participants. These arrangements include processes and procedures for design risk management and competence assessment that provide guidance to the Construction (Design and Management) (CDM) duty holders to help them deliver the outcome stated in the high-level claim."
- "Argument 4.2.SC25.1-A3: The implementation of the management arrangements is being monitored, inspected, audited and reviewed at an agreed frequency, based on risk. Any corrective action required is being documented and closed."
- "Argument 4.2.SC25.1-A4: The information about the health and safety risks is provided and communicated to all relevant parties and suitable and sufficient health and safety advice relative to the risks is provided to all relevant parties."
- "Argument 4.2.SC25.1-A5: Designers have complied with CDM regulations 2015 Regulation 9 (Designers Duties) when they prepare the design of the UK HPR1000."

32. The evidence that has formed the basis for my assessment consists of a hierarchy of documentation which is described below:

- The 'Pre-Construction Safety Report Chapter 25 Conventional Safety and Fire Safety, HPR/GDA/PCSR/0025, Rev 001' provides information to demonstrate how the generic UK HPR1000 design is compliant with GB legal requirements and RGP. The document introduces applicable codes and standards and explains how the RP has implemented UK legislation through the 'Construction

Design Management Strategy HPR-GDA-REPO-0057, Rev 002' (Ref. 26) and the 'CDM Design Risk Management Work Instruction HPR-GDA-PROC-0114, Rev 002' (Ref. 27).

- The 'Construction Design Management Strategy HPR-GDA-REPO-0057, Rev 002' explains how the UK HPR1000 project intends to comply with the requirements of CDM 2015.
- The purpose of the 'CDM Design Risk Management Work Instruction HPR-GDA-PROC-0114, Rev 002' is to establish how the requirements of the Construction (Design and Management) Regulations 2015 will be fulfilled by designers and the Principal Designer. The methodology explained in the document applies to all design work relating to construction, operation, maintenance, and demolition work.
- A requirement of the CDM Design Risk Management Work Instruction is that a Design Risk Register (DRR) must be produced for each design package to record the design risk management process. In total a suite of 78 DRR's have been produced.
- The CDM Design Risk Management Work Instruction additionally requires the development of a Master Hazard Log, to support the ongoing monitoring of hazards and design mitigation. It is used to collate significant hazards and risks compiled from DRR entries.
- In response to the GDA Step 4 Assessment Plan of Conventional Health and Safety for the UK HPR1000 Reactor the RP provided the following submissions:
    - Constructability Optimisation of Fuel Building and External Containment GHX00100092DOHB03GN Rev B (Ref. 28)
    - Ladder Strategy GHX00100087DOHB03GN Rev B (Ref. 7)
    - Ladder Strategy Examples Report GHX00100088DOHB03GN Rev B (Ref. 29)
    - Dangerous Substances and Explosive Atmospheres Topic Report GHX00100090DOHB03GN Rev B (Ref. 30)
    - Strategy for Integrating DRR Information with 3D Model GHX00100091DOHB03GN Rev B (Ref. 31)
- Additionally, two Regulatory Observations were raised which required Conventional Health and Safety input into their resolution which I have addressed in my assessment:
    - Spent Fuel Building – Design of Nuclear Lifting Operations to Demonstrate Relevant risks are reduced to ALARP, RO-UKHPR1000-0014 (Ref. 32)
    - Fuel Route Safety Case, RO-UKHPR1000-0056 (Ref. 32)

# 4 ONR ASSESSMENT

## 4.1 Structure of Assessment Undertaken

33. This assessment has been carried out in accordance with ONR's approach to regulating GB safety legal requirements, focussing on controlling significant risks.

34. In line with ONR's guidance on mechanics of assessment (Ref. 3) I have sampled a selection of information which forms part of the RP's generic safety case for the UK HPR1000 design. I have focussed on matters which I have judged to be the most safety significant, where significant design or safety case changes may be needed, or where there was the potential for a major issue that could influence whether ONR would issue a DAC. I also followed up items addressed in my 'GDA Step 3 Assessment of Conventional Health and Safety for the UK HPR1000 Reactor' (Ref. 33) which required further attention.

35. Based upon the assessment scope contained within my GDA Step 4 assessment plan, I have focussed on the following topics:

- Work at height
- Design Risk Register (DRR)
- Constructability
- Dangerous Substances and Explosive Atmospheres Regulations (2002)

36. I have considered each of these topics in turn in the following sections.

37. In addition to my initial planned assessment scope, I was involved in the assessment of the RP's response to RO-UKHPR1000-0014 and RO-UKHPR1000-0056 to judge whether the RP had adequately addressed Conventional Health and Safety hazards associated with lifting operations and the fuel route in the Fuel Building (BFX). These are also considered in separate sections.

38. Finally, I assessed whether it had been demonstrated that relevant risks have been reduced to ALARP and considered the consolidated safety case.

## 4.2 Working at Height

### 4.2.1 Assessment

39. My assessment of work at height has explored the RP's ability to develop the generic UK HPR1000 design against GB legal requirements. In doing so the RP is required to identify key hazards relating to work at height during the design phase and address them by eliminating, reducing or controlling foreseeable risks during development of the design, so far as is reasonably practicable.

40. The key pieces of legislation that have informed my judgements are:

- Health and Safety at Work etc. Act 1974 (Ref. 4)
- Construction (Design and Management) Regulations 2015 (Ref. 13)
- Work at Height Regulations 2005 (Ref. 6)
- Management of Health and Safety at Work Regulations 1999 (Ref. 12)

41. In addition, I considered the guidance document 'Managing health and safety in construction. Construction (Design and Management) Regulations 2015 Guidance on Regulations' (Ref. 21) as RGP to provide further clarification where necessary when assessing the RPs compliance with the CDM 2015 as a designer.

42. A technical meeting was held to introduce and discuss the GDA Step 4 assessment plan (Ref. 5). I explained that the focus of my assessment of work at height would be to examine strategies the designers propose for providing access to work at height tasks within the generic UK HPR1000 design. I outlined the type of information that would be required within the RP's submission to demonstrate design compliance with the Work at Height Regulations 2005 (WAHR) and where appropriate also referencing CDM 2015.

43. In response the RP submitted the following documents to demonstrate their approach to the design of access at height within the UKHPR1000 design:

- Ladder Strategy GHX00100087DOHB03GN (Rev B) (Ref. 7)
- Ladder Strategy Examples Report GHX00100088DOHB03GN (Rev B) (Ref. 29)

44. The Ladder Strategy enhances the RP's earlier response presented in the GDA Step 3 Work at Height topic report (Ref. 34). The scope of the Ladder Strategy topic report and Ladder Strategy Examples Report focus on worker access required by the permanent design when undertaking operational plant activities including outages. It excludes site specific construction access arrangements during the initial construction phase and during decommissioning. The RP has justified this decision on the basis that access strategies for construction will need to be assessed during the site-specific phase by the CDM 2015 Principal Contractor alongside designers. I judge that this is a reasonable approach.

45. The purpose of the Ladder Strategy is to outline how the RP, as the designer of the generic UK HPR1000 design, intends to comply with the requirements of WAHR. It also aligns with the duties placed on the RP as a designer by CDM 2015 when undertaking design work. The Ladder Strategy aims to provide general principles for the selection of an approach to access arrangements and contains a method to be used by designers to enable them to carry out a suitable and sufficient risk assessment. By following this approach, the designer should be able to select and design the most suitable access solution for a specific situation.

