

UK ABWR

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UK ABWR Generic Design Assessment

Consideration of and Compliance with the Radioactive Substances Regulation Environmental Principles (REPs)



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1. Acronyms

ABWR	Advanced Boiling Water Reactor
ALARA	As Low As Reasonably Achievable
BAT	Best Available Techniques
FAP	Forward Action Plan
GDA	Generic Design Assessment
GEP	Generic Environmental Permit
HF	Human Factors
IWS	Integrated Waste Strategy
OpEx	Operational Experience
P&ID	Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Design
PCSR	Pre-Construction Safety Report
QMP	Quality Management Plan
REP	Radioactive Substances Regulation – Environmental Principle
RWMA	Radioactive Waste Management Arrangement
SQEP	Suitably Qualified and Experienced Person (UK)
UK	United Kingdom

2. References

- [Ref-1] Process and Information Document for the Generic Assessment of Candidate Nuclear Power Plant Designs, version 2, Environment Agency, March 2013
- [Ref-2] Radioactive Substances Regulation – Environmental Principles, version 2, Environment Agency, April 2010
- [Ref-3] Radioactive Waste Management Arrangements, GA91-9901-0022-00001, WE-GD-0001, Rev. D, Hitachi-GE, August 2014.
- [Ref-4] Approach to Optimisation, GA91-9901-0021-00001, XE-GD-0096, Rev. D, Hitachi-GE, August 2014.
- [Ref-5] Demonstration of BAT, GA91-9901-0023-00001, XE-GD-0097, Rev. D, Hitachi-GE, August 2014.
- [Ref-6] Genesis of ABWR Design, GA91-9901-0011-00001, XE-GD-0083, Rev. A, Hitachi-GE, 04 October 2013
- [Ref-7] Quantification of Discharges and Limits, GA91-9901-0025-00001, HE-GD-0004, Rev. D, Hitachi-GE, August 2014.
- [Ref-8] Approach to Sampling and Monitoring, GA91-9901-0029-00001, 3E-GD-K002, Rev. D, Hitachi-GE, August 2014.
- [Ref-9] Description of Hitachi-GE Organisation Capability, Systems and Management Arrangements, GA91-9901-0016-00001, XE-GD-0085, Rev. A, Hitachi-GE, 03 October 2013
- [Ref-10] Quality Management Plan (For UK ABWR GDA Project), GA70-1501-0007-00001, GNQA13-0066, Rev. 4, Hitachi-GE, August 2014.
- [Ref-11] Prospective Dose Modelling, GA91-9901-0026-00001, HE-GD-0005, Rev. D, Hitachi-GE, August 2014.
- [Ref-12] Generic Site Description, GA91-9901-0020-00001, XE-GD-0095, Rev. D, Hitachi-GE, August 2014.
- [Ref-13] Other Environmental Regulations, GA91-9901-0027-00001, XE-GD-0098, Rev. D, Hitachi-GE, August 2014.
- [Ref-14] Summary of the Generic Environmental Permit Applications, GA91-9901-0019-00001, XE-GD-0094, Rev. D, Hitachi-GE, August 2014.

3. Introduction

The Environment Agency has identified the information they require to assess the environmental impacts of the UK ABWR at a generic site in their Process and Information Document for the Generic Assessment of Candidate Nuclear Power Plant Designs (P&ID) [Ref-1]. The P&ID states that the Environment Agency's assessment of the requesting parties' submission (Hitachi-GE in the case of the UK ABWR) will be guided by their Radioactive Substances Regulation - Environmental Principles (REPs) [Ref-2].

The REPs are intended to form a consistent and standardised framework for the technical assessments and judgements that are made by the Environment Agency in relation to radioactive substances regulation, across permitting, compliance and enforcement. As such they are an important reference for Hitachi-GE as part of the design process for the UK ABWR, to ensure acceptability of the UK ABWR as part of the GDA.

This document identifies the REPs which Hitachi-GE believes are relevant to the UK ABWR GDA process. If relevant, a statement of compliance is provided along with a reference to the relevant part of the GDA submission to provide the necessary evidence (including the Generic Environmental Permit (GEP), Pre-Construction Safety Report (PCSR) and PCSR/GEP Common Documents (e.g. Genesis of ABWR Design [Ref-6], etc. A summary of the documentation that is included as part of the GEP submission is shown in the GEP Summary Document [Ref-14].)). This information is provided to allow the Environment Agency (and other interested parties) to determine the basis of Hitachi-GE's GDA submission, and carry out their own check or assessments, as required.