46. The Ladder Strategy Examples Report contains six different examples, taken from across the generic UK HPR1000 design, of where access for work at height is required and a solution has been designed to enable it:

- Resin regeneration system for condensate polishing system (access to tanks)
- Essential service water system pipe and wells (access to galleries)
- Deaerator platform (access to valves)
- Reactor pressure vessel head (access for outages)
- Fuel pool hall (access for crane maintenance)
- Diesel oil storage tank (access for internal maintenance)

47. I judged that this was an acceptable number of examples which provided sufficient variety to demonstrate the RPs approach to providing access for work at height when it is required.

48. Each example contains a narrative to explain; the situation where access at height is required; how the general principles contained within the Ladder Strategy have been applied; what has been considered when addressing the risk, and; the design mitigation that has been selected as appropriate. To support each example diagrams and excerpts from relevant Design Risk Registers (DRR's) are included in the report.

49. During my assessment I sampled and assessed the RP's understanding of the WAHR and their implementation of the hierarchy of control within the regulations to reduce risk during the design process to ALARP. I examined how the RP as a designer

demonstrated compliance with the requirements of Regulation 9 of CDM 2015 and associated guidance (Ref. 13, Ref. 21).

50. I raised RQ-UKHPR1000-0825 (Ref. 35) to gain further clarification on the arrangements for assessing work at height within the Ladder Strategy and clarification on technical detail presented within the Ladder Strategy Examples Report (Ref. 29).

51. I reviewed the Ladder Strategy and the adequacy of the arrangements contained within it. I have found that the Ladder Strategy has provided designers with a systematic tool to assist in assessing access at height requirements during the operational phase of the NPP, including during outages. The strategy guides designers through the risk assessment process for access at height. It highlights to the designer different variables which should be considered during their assessment, with the aim of arriving at an ALARP solution that complies with the WAHR 2005. Once an ALARP solution has been identified the Ladder Strategy provides signposts to applicable RGP to ensure the selected solution is designed to the correct specification.

52. Importantly I found that the Ladder Strategy references; the CDM Design Risk Management Work Instruction (Ref. 27); the involvement of other designers, including the Principal Designer, to ensure that the assessment considers the requirements of other parties, and; the recording of the risk assessment and subsequent design decisions within the DRR process. This allows the decisions made by the designer to be recorded and communicated to other parties who are impacted by it. Applying the General Principles of Prevention (GPP) whilst preparing a design and providing sufficient information about the designer to assist other CDM 2015 dutyholders to comply with their duties under the regulations are key requirements.

53. The Ladder Strategy Examples Report (Rev B) provided six different examples where access for work at height is required. During my assessment I was able to explore each of the examples with the relevant designer and the GNSL CDM Adviser. Each of the examples demonstrated how the designer had followed the process described in the Ladder Strategy (Rev B) to achieve an access solution that would be compliant with GB legal requirements. The examples also provided excerpts taken from the relevant DRR relating to work at height. I judged that this demonstrated that the designer was recording the outcome of their design decision as required by the RP's document 'CDM Design Risk Management Work Instruction HPR-GDA-PROC-0114' (Ref. 27) and therefore compliant with WAHR and CDM 2015.

54. During my assessment I explored the design of personal fall protection and fall arrest systems when they are identified as a design solution during GDA for work at height. The RP consider such decisions should be made in site specific design. I acknowledged the designer reference to BS 8437:2005+A1:2012 *'Code of practice for selection, use and maintenance of personal fall protection systems and equipment for use in the workplace'* as RGP. I emphasised that the designer should confirm that when a personal fall protection system is selected as a design solution, that all elements of the concept, such as rescue in the event of a fall, can be implemented safely. This topic is discussed further in Section 4.6 in relation to the RP's response to RO-UKHPR1000-0014 (Ref. 32).

55. In the examples provided I judged that the RP has demonstrated that designers are complying with the requirements of the Ladder Strategy (Rev B) (Ref. 7) and CDM Design Risk Management Work Instruction (Ref. 27).

### 4.2.2 Strengths

56. During my Step 4 GDA assessment of working at height I have identified the following strengths:

- The RP has developed a Ladder Strategy (Rev B) which provides an effective process for designers to; assess access requirements for work at height; select a suitable design solution, and; incorporate it into the generic UK HPR1000 design.
- The RP has presented several examples that illustrate how designers have successfully applied the Ladder Strategy within the generic UK HPR1000 design.
- The RP has demonstrated in the Ladder Strategy Examples (Rev B) compliance with the 'CDM Design Risk Management Work Instruction HPR-GDA-PROC-0114' by recording the significant design decisions in the relevant DRR.

### 4.2.3 Outcomes

57. The development of the generic UK HPR1000 design is an iterative process. I have found in my assessment of work at height that the RP has demonstrated understanding of the relevant GB legal requirements during GDA. As the design continues to evolve it is essential that designers, the Principal Designer, and the Principal Designer CDM Advisor continue to implement the requirements of the Ladder Strategy, the Construction Design Management Strategy and the CDM Design Risk Management Work Instruction to ensure the design remains compliant with GB legal requirements.

### 4.2.4 Conclusion

58. Based on the outcome of my assessment of the Ladder Strategy topic report (Rev B) and Ladder Strategy Examples report (Rev B) I have concluded that the submissions and responses to Regulatory Queries, indicate that the generic UK HPR1000 design can satisfy GB legal requirements regarding Working at Height. In doing so the RP has demonstrated support for the claims made in Chapter 25 of the PCSR relating to Conventional Health and Safety.

## 4.3 Construction (Design and Management) Regulations and Design Risk Register

### 4.3.1 Assessment

59. My assessment of the RP's Design Methodology has explored their approach to design risk management and risk reduction through the production and implementation of the DRR process. This process aims to enable the application of GB legal requirements in the transition from the reference plant design of Fangchenggang Nuclear Power Plant (NPP) Unit 3 (FCG3) to the generic UK HPR1000 GDA design to ensure that hazards are identified during the design and eliminated or controlled to ALARP.

60. The key legislation that informed my judgements are:

- Health and Safety at Work etc. Act 1974 (Ref. 4)
- Construction (Design and Management) Regulations 2015 (Ref. 13)
- Management of Health and Safety at Work Regulations 1999 (Ref. 12)

61. A technical meeting was held to introduce and discuss the GDA Step 4 assessment plan (Ref. 5). I explained that the focus of my assessment would be to look at the process of hazard elimination, reduction or control that has taken place during the development of the UK HPR1000 design with reference to the principles of prevention, and wider GB legal requirements with reference to RGP. I sought assurance of the following:

- The generation of DRRs and evidence of detailed review in respect of their content.
- A focus on DRR consistency of approach, including content, risk elimination or reduction, and recording of residual risks.
- At this point in the GDA design a specific 3D model for the generic UK HPR1000 design has not been developed. I therefore sought assurance that the strategy would enable development of a future 3D model and demonstrate how it would be applicable to the management of conventional health and safety.

62. In response the RP submitted the following documents to demonstrate their approach during the GDA design which I reviewed:

- Strategy for Integrating DRR Information with 3D Model GHX00100091DOHB03GN (Ref. 31)
- Construction Design Management Strategy HPR-GDA-REPO-0057 (Ref. 26)
- CDM Design Risk Management Work Instruction HPR-GDA-PROC-0114 (Ref. 27)

63. I assessed the 'Strategy for Integrating DRR Information with 3D Model' (Ref. 31). It explains how the UK HPR1000 GDA project is utilising the existing FCG3 3D model to aid the development of conventional health and safety design solutions. The document contains a series of examples to practically demonstrate how the FCG3 3D model has been used during the GDA design process to address conventional health and safety risks. The examples are accompanied by 3D images taken from the FCG3 3D model and they are accompanied with excerpts from the relevant DRRs.

64. The 'Strategy for Integrating DRR Information with 3D Model' (Ref. 31) references the RP's 'Construction Design Management Strategy'. This document outlines how the RP is seeking to deliver a project that will comply with the requirements of CDM 2015, and establish an approach which can be used and developed post-GDA. The Construction Design Management Strategy assigns roles and responsibilities and describes how the RP proposes to enact dutyholder roles that are a requirement of CDM 2015.

65. The three CDM dutyholder roles held by the RP during GDA that the Construction Design Management Strategy addresses are the Client, Principal Designer, and designer. In addition, the strategy introduces a Client CDM Advisor role and Principal Designer CDM Advisor role to provide guidance to the Client and Principal Designer respectively. These functions have been fulfilled by UK based contractors during GDA. The strategy document describes the RP's arrangements for enacting these roles and references the CDM Design Risk Management Work Instruction.

66. The CDM Design Risk Management Work Instruction details the RP's procedure for implementing CDM 2015 and explains how it must be followed by the designers, the Principal Designer, and the Principal Designer CDM Advisor whilst working on the project. A requirement of the work instruction is the generation of a suite of DRRs which are used to enable, record, and communicate the risk management process. Evidence of compliance with this process is crucial for demonstrating the RPs compliance with CDM 2015 during design work.

67. After assessing these reports I raised several regulatory queries. RQ-UKHPR1000-0787 (Ref. 35) was raised to gain further assurance of how design risk management and design co-ordination is being achieved in the GDA design and in doing so, meeting the requirements and claims made in in Chapter 25 of the PCSR (Ref. 2) relating to Conventional Health and Safety. RQ-UKHPR1000-0820 (Ref. 35) was

raised to gain further assurance relating to the transfer of health and safety information from the RP to the future operating organisation.

68. The RP provided a written response to RQ-UKHPR1000-0787 and RQ-UKHPR1000-0820 and updated the document 'Strategy for Integrating DRR Information with 3D Model'.

69. I reviewed the Construction Design Management Strategy (Ref. 26). I found this to be a key document in the RP's compliance with CDM 2015 throughout the GDA phase of the project. It allocates key dutyholder roles, describes the responsibilities of each dutyholder, and recognises Bradwell B as a key stakeholder within the strategy due to their role in the next phase of the project following completion of GDA. The document highlights the requirements of Regulation 9 of CDM 2015, duties of designers, and commits that all designers, including those based overseas, will work in accordance with the CDM Design Risk Management Work Instruction to ensure compliance with the relevant requirements of CDM 2015

70. The 'CDM Design Risk Management Work Instruction' sets out how the requirements of CDM 2015 will be met by designers, the Principal Designer and the Principal Designer CDM Advisor during the GDA phase of the project. It has established a process for hazard identification, elimination / mitigation, recording and communication. The outputs from this process are package DRRs. In my opinion the UK based Principal Designer CDM Advisor has played a significant role in advising designers on UK legislation, and reviewing the quality and consistency of DRRs throughout the GDA design phase.

71. In total 78 DRR packages have been generated by the RP which I have sampled throughout my GDA assessment. I have found that the implementation of the CDM Design Risk Management Work Instruction has led to the suitability, sufficiency, and consistency of DRRs improving as the project has progressed. This improvement has helped demonstrate that designers are identifying hazards and reducing risk during design as required by GB statutory legislation. Where residual hazards exist, they are being recorded on DRRs to enable future communication and consideration of hazards and associated risks.

72. One of the duties of the Principal Designer and Principal Designer CDM Advisor required by the CDM Design Risk Management Work Instruction is to compile a master hazard log (MHL). To achieve this the significant findings from the DRRs in terms of hazard and risk are collated from each DRR and added to a master hazard log. I found that as the content and sufficiency of the DRR's has improved as design has progressed, it has been reflected in the content and sufficiency of the MHL. The CDM Design Risk Management Work Instruction stipulates that input into DRRs and the MHL is an ongoing progress and will continue until the completion of the GDA design.

73. I was satisfied that the DRRs and MHL have evolved through the GDA design phase, and the documents are sufficient to demonstrate compliance with the requirements of CDM 2015 and other relevant GB legal requirements. I welcomed the provision of these documents to Bradwell B CDM personnel as the prospective site licensee before the completion of the GDA phase as good practice, facilitating early communication of pre-construction design information.

74. From the examples contained within the 'Strategy for Integrating DRR Information with 3D Model', the RP has demonstrated how they have used the existing FCG3 3D model to identify hazards and assess the risk associated with them. Examples are included which demonstrate how considerations have been made by designers for adequate access and space during construction and during maintenance operations.

75. The ‘Strategy for Integrating DRR Information with 3D Model’ recognises that for a site licensee to generate a Building Information Management (BIM) model for a detailed site-specific design, any health and safety information must be structured and shared in a format that would facilitate its inclusion. I was satisfied that the RP has written the ‘Construction Design Management Strategy’ and the ‘CDM Design Risk Management Work Instruction’ in a way that ensures the outputs from the documents, in the form of DRRs and MHL, align with the requirements of PAS 1192-6:2018 ‘Specification for collaborative sharing and use of structured Health and Safety information using BIM’ (Ref. 36).

76. During my assessment the RP has demonstrated designer, Principal Designer, and Principal Designer CDM Advisor compliance with the ‘Construction Design Management Strategy’ and ‘CDM Design Risk Management Work Instruction’.

77. The RP has adequately recorded design decisions and assumptions relating to hazards and residual risk identified during GDA design work within DRRs and the MHL. The format used to record this information will allow for it to be communicated to a future licensee for utilisation in a site-specific 3D model.

### 4.3.2 Strengths

78. During my assessment of DRRs I have identified the following strengths:

- The RP has demonstrated in the ‘Strategy for Integrating DRR Information with 3D Model’ that hazard identification and risk assessment in design has been facilitated using the existing FCG3 3D model.
- The RP has developed a Construction Design Management Strategy and CDM Design Risk Management Work Instruction which requires designers and Principal Designers to follow the requirements of CDM 2015 and associated guidance (Ref. 21).
- The DRRs and MHL have improved in consistency and quality as the generic UK HPR1000 design has developed. They have been recorded in a format which aligns with PAS 1192-6:2018 ‘Specification for collaborative sharing and use of structured Health and Safety information using BIM’. This will allow them to be communicated in a suitable format for future use by a licensee.
- The DRRs and MHL produced by the RP has been shared with BRB as a key stakeholder to enable early communication and consideration of pre-construction design information.

### 4.3.3 Outcomes

79. The development of the generic UK HPR1000 design is an iterative process. I have found in my assessment of CDM 2015 that the RP has demonstrated understanding of the regulations and implemented its requirements. As the generic design continues to evolve it is essential that the designers, the Principal Designer, and the Principal Designer CDM Advisor continue to implement the requirements of the ‘Construction Design Management Strategy’ and the ‘CDM Design Risk Management Work Instruction’ to ensure the design remains compliant with GB legal requirements.

### 4.3.4 Conclusion

80. Based on the outcome of my assessment of the ‘Strategy for Integrating DRR Information with 3D Model’ (Rev B) I have concluded that the submissions and responses to Regulatory Queries, indicate that the design will satisfy the requirements of CDM 2015. In doing so the RP has demonstrated support for the claims made in Chapter 25 of the PCSR relating to Conventional Health and Safety.