The content of this document represents an assessment based on the information submitted at GDA Step 2. The information presented here is likely to evolve but a complete assessment will be presented for Step 3.

4. Applicability of the REPs to GDA

Hitachi-GE has reviewed the full list of 'Fundamental' and 'Generic Developed Principles: Regulatory Assessment' [Ref-2] for applicability to the entire GDA submission, including the PCSR, GEP and the Common Documents. The 'Generic Developed Principles: Regulatory Process' REPs have been deemed to be entirely out of scope of Hitachi-GE's assessment since they govern the activities of the Regulator, rather than guiding the provision of specific RSR content for assessment.

The Fundamental Principles have been deemed to be captured within the design of the reactor itself (taking into account its genesis and feedback from operational experience) as well as the management and organisational philosophy of Hitachi-GE, demonstrated throughout the overall GDA process. However, some elements may require continued action from the site operator and these points are highlighted. A description of compliance with each of these principles is provided in section 4.1 below. It is also worth noting that the Fundamental Principles are, where relevant, effectively embodied in the 'Generic Developed Principles: Regulatory Assessment' ('Generic REPs') (see below).

The "Generic" REPs are more relevant to the UK ABWR and any particular Requesting Party. Individual REPs in this category are highlighted in the Environment Agency's P&ID document [Ref-1] to guide the development of the content of the requesting party's GDA submission. As a consequence, Hitachi-GE has assessed which Generic REPs they believe to be applicable to the UK ABWR design and GDA process and provided a signpost to the relevant part of the GDA submission documentation where the Generic REP is addressed. This is an appropriate approach due to the cross-cutting nature of many of the Generic REPs, which (amongst other things) focus on design principles, safety assessment and management practices as well as radioactive waste management practices. The output of this review is provided in Table 4.2-1 in section 4.2 below. Where Generic REPs are deemed not to be relevant to the GDA process or Hitachi-GE's submission due to the nature of the project or because the REP concerns site-specific licensing activities this is also highlighted.

4.1. RSR Fundamental Principles

Fundamental Principle A – Sustainability

Radioactive substances should be managed to avoid placing a burden on future generations and their environment such that it compromises their ability to meet their needs.

The UK ABWR design supports sustainability through the minimisation of radioactive substances at source, a major input into the waste management process. This is supported by further design characteristics that promote recycling of material (such as the cooling water system). Site-specific application of the reactor technology, including further application of Best Available Technique (BAT) and abatement technologies, by the operator is therefore enabled through the design and the GDA process.

Fundamental Principle B – Stakeholders

To give confidence that the right decisions will be made for the right reasons, citizens, communities and organisations should have access to information relating to radioactive substances, key decisions should be informed by their views, and the right to justice should be respected.

Hitachi-GE is fully committed to the openness and transparency of the GDA process, including the public consultation undertaken by the Environment Agency, and is supporting the process with the ongoing and timely provision of required information. The Hitachi-GE GDA website is now live and will greatly assist the engagement of stakeholders on the development of the Hitachi-GE submission.

Fundamental Principle C – Integrated Planning

All radioactive substances should be managed within integrated strategies that plan their complete lifecycle taking account of all interactions, dependencies and principles.

Waste management is accounted for across the design and operation of the UK ABWR through consideration of the waste hierarchy and a ‘designed for decommissioning’ philosophy. The Radioactive Waste Management Arrangements (RWMA) document [Ref-3] submitted as part of the GEP delivers a comprehensive overarching strategy under which specific waste management activities and plans for the UK ABWR are to be co-ordinated. The RWMA document also paves the way for effective interfacing with subsequent operator-led work, including Integrated Waste Strategies (IWS), for future sites.

Fundamental Principle D – Selecting and Implementing Management Options

The best available techniques for the management of radioactive substances should be used. These should be identified from systematic consideration of potential alternatives. Consideration should include human health, safety, the environment, waste prevention, minimisation and disposal and other likely costs and benefits.