## 4.4 Constructability

### 4.4.1 Assessment

81. My assessment of the topic of constructability within the generic UK HPR1000 design has examined the Fuel Building (referred to as the BFX), and the External Containment Dome (referred to as the BRX), focussing on construction activities including decommissioning. I have discussed the suggested methods of construction arising from the permanent works design, and how designers have addressed construction health and safety risks during design work in the context of UK RSPs.

82. The key RSPs that have informed my judgements are:

- Health and Safety at Work etc. Act 1974 (Ref. 4)
- Construction (Design and Management) Regulations 2015 (Ref. 13)
- Management of Health and Safety at Work Regulations 1999 (Ref. 12)
- Work at Height Regulations 2005 (Ref. 6)

83. In addition, the following RGP has also been used in my assessment:

- Construction (Design and Management) Regulations 2015. Guidance on the Regulations (Ref. 21)
- BS5975:2019 Code of practice for temporary works procedures and the permissible stress design of falsework (Ref. 23)

84. A technical meeting was held to introduce and discuss the 'GDA Step 4 assessment plan' (Ref. 5). I explained that the focus of my assessment would include the following:

- Demonstration that the designer has integrated previous construction experience and knowledge when applying the general principles of prevention detailed in the Management of Health and Safety at Work Regulations 1999 in relation to the proposed method of construction during the GDA design phase.
- The designer has demonstrated to ALARP the consideration of any temporary works required by the design and the assumed method of construction.
- The integration of designer construction knowledge when addressing health and safety risk elimination, reduction, and control in compliance with GB legal requirements including CDM 2015.
- The RP has considered the topic of constructability to include reference to de-constructability during future decommissioning activities.

85. In response the RP submitted the following document to demonstrate their approach during GDA:

- Constructability Optimisation of Fuel Building and External Containment GHX00100092DOHB03GN (Rev B) (Ref. 28)

86. The purpose of the 'Constructability Optimisation of Fuel Building and External Containment' topic report is to demonstrate that the designer is complying with the requirements of CDM 2015 by identifying conventional health and safety risk through the whole life of the generic UK HPR1000 design, and providing, where it is reasonably practicable to do so, mitigation for those risks during development of the generic design.

87. The report contains seven examples to illustrate the approach taken by the designer to identify and mitigate risk. The examples provided focussed on the following areas:

- Structural stability whilst incomplete

- Temporary support during external containment dome concrete works
- Worker access during concrete dome construction
- Provision of embedded plates to aid construction
- Construction of BFX roof
- Detailing and prefabrication of reinforcing bar
- Reference to additional examples of design for construction previously assessed during Step 3 of GDA

88. In addition, the report also refers to the documents Consistency Evaluation for Design of Facilitating Decommissioning (Ref. 37), and Decommissioning Building Dismantling Proposal (Ref. 38) to signpost design measures that have been considered to aid future decommissioning.

89. I reviewed the 'Constructability Optimisation of Fuel Building and External Containment' topic report including its scope and the adequacy of the examples contained within it and their applicability to the whole life of the design, including construction, operation, and decommissioning. I assessed how the decisions made by designers to identify hazards and mitigate risk are being recorded and communicated for consideration during later stages of design or, where relevant during the whole life of the NPP including decommissioning.

90. I raised RQ-UKHPR1000-1301 (Ref. 35) to gain further assurance regarding how the permanent works designer records and communicates any assumptions they make that might affect temporary works design, and to gain clarity on the consideration of access arrangements by the designer regarding the construction of the BFX building roof. In response to RQ-UKHPR1000-1301 the RP reviewed and revised the 'Constructability Optimisation of Fuel Building and External Containment' topic report.

91. I attended a workshop on 'Health and Safety/Construction Aspects' lead by ONR Civil Engineering inspectors. The workshop addressed elements of construction and decommissioning that are relevant to the constructability topic. As a result of the workshop RQ-UKHPR1000-1629 (Ref. 35), RQ-UKHPR1000-1631 (Ref. 35) and RQ-UKHPR1000-1628 (Ref. 35) were generated and the responses received from the RP have been considered in this section of my assessment.

92. The 'Constructability Optimisation of Fuel Building and External Containment' topic report provided a wide range of examples which demonstrate that the designer has considered the foreseeable health and safety risks to those carrying out construction work associated with the generic UK HPR1000 design. The RP's designers have sought to work closely with the China General Nuclear (CGN) construction team to ensure the buildability of the design. Knowledge from the CGN construction team is apparent from the examples as is the inclusion of experienced gained during the construction of FCG3, and other existing power plants constructed in China.

93. The Constructability Optimisation of Fuel Building and External Containment topic report refers to the CDM Design Risk Management Work Instruction. It explains how permanent works designers should consider how their design will potentially require temporary works during construction. Any assumptions made by designers are recorded in the 'BFX Conventional Health and Safety Design Risk Register' (Ref. 39) and the 'BRX Conventional Health and Safety Design Risk Register' (Ref. 40), and will be added to the MHL by the Principal Designer CDM Advisor. This process facilitates evolution of the DRRs and the MHL as the design develops and it remains ongoing throughout the whole of the GDA design phase until the generic design has been completed.

94. I found that in their response to RQ-UKHPR1000-1631 the RP has demonstrated a wider understanding of CDM 2015 by recognising that it is important for the permanent works designer to continue to work with the temporary works designer and Principal Contractor at the site-specific phase once GDA has completed. This approach will help enable the Principal Contractor to develop their own construction methodology, in line with GB legal requirements, informed by the information already supplied by the RP in the DRRs, MHL and other pre-construction information. This collaborative approach aligns with the RGP 'Managing health and safety in construction. Construction (Design and Management) Regulations 2015 Guidance on Regulations' (Ref. 21).

95. RQ-UKHPR1000-1628 (Ref. 35) was written following discussions around the types of materials used for fire barriers within the annulus of the internal and external containment. The RP's response confirmed that all asbestos containing materials are prohibited and the UKHPR1000 GDA design does not contain any such materials as stated in section 25.3.2.5.1 of the PCSR.

96. In my assessment of constructability, I have found that the RP has demonstrated the consideration of previous construction experience in the generic UK HPR1000 design. The RP has evidenced the application of the GPP within the design and has applied the ERIC principles to address hazard and risk. The RP, as the designer, has demonstrated an appropriate consideration of temporary works for the generic design.

### 4.4.2 Strengths

97. During my assessment of the Constructability Optimisation of Fuel Building and External Containment topic report (Ref. 28) I have identified the following strengths:

- The range of examples that were provided demonstrate that the designer has considered the elimination of hazards and / or the mitigation of risk during the construction and decommissioning phases of the generic UK HPR1000 design.
- The involvement of the CGN construction team during the design phase has enabled knowledge, experience and learning gained from the construction of NPPs including the FCG3 project, to be considered within the generic UK HPR1000 design.
- The RP has utilised the Principal Designer CDM Advisor to ensure that their experience and expectations of design and construction has been applied to ensure outputs of design work are compliant with GB legal requirements.
- The RP has demonstrated that the designer has followed the CDM Design Risk Management Work Instruction through the examples in the topic report, which include the production of DRRs for the Fuel Building and External Containment of the Reactor Building.

### 4.4.3 Outcomes

98. The development of the UK HPR1000 GDA design is an iterative process. I have found in my assessment of the Constructability Optimisation of Fuel Building and External Containment topic report (Rev B) that the RP's designers are following the CDM Design Risk Management Work Instruction, and through it demonstrating compliance with CDM 2015 and other relevant RSPs.

99. As the generic design continues to evolve it is essential that the designers, the Principal Designer, and the Principal Designer CDM Advisor continue to implement the requirements of the 'Construction Design Management Strategy' and the 'CDM Design Risk Management Work Instruction' to ensure the design remains compliant with GB legal requirements.

### 4.4.4 Conclusion

100. Based on the outcome of my assessment of the Constructability Optimisation of Fuel Building and External Containment topic report (Rev B), I have concluded that the submissions and responses to Regulatory Queries indicate that the design can satisfy the requirements of CDM 2015. In doing so the RP has demonstrated support for the claims made in Chapter 25 of the PCSR relating to Conventional Health and Safety.

## 4.5 Dangerous Substances and Explosive Atmospheres Regulations 2002

### 4.5.1 Assessment

101. My assessment of Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) has explored the RP's consideration and application of the requirements of DSEAR in the generic design of the UK HPR1000, to ensure the protection of workers from risks relating to dangerous substances and potentially explosive atmospheres which it is known will be, or are liable to be, present in the workplace.

102. The legislation that has informed my judgements are:

- Health and Safety at Work etc. Act 1974 (Ref. 4)
- Dangerous Substances and Explosive Atmospheres Regulations 2002 (Ref. 8)
- European Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances (Ref. 18)
- Construction (Design and Management) Regulations 2015 (Ref. 13)
- Management of Health and Safety at Work Regulations 1999 (Ref. 12)

103. In addition, I have used the following documents as RGP during my assessment:

- Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance (Ref. 20)
- Construction (Design and Management) Regulations 2015. Guidance on the Regulations (Ref. 21)

104. A technical meeting was held to introduce and discuss the GDA Step 4 assessment plan (Ref. 5). I explained that my assessment of DSEAR would focus on the RP and designers demonstrating that the generic UK HPR1000 design is being developed with appropriate consideration of DSEAR during construction, operation/maintenance, and decommissioning.

105. During my assessment I referred to the DSEAR Approved Code of Practice (Ref. 20), with particular emphasis on Regulation 5 which requires a risk assessment to be undertaken, Regulation 6 which requires the elimination or reduction of risks from dangerous substances, and Schedule 1 of the Regulations which discusses general safety measures. Areas of focus included the storage and use of dangerous substances, and areas where explosive atmospheres could potentially be generated by work activities. I stressed that my intention was to focus on the requirements of DSEAR and not to re-assess the work already done under ONR's Internal Hazards and Conventional Fire Safety assessments.

106. The RP submitted the following document to demonstrate their approach to DSEAR during the GDA design:

- Dangerous Substances and Explosive Atmospheres Topic Report CHX00100090DOHB03GN (Rev B) (Ref. 30)

107. The initial report (Rev A) contains 3 examples taken from the generic UK HPR1000 design which the RP used to demonstrate their understanding of DSEAR. The examples provided were:

- Hydrogen within the Nuclear Island Building
- Diesel Oil
- High Pressure Steam

108. I reviewed the 'Dangerous Substances and Explosive Atmospheres' topic report and the adequacy of the examples contained within it. I considered the scope of the report, the inclusion of high-pressure steam as an example, and consideration of DSEAR during construction and decommissioning in addition to the operational phase of the design. I examined the recording and communication of residual risks which would need to be considered at later stages of design as required by CDM 2015.

109. I raised RQ-UKHPR1000-1193 (Ref. 35) to gain further assurance on the application of DSEAR during the development of the design, the understanding of the classification of hazardous areas and their identification, and how this information will be recorded and communicated. I questioned the inclusion of high-pressure steam as an example relevant to DSEAR and asked how the designer is addressing issues relating to DSEAR during construction and decommissioning. In response to RQ-UKHPR1000-1193 the RP reviewed and revised the topic report, submitting Revision B (Ref. 30).

110. In Rev B of the DSEAR topic report the example relating to high pressure steam has been removed. The RP recognised that the relevant GB legislation which addresses hazards relating to high pressure steam is the Pressure Systems Safety Regulations 2000.

111. I was satisfied that the DSEAR topic report (Rev B) provided evidence that the RP understands the relevance of DSEAR to the development of the generic UK HPR1000 design and has applied its requirements during design work. The scope of the topic report focusses exclusively on areas covered within the GDA scope. To demonstrate broader understanding the RP has recognised that other substances relevant to DSEAR will be used in the wider UK HPR1000 design including areas that are currently out of scope, and they have submitted a chemical inventory that covers this aspect (Ref. 41). The RP has used their existing operating experience from other NPPs to compile this list with the expectation that it will be adjusted at the site-specific stage.

112. The DSEAR topic report (Rev B) recognises two substances, hydrogen and diesel oil, that are within the GDA scope, and examples are presented for each of them. I judged that the examples adequately demonstrate that the principles required by DSEAR are being applied by the RP to the generic design. The examples demonstrate that an assessment has taken place which identifies a provisional zone classification for areas where an explosive atmosphere might occur, along with a description of the measures incorporated into the design to control risk.

113. Where residual risks are identified that cannot be eliminated within the generic design, the designer has recorded them on DRRs (Ref. 42, Ref. 43, Ref. 44, Ref. 45, Ref. 46) to ensure they are communicated for consideration in subsequent design work post GDA. Where explosion hazards and residual risks exist relating to the operation, maintenance or decommissioning of plant these have also been recorded in DRR form and the topic report confirms that they will be provided as part of the Pre-Construction Information. This recording of residual risks and communication to other relevant parties demonstrates that the designer is fulfilling the requirements of the CDM Design

Risk Management Work Instruction and in doing so this demonstrates compliance with CDM 2015.

114. Overall, I am content that my assessment has found that the approach to DSEAR taken by the RP during the generic design is adequate.

### 4.5.2 Strengths

115. During my Step 4 of GDA assessment of compliance with DSEAR I have identified the following strengths:

- The RP demonstrated an appreciation of relevant GB legal requirements and illustrated this understanding through the presentation of two relevant examples.
- The RP recognised and understood that the original example of high-pressure steam was erroneous and accepted that it was not applicable to DSEAR.
- The RP demonstrated their broader understanding by compiling a chemical inventory of substances relevant to DSEAR used in the wider UKHPR1000 design. The RP developed this list using their own wider operating experience.
- Designers have identified residual risks relating to DSEAR and recorded them on the relevant DRR's. This process will enable these risks to be understood and considered during future design work.
- The DSEAR topic report demonstrates that designers are following the CDM Design Risk Management Work Instruction and in doing so demonstrating compliance with CDM 2015.

### 4.5.3 Outcomes

116. The development of the generic UK HPR1000 design is an iterative process. I have found in my assessment of DSEAR that the RP has demonstrated understanding of DSEAR and, in the examples provided, implemented its requirements. The designer, by identifying hazards and recording risk using the DRR process, has demonstrated that they are complying with the requirements of CDM 2015.

117. As the generic design continues to evolve it is essential that designers, the Principal Designer, and the Principal Designer CDM Advisor continue to implement the requirements of the Construction Design Management Strategy and the CDM Design Risk Management Work Instruction to ensure the design remains compliant with GB legal requirements.

### 4.5.4 Conclusion

118. Based on the outcome of my assessment of the Dangerous Substances and Explosive Atmospheres Regulations 2002 topic report I have concluded that the formal submissions and full response to Regulatory Queries demonstrates that the design can fulfil the requirements of DSEAR. In doing so the RP has demonstrated support for the claims made in Chapter 25 of the PCSR.

## 4.6 Spent Fuel Building – Design of Nuclear Lifting Operations to Demonstrate Relevant Risks are Reduced to ALARP (RO-UKHPR1000-0014)

### 4.6.1 Assessment

119. I assessed the Conventional Health and Safety aspects of RO-UKHPR1000-0014 (Ref. 32). This regulatory observation was raised by the Mechanical Engineering specialism to focus on the RP's demonstration that risks related to lifting operations in the spent fuel building have been reduced to ALARP.