A comprehensive review of the application of BAT to the UK ABWR design has been carried out to support the GEP submission [Ref-4] [Ref-5]. This optimisation process will be ongoing and the studies and assessments undertaken as part of GDA will enable future operators to revisit and update the work at appropriate intervals over the duration of the plant’s lifecycle. Hitachi-GE is confident that the evidence presented within the BAT Case shows that the best available technologies have been selected.

Fundamental Principle E – Protecting Human Health and the Environment

Radioactive substances should be managed to ensure an optimal level of protection to human health, wildlife, organisms and the wider environment, and compliance with relevant dose limits and constraints is achieved. Monitoring and assessment should be undertaken to inform decisions about radioactive substances and to establish the state of the environment.

The UK ABWR design itself is optimised to reduce radiological exposure to its operators, the public and the surrounding environment. This is demonstrated through the genesis of the design [Ref-6] and its refinement through operational experience. The proposed discharge limits made as part of this submission [Ref-7] are also within the conservative estimate required at this stage whilst the sampling and monitoring system is based upon significant operational experience [Ref-8].

Fundamental Principle F – Regulation

Regulatory systems for radioactive substances should be independent, seek best practice through high standards of management, take account of risk, and be transparent, accountable, consistent and targeted.

This principle is not applicable to Hitachi-GE’s role as the requesting party of GDA; however Hitachi-GE support the approach adopted by the UK Regulators.

Fundamental Principle G – Best Scientific Knowledge

Decisions on radioactive substances should be informed by the best scientific knowledge. Appropriate research should be undertaken to facilitate technology development, to promote innovative solutions and where significant gaps in knowledge are recognised.

The UK ABWR is the latest application of a design that has nearly 15 years of operating experience and refinement; this operating knowledge extends to the radioactive waste management system and the management of radioactive substances.

Fundamental Principle H – Uncertainties and the Precautionary Principle

Decisions about radioactive substances should take into account uncertainties and where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing cost effective measures to prevent potential harm to people and the environment.

Design of the reactor and its associated radioactive waste management systems fully account for the precautionary principle. The effects of uncertainties on system design and equipment selection are included as part of the safety case process.

Fundamental Principle I – Polluter Pays

Producers, owners and users of radioactive substances should be accountable for the costs of managing and disposing of their radioactive substances, for associated regulation and research and for rectifying environmental damage.

This principle is not directly applicable to Hitachi-GE’s role as part of GDA and will be for the operator of any future site to consider. However, the UK ABWR is designed in such a way to minimise radioactive waste arisings and discharges, which will put the future operator in the best position possible to discharge its related responsibilities.

Fundamental Principle J – Justification of Practices and Interventions

Benefits and detriments arising from practices or interventions involving radioactive substances should be considered to establish whether the practice or intervention is justified.

As part of the process to build new UK ABWR powerstations in the UK, there is a need to undertake a assessment to establish whether the practice (i.e. the operation of UK ABWR in the UK) or intervention is justified. This is being undertaken by potential future site operators.

4.2. Generic Developed Principles: Regulatory Assessment

The following table sets out the main REPs, the link between the REP and the GDA P&ID, the details of the REP itself and how Hitachi-GE aim to address it within the design and documentation for GDA of the UK ABWR.