120. The legislation that has informed my judgements are:

- Health and Safety at Work etc. Act 1974 (Ref. 4)
- Construction (Design and Management) Regulations 2015 (Ref. 13)
- Work at Height Regulations 2005 (Ref. 6)
- Management of Health and Safety at Work Regulations 1999 (Ref. 12)
- Lifting Operations and Lifting Equipment regulations 1998 (Ref. 16)
- Provision and Use of Work Equipment Regulations 1998 (Ref. 17)

121. I also referred to the following RGP:

- BS 7121-1:2016 “Code of practice for safe use of cranes – Part 1: General” (Ref. 24)
- BS 7121-2-7:2012+A1:2015 “Code of practice for the safe use of cranes – Part 2-7: Inspection, maintenance and thorough examination – Overhead travelling cranes, including portal and semi-portal cranes, hoists, and their supporting structures’ (Ref. 25)

122. The RP had initially proposed in the generic design that access to the spent fuel handling crane for EMIT and during breakdowns would be provided by the installation and use of a personal fall arrest or fall restraint system that would be detailed during post GDA design. The crane is 27.265m above the spent fuel pond and I was not satisfied that this was an ALARP solution.

123. In response to RO-UKHPR1000-0014 the RP has produced the report ‘ALARP Assessment of the BFX Cranes Arrangements’ (Ref. 47). This identifies access to cranes for the purposes of EMIT and breakdown recovery as a conventional health and safety issue and provides several different proposals of how the issue could be resolved.

124. The RP demonstrates how they have assessed each of the proposed options and justified the solution they have selected. The RP has recommended that a series of design changes are made that will allow the installation of full-length walkways along the crane bracket on both sides of the building. They are installed with suitable guardrails to prevent falls from height eliminating the need for a personal fall arrest / restraint system to be designed and installed. This will enable operatives to access the cranes safely whilst performing EMIT operations and in the event that there is an unexpected breakdown. This is detailed in modification M75 (Ref. 48), which has been included in Design Reference 3 by the RP.

125. A holistic approach has been taken to assess how the design changes impact on other disciplines associated with the fuel building. This has helped to confirm that no unintended consequences have arisen as a result of the modifications.

126. I have judged that the RP has designed a solution that meets the requirements of the LOLER ACoP and UK RGP where walkways to access overhead electric cranes are commonplace on GB sites regulated by the ONR. The approach taken to assess the hazard and address the risks complies with the requirements placed on designers by CDM 2015.

127. From a Conventional Health and Safety perspective I am satisfied that the resolution of this matter is satisfactory.

### 4.6.2 Strengths

128. During my assessment of the Conventional Health and Safety aspects of RO-UKHPR1000-0014 I have identified the following strengths:

- The RP has identified and understood the relevant standard and RGP.
- The RP has assessed the access requirements required for EMIT and during breakdowns.
- An optioneering process has been followed to systematically identify and consider various solutions.

### 4.6.3 Outcomes

129. I judge that the RP has demonstrated an understanding of LOLER, WAHR and RGP. The approach taken in addressing access onto overhead electric travelling cranes in the fuel building is consistent with the requirements placed on designers to follow the general principles of prevention in Regulation 9 of CDM 2015.

130. As the generic design continues to evolve it is essential that the designers, the Principal Designer, and the Principal Designer CDM Advisor continue to implement the requirements of the Construction Design Management Strategy and the CDM Design Risk Management Work Instruction to ensure the design remains compliant with GB legal requirements.

### 4.6.4 Conclusions

131. Based on the outcome of my assessment of the Conventional Health and Safety aspects of RO-UKHPR1000-0014 I have concluded that the submissions and response to the Regulatory Observation demonstrates that the modified design can fulfil the requirements of GB legal requirements, including LOLER and WAHR (Ref. 6). In demonstrating this the RP has provided support for the claims made in Chapter 25 of the PCSR.

## 4.7 Fuel Route Safety Case (RO-UKHPR1000-0056)

### 4.7.1 Assessment

132. I assessed the Conventional Health and Safety aspects of RO-UKHPR1000-0056 (Ref. 32). This Regulatory Observation was raised by Fault Studies inspectors and was assessed jointly by Fault Studies, Mechanical Engineering and Conventional Health and safety inspectors. In response the RP modified the spent fuel pond crane design (Ref. 49). I required assurance that the change from an overhead electric crane to a gantry type fuel handling crane had considered how access for EMIT functions would be achieved, and whether any new crush hazards had been introduced as a result of the design change away from an overhead electric crane.

133. The legislation that has informed my judgements are:

- Health and Safety at Work etc. Act 1974 (Ref. 4)
- Construction (Design and Management) Regulations 2015 (Ref. 13)
- Work at Height Regulations 2005 (Ref. 6)
- Management of Health and Safety at Work Regulations 1999 (Ref. 12)
- Lifting Operations and Lifting Equipment Regulations 1998 (Ref. 16)
- Provision and Use of Work Equipment Regulations 1998 (Ref. 17)
- The Confined Spaces Regulations 1997 (Ref. 14)

134. I also considered the following RGP:

- BS 7121-1:2016 “Code of practice for safe use of cranes – Part 1: General” (Ref. 24)
- BS 7121-2-7:2012+A1:2015 “Code of practice for the safe use of cranes – Part 2-7: Inspection, maintenance and thorough examination – Overhead travelling

cranes, including portal and semi-portal cranes, hoists, and their supporting structures' (Ref. 25)

135. The RP has established that the maintenance area for the spent fuel pool crane will be above the fuel transfer compartment. When the fuel transfer compartment is dry this will enable operatives to access the telescopic sleeve and the gripper for the fuel assembly, the gripper for the non-fuel core components, and associated equipment. Assurance was provided by the RP that safe access could be achieved and work at height risks controlled, with all EMIT work taking place from behind fixed guardrails.

136. The grippers within the telescopic sleeve are powered by a pneumatic system. The potential hazard of stored energy remaining present in the grippers after isolation to enable EMIT to be undertaken was discussed. The RP understood that this hazard would need to be considered during further detailed design work and it will be recorded in the relevant DRR.

137. The RP provided assurances that the transfer compartment is not a confined space under the Confined Spaces Regulations 1997 (Ref. 14). I judged that this assumption should be reassessed in line with the definition of a confined space contained in the document 'Safe work in confined spaces. Confined Spaces Regulations1997. Approved Code of Practice and guidance' (Ref. 22) . The transfer compartment is a large, deep pit, designed so that it can be flooded with water during normal operation. The risk of drowning from the increase in the level of a liquid (in this case water) is a 'specified risk' under The Confined Spaces Regulations 1997 and is relevant to any operatives undertaking EMIT work within the transfer compartment. I consider this to be a shortfall, and therefore raised the following Assessment Finding:

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| AF-UKHPR1000-0156 – The licensee shall, as part of detailed design, justify whether the UK HPR1000 fuel route, including the transfer compartment, spent fuel pond, cleaning pit, and loading pit, are required to be risk assessed as confined spaces as defined by the Confined Space Regulations 1997. This should demonstrate that risks have been reduced as low as reasonably practicable and include construction, operation and examination, maintenance, inspection, and testing activities. |

138. The RP described access to the crane bridge of the spent fuel crane using fixed access steps. The crane bridge has permanent handrails as does the crane trolley to prevent falls from height. I judged this as being a suitable solution for access.

139. The RP demonstrated how potential crush hazards associated with the design and installation of a gantry crane had been considered during new fuel receipt, during the spent fuel delivery processes, and when undertaking EMIT operations. Where a potential issue has been identified the RP has addressed the issue to either eliminate or mitigate the risk. I was satisfied that the RP was adequately considering crush hazards associated with the handling of new and spent fuel in the generic UK HPR1000 design.

140. The RP has confirmed that they will continue to use the DRR process contained in the CDM Design Risk Management Work Instruction during the remainder of the GDA phase and will communicate the DRR's and MHL to the licensee following the completion of GDA.

141. From a Conventional Health and Safety perspective I am satisfied that the resolution of this matter is adequate and satisfies GB legal requirements.

### 4.7.2 Strengths

142. During my Step 4 GDA assessment of the Conventional Health and Safety aspects of RO-UKHPR1000-0056 I have identified the following strengths:

- The RP has considered EMIT operations associated with the design and installation of a gantry crane with a telescopic sleeve to perform fuel handling operations.
- The RP has considered the potential for new crush hazards to arise as a result of the introduction of a gantry crane and considered how they can be eliminated or mitigated.
- Relevant information and decisions arising from this design change are being recorded in DRRs to enable them to be considered during future detailed design.

### 4.7.3 Outcomes

143. I have found in my assessment of the Conventional Health and Safety aspects of RO-UKHPR1000-0056 that the RP has considered the impact of designing and installing a gantry crane with a telescopic sleeve as an alternative to an overhead electric crane. Many of the Conventional Health and Safety risks that this design change could potentially introduce have been identified and design mitigations have been proposed which align with GB legal requirements.

144. Currently the transfer compartment has not been identified as a confined space, despite the presence of a ‘specified risk’ as defined by the regulations. I have therefore raised an Assessment finding to track the assessment of EMIT tasks within the transfer compartment to ensure any potential confined space hazards are fully understood and addressed.

145. As the generic design continues to evolve it is essential that the designers, the Principal Designer, and the Principal Advisor CDM Advisor continue to implement the requirements of the Construction Design Management Strategy and the CDM Design Risk Management Work Instruction.

### 4.7.4 Conclusion

146. Based on the outcome of my assessment I have concluded that the RP has demonstrated that they can address the Conventional Health and Safety risks related to the modified design adequately for GDA and fulfil GB legal requirements. In demonstrating this, the RP has provided support for the claims made in Chapter 25 of the PCSR.

## 4.8 Demonstration that Relevant Risks Have Been Reduced to ALARP

### 4.8.1 Assessment

147. The RP outlined the basis for their approach to ensuring that the generic UK HPR1000 design is ALARP in section 25.3.4 of Chapter 25 of the PCSR. The approach highlights the HSE document ‘Reducing risks, protecting people’ (Ref. 50) as a reference to be used by the designer throughout the generic design of the UK HPR1000 as it outlines the UK regulatory approach to risk.

148. Section 25.3.4 of the PCSR explains the RP’s approach to achieving ALARP in the generic UK HPR1000 design. The RP has identified GB legislation relevant to Conventional Health and Safety along with ACoPs and RGP and the requirements of

which are applied during the generic design of the UK HPR1000. Table T-25.3-1 of the PCSR contains a list of applicable Acts, Regulations, ACoPs and RGP.

149. In my assessment I have considered relevant GB guidance from HSE relating to ALARP in design (Ref. 50, Ref. 51).

150. I have found that the RP has identified the requirements of CDM 2015 as being key to achieving an ALARP design. To ensure that they are properly applied during the GDA process, a Construction Design Management Strategy and CDM Design Risk Management Work Instruction have been developed and implemented. The design methodology contained within these documents applies the GPP to the design process, requiring designers to eliminate, reduce, isolate or control conventional health and safety hazards with the aim of ensuring risks are reduced to ALARP.

151. During my assessment I have assessed the following topics:

- Work at height
- Design Risk Register (DRR)
- Constructability
- Dangerous Substances and Explosive Atmospheres
- Spent Fuel Building – Design of Nuclear Lifting Operations to Demonstrate Relevant Risks are Reduced to ALARP (RO-UKHPR1000-0014)
- Fuel Route Safety Case (RO-UKHPR1000-0056)

152. When assessing each of the topics I considered the RP's compliance with the requirements of Regulation 9 of CDM 2015. The legislation is non-prescriptive and requires designers to take a risk-based approach during design work to eliminate foreseeable risks to the health or safety of persons so far as is reasonably practicable (i.e. to ALARP). Where it is not practicable to eliminate these risks, designers must, so far as is reasonably practicable, take steps to reduce risks and where that is not possible control them through the subsequent design process.

153. My assessment found that by following the design methodology outlined in section 3.2.3 of the UK HPR1000 Construction Design Management Strategy, and the requirements of the CDM Design Risk Management Work Instruction, the RP has applied the general principles of prevention throughout design work.

154. A requirement of the CDM Design Risk Management Work Instruction is the production of Design Risk Register (DRR) for each design package. The DRR records hazard identification and mitigation and identifies significant residual risk information for communication and use during further design, or alternatively, for passing on to others who may require it. The RP has stated that their objective is for all elements of design, and the interfaces between them, to have DRRs generated which address them.

155. The DRR process highlights and prioritises items with a higher risk rating. I found that at the time of my assessment 78 DRRs had been generated in relation to the generic design of the UK HPR1000. Risks considered for the inclusion on to DRRs include those arising from:

- Construction
- Commissioning work
- Maintaining or cleaning a structure
- Using a system or structure designed as a workplace / operation
- Decommissioning, dismantling and demolition

156. An important part of the CDM Design Risk Management Work Instruction has been the undertaking of hazard workshops and studies as outlined in section 2.2.2.7., the results of which are recorded in DRR's.

157. I have assessed the role of the Principal Designer and the Principal Designer CDM Advisor in undertaking DRR reviews and design workshops. The role of the Principal Designer CDM Advisor has been significant in improving risk reduction in the design. In my opinion, the experience and knowledge of CDM 2015 and RGP that the UK-based Principal Designer CDM Advisor has brought to the design process during interactions with designers has resulted in a significant improvement in the quality and consistency of the DRR's.

158. It is recognised by the RP that for a site licensee to generate a BIM model during a detailed site-specific design, health and safety information must be structured and shared in a format that would facilitate this inclusion. The RP has written the Construction Design Management Strategy and the CDM Design Risk Management Work Instruction to enable DRRs and MHL to be incorporated into a BIM model. The format they have been recorded in aligns with the requirements of PAS 1192-6:2018 'Specification for collaborative sharing and use of structured Health and Safety information using BIM'.

159. A further requirement of the CDM Design Risk Management Work Instruction is that the Principal Designer and Principal Designer CDM Advisor compiles a Master Hazard Log (MHL). This document collates together significant hazards and risks drawn from the DRRs and is continuously updated throughout the design process. In my opinion it has played an important role in raising awareness of the most significant hazards throughout the design process. It also plays an important part in communicating these hazards and has been used during meetings with the licensee to make these hazards visible to them.

### 4.8.2 Strengths

160. During my Step 4 GDA assessment of ALARP I have identified the following strengths:

- The RP has developed a Construction Design Management Strategy (Ref. 26) and CDM Design Risk Management Work Instruction (Ref. 27) which closely aligns with CDM 2015.
- The RP has implemented these processes effectively throughout GDA.
- The RP has utilized the experience and knowledge of the UK-based Principal Designer CDM Advisor to improve the implementation of the Construction Design Management Strategy and CDM Design Risk Management Work Instruction.
- The DRRs and MHL are of a high standard and have played an effective role in the elimination and mitigation of hazard and risk throughout GDA.
- Information has been prepared in the form of DRR's and MHL to be passed to the licensee at the end of GDA and are in a format ready to be incorporated into any proposed site-specific BIM model.