Table 4.2-1: Review of Generic REP Applicability and Statement of Compliance

REP	Relevant P&ID item	REP Principle	Approach to Compliance
MLDP1 - Establishing and Sustaining Leadership and Management	2. A description of the requesting party's management arrangements and responsibilities	All organisations whose activities might adversely affect people or the environment should establish and sustain effective leadership and management for the environment to ensure that people and the environment are properly protected from adverse effects.	The UK ABWR will be shown to comply with MLDP1 during GDA. Hitachi-GE's management systems are outlined in the Description of Hitachi-GE Organisation Capability, Systems and Management Arrangements document [Ref-9]. This is supported by the GDA project's own Quality Management Plan [Ref-10] (QMP), with the approach to environmental leadership described in the Management Commitment sub-section. Maintenance of SQEP environmental capability is managed through the Resource Management process documented in the QMP.
MLDP2 - High Standards of Environment Protection	2. A description of the requesting party's management arrangements and responsibilities	Directors, managers and leaders at all levels should focus the organisation on achieving and sustaining high standards of protection of people and the environment.	The UK ABWR will be shown to comply with MLDP2 during GDA. The environmental responsibilities of all levels of management staff are described in the Management Commitment sub-section of the QMP [Ref-10], along with provision of the relevant organisational policies.
MLDP3 - Capability	2. A description of the requesting party's management arrangements and responsibilities	Organisations should have the capability to secure and maintain proper protection of people and the environment.	The UK ABWR will be shown to comply with MLDP3 during GDA. Hitachi-GE's management systems are outlined in the Description of Hitachi-GE Organisation Capability, Systems and Management Arrangements document [Ref-9]. Resource management is described in QMP [Ref-10] with the capability of staff through their skills, competencies and knowledge is maintained via the documented SQEP procedure. The technical provision made to secure protection of people and environment is provided across the PCSR and GEP documents.

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
MLDP4 - Decision Making	2. A description of the requesting party's management arrangements and responsibilities	Decisions at all levels that might affect environment protection should be rational, objective, timely, transparent and prudent.	The UK ABWR will be shown to comply with MLDP4 during GDA. The Hitachi-GE decision-making process gives full consideration to any potential environmental effects. For the GDA, this is achieved through internal design development procedures and adherence to the SQEP process and readiness review stipulated in the QMP [Ref-10].
MLDP5 - Learning from Experience	2. A description of the requesting party's management arrangements and responsibilities	Organisations should learn from their own and others' experience so as to continually improve their ability to protect the environment.	The UK ABWR will be shown to comply with MLDP5 during GDA. The Measurement, Assessment and Improvement process detailed in the QMP [Ref-10] details the internal and external assessment that will be undertaken to learn from OpEx from both within and outside Hitachi-GE. Monitoring and assessment will provide opportunity for feedback, corrective and preventative actions.
RSMDP1 - Radioactive Substances Strategy	4. A detailed description of the radioactive waste management arrangements	A strategy should be produced for the management of all radioactive substances.	The UK ABWR will be shown to comply with RSMDP1 during GDA. A comprehensive waste management strategy is provided in the RWMA document [Ref-3].
RSMDP2 - Justification	4. A detailed description of the radioactive waste management arrangements	Radioactive wastes shall not be created unless the practice giving rise to the waste has been justified (in advance for new practices).	The UK ABWR will be shown to comply with RSMDP2 during GDA. This principle is fundamentally addressed through the commencement of the GDA process (see Fundamental Principle J).
RSMDP3 - Use of BAT to minimise waste	4. A detailed description of the radioactive waste management arrangements	The best available techniques should be used to ensure that production of radioactive waste is prevented and where that is not practicable minimised with regard to activity and quantity.	The UK ABWR will be shown to comply with RSMDP3 during GDA. The design of the UK ABWR will ensure that the production and disposal of radioactive substances will be minimised over the lifetime of the facility including testing, maintenance, operating and decommissioning. The details of the optimisation process are shown in the Approach to Optimisation report [Ref-4] of the GEP submission with the demonstration shown in the Demonstration of BAT report [Ref-5].

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
RSMDP4 - Methodology for Identifying BAT	4. A detailed description of the radioactive waste management arrangements	The best available techniques should be identified by a methodology that is timely, transparent, inclusive, based on good quality data, and properly documented.	<p>The UK ABWR will be shown to comply with RSMDP4 during GDA.</p> <p>The methodology for identifying BAT is provided in the Approach to Optimisation document [Ref-4]. This assessment process will remain live and the results updated over time as new data and technologies become available. The results of all BAT assessments will be properly documented in accordance with the management system outlined in Hitachi-GE's Document Control Manual.</p>
RSMDP5 - Actions having Irreversible Consequences	4. A detailed description of the radioactive waste management arrangements	Actions with radioactive substances having irreversible consequences should only be undertaken after thorough, detailed, consideration of the potential consequences of those actions and of the other available options. The best available techniques should be used to prevent irreversible consequences from occurring inadvertently.	<p>The UK ABWR will be shown to comply with RSMDP5 during GDA.</p> <p>The RWMA document [Ref-3] outlines the thorough and considered philosophy underpinning all radioactive waste management decisions. The Approach to Optimisation report [Ref-4] highlights the process by which specific waste management decisions are made, where full consideration is given to all possible options in a structured and auditable process. The strategy outlined in the RWMA document [Ref-3] will be updated should the BAT case require updating.</p>
RSMDP6 - Application of BAT	4. A detailed description of the radioactive waste management arrangements	In all matters relating to radioactive substances, the "best available techniques" means the most effective and advanced stage in the development of activities and their methods of operation.	<p>The UK ABWR will be shown to comply with RSMDP6 during GDA.</p> <p>The systems and components of the UK ABWR relating to the management of radioactive substances will be designed and operated using the most effective and appropriate methodology and techniques, as identified through the methodology outlined in Approach to Optimisation report [Ref-4] with the proposed practices detailed in the RWMA [Ref-3].</p>

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
RSMDP7 - BAT to Minimise Environmental Risk and Impact	4. A detailed description of the radioactive waste management arrangements	When making decisions about the management of radioactive substances, the best available techniques should be used to ensure that the resulting environmental risk and impact are minimised.	The UK ABWR will be shown to comply with RSMDP7 during GDA. All decision-making regarding the management of radioactive substances for the UK ABWR will comply with the process outlined in the Approach to Optimisation report [Ref-4] to ensure that any resulting environmental risk and impact are minimised, with the demonstration provided in the Demonstration of BAT report [Ref-5]. Systems descriptions are provided in PCSR Chapter 18 Radioactive Waste Management.
RSMDP8 - Segregation of Wastes	4. A detailed description of the radioactive waste management arrangements	The best available techniques should be used to prevent the mixing of radioactive substances with other materials, including other radioactive substances, where such mixing might compromise subsequent effective management or increase environmental impacts or risks.	The UK ABWR will be shown to comply with RSMDP8 during GDA. Fundamentally the design of the UK ABWR takes into account the needs of appropriate waste management techniques, such as maintaining separation of waste streams where appropriate. The RWMA document [Ref-3] in the GEP demonstrates the philosophy underpinning waste management arrangements, including appropriate emphasis on the waste hierarchy. The Approach to Optimisation report [Ref-4] demonstrates how the most suitable equipment and management techniques are assessed and applied. Systems descriptions are provided in PCSR 18 Radioactive Waste Management.
RSMDP9 - Characterisation	4. A detailed description of the radioactive waste management arrangements	Radioactive substances should be characterised using the best available techniques so as to facilitate their subsequent management, including waste disposal.	The UK ABWR will be shown to comply with RSMDP9 during GDA. Each major radioactive waste group (i.e. solid, liquid, gaseous) will be managed in accordance with best available techniques, including the characterisation of individual streams, to ensure most appropriate handling and disposal. This approach is outlined in the RWMA document [Ref-3].

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RSMDP10 - Storage	4. A detailed description of the radioactive waste management arrangements	Radioactive substances should be stored using the best available techniques so that their environmental risk and environmental impact are minimised and that subsequent management, including disposal is facilitated.	The UK ABWR will be shown to comply with RSMDP10 during GDA. Liquid waste and solid waste will be stored independently inside multi-layered containment to prevent any radioactivity leaks from the facilities. The storage methods for liquid and solid waste will be demonstrated to be BAT through the Demonstration of BAT [Ref-5]. Further information on the proposed practices is outlined in the RWMA document [Ref-3].
RSMDP11 - Storage in a Passively Safe State	4. A detailed description of the radioactive waste management arrangements	Where radioactive substances are currently not stored in a passively safe state and there are worthwhile environmental or safety benefits in doing so then the substances should be processed into a passively safe state.	The UK ABWR will be shown to comply with RSMDP11 during GDA. Mobile solid wastes and liquid wastes will require conditioning to a passively safe condition as soon as is reasonably practicable. Concentrating waste and resin conditioning technology to deliver a solid waste form will be applied. The approach to be taken is outlined in the RWMA [Ref-3].
RSMDP12 - Limits and Levels on Discharges	5. Quantification of radioactive waste disposals	Limits and levels should be established on the quantities of radioactivity that can be discharged into the environment where these are necessary to secure proper protection