### 4.8.3 Outcomes

161. In my opinion I am satisfied that, through the approach taken by designers, the Principal Designer, and the Principal Designer CDM Advisor to comply with CDM 2015, there has been an effective process of conventional health and safety hazard and risk elimination and mitigation applied to the generic UK HPR1000 design.

### 4.8.4 Conclusion

162. I am satisfied in my assessment of ALARP, that the RP has implemented suitable design processes to enable the generic UK HPR1000 design to meet the requirements of relevant GB legislation, ACoPs and RGP and reduce the hazards and risks in the design. By taking this approach I have confidence that a site licensee can ensure the conventional health and safety risks are reduced to ALARP.

## 4.9 Consolidated Safety Case

### 4.9.1 Assessment

163. The purpose of Chapter 25 of the PCSR (Ref. 2) is to provide information relating to conventional health and safety that demonstrates that the generic UK HPR1000 design is compliant with the requirements of GB legislation, ACoPs and RGP to achieve the fundamental objective set out in section 25.2.1.

164. Table T-25-2-2 of the PCSR identifies where interfaces exist between Chapter 25 and the other Chapters that make up the wider safety report. I judge this as important as the RP demonstrates that the requirements of Regulation 9 of CDM 2015 and the application of the GPP to eliminate, reduce, isolate, or control the conventional health and safety risks applies to all stages of the generic UK HPR1000 design.

165. Section 25.3.1 of the PCSR demonstrates that the RP has performed an analysis of applicable legislation, codes and standards that are relevant to conventional health and safety. I judge this demonstration of knowledge as significant as it helps to confirm that the RP has a wide understanding of the requirements that need to be considered by designers when applying the GPP to the generic UK HPR1000 design.

166. Reference is made within the PCSR to how the RP will comply with the requirements of CDM 2015. The UK HPR1000 Construction Design Management Strategy Document (Ref. 26) describes the arrangements the RP has established to meet the requirements of CDM 2015 during the GDA process. This includes the identification and the appointment of the Client, designers, and the Principal Designer. It also identifies BRB Gen Co as a key stakeholder as they are the licensee for the Bradwell ‘B’ NPP.

167. The strategy document (Ref. 26) establishes the expected standards of health and safety in design. This includes applying the GPP and all hierarchies of design controls, the recording of design-generated hazard and risk information in DRRs / MHL, the creation of pre-construction information, and communicating that information to the appropriate people at the earliest opportunity.

168. The CDM Design Risk Management Work Instruction provides detail of how the process of hazard identification, risk elimination/mitigation to ALARP, recording of hazard / risk information, and communication will take place. This process also includes a formal design gateway review process carried out by the Principal Designer or the Principal Designer CDM Advisor role holders. I have found that the RP has demonstrated this approach during Step 4a of GDA assessment.

169. As my Step 4 GDA assessment of Conventional Health and Safety in the generic UK HPR1000 design has progressed, the RP has presented arguments and evidence to support the claims made in Chapter 25 of the PCSR. This has been in the form of topic reports, and Regulatory Queries to which the RP has provided responses. I am satisfied that this information has been adequately consolidated into Chapter 25 of the PCSR. The information has demonstrated the robustness of the conventional health and safety risk management process established by the RP.

### 4.9.2 Strengths

170. During my assessment of Chapter 25 of the Consolidated Safety Case I have identified the following strengths:

- The RP has identified the interfaces between Chapter 25 and the other chapters of the Safety Case, as they have recognised that conventional health and safety risks need to be addressed throughout the generic UK HPR1000 design.
- The RP demonstrates an awareness of the requirements of GB legislation, ACoPs and RGP that are relevant to conventional health and safety during the generic design of the UK HPR1000.
- The RP has established a UK HPR1000 Construction Design Management Strategy Document which addresses the requirements of CDM 2015.
- The RP has developed the CDM Design Risk Management Work Instruction which contains a clear process for addressing hazard and risk in design and provides clarity to CDM 2015 dutyholders with respect to how they must comply with their duties.

### 4.9.3 Outcomes

171. I have found in my assessment of Chapter 25 of the Consolidated Safety Case that the RP has demonstrated a thorough understanding of relevant GB legal requirements, including the requirement to apply the GPP throughout the generic UK HPR1000 design. Chapter 25 explains how the GPP are being applied and refers to evidence of examples taken from the generic UK HPR1000 design where Conventional Health and Safety risks have been reduced to ALARP.

172. As the generic design continues to evolve it is essential that the designers, the Principal Designer, and the Principal Designer CDM Advisor continue to implement the requirements of the Construction Design Management Strategy and the CDM Design Risk Management Work Instruction to ensure the design continues to remain compliant with GB legal requirements.

### 4.9.4 Conclusion

173. From my assessment, I am content that in respect of Conventional Health and Safety aspects, the safety case set out in Chapter 25 of the PCSR accurately reflects the RP's approach to the generic design. I consider that this approach meets the expectations of the relevant SAPs.

174. The supporting evidence supplied by the RP has been consolidated and is consistent with my overall assessment of Conventional Health and Safety.

## 4.10 Comparison with Standards, Guidance and Relevant Good Practice

175. The standards, guidance and RGP used in the assessment have been referenced and commented on throughout section 4, with the most relevant standards listed in section 2.4.3.

176. The RP has demonstrated compliance with these standards throughout my assessment of Conventional Health and Safety.

# 5 CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Conclusions

177. This report presents the findings of my Conventional Health and Safety assessment of the generic UK HPR1000 design as part of the GDA process.

178. Based on my assessment, undertaken on a sampling basis, I have concluded the following:

- I am satisfied that the RP has demonstrated sufficient appreciation, understanding and application of GB conventional health and safety requirements.
- The RP has developed a CDM 2015 strategy and procedure which requires the application of the GPP and ERIC principles during the generic design of the UK HPR1000.
- The evidence supplied from the RP during my assessment has demonstrated the application of the GPP and ERIC Principles sufficient for GDA.
- Where possible conventional health and safety risks within the generic UK HPR1000 design have been eliminated or reduced ALARP.
- Where residual hazards and risks remain that cannot be fully addressed during the GDA, the RP has systematically recorded them to ensure they can be effectively communicated and considered during future design work.

179. Overall, based on my sample assessment of the safety case for the generic UK HPR1000 design undertaken in accordance with ONR's procedures, I am satisfied that the case presented within the PCSR and supporting documentation is adequate. On this basis, I am content that a DAC should be granted for the Generic UK HPR1000 design from a Conventional Health and Safety perspective.

## 5.2 Recommendations

180. Based upon my assessment detailed in this report, I recommend that:

- **Recommendation 1**: From a Conventional Health and Safety perspective, ONR should grant a DAC for the generic UK HPR1000 design.
- **Recommendation 2**: The Assessment Finding identified in the report must be resolved by a future licensee for a site-specific adaptation of the generic UK HPR1000 design.

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## Annex 1

Assessment Findings

| Number | Assessment Finding | Report Section |
|---|---|---|
| AF-UKHPR1000-0156 | The licensee shall, as part of detailed design, justify whether the UK HPR1000 fuel route, including the transfer compartment, spent fuel pond, cleaning pit, and loading pit, are required to be risk assessed as confined spaces as defined by the Confined Space Regulations 1997. This should demonstrate that risks have been reduced as low as reasonably practicable and include construction, operation and examination, maintenance, inspection, and testing activities. | Section 4.7 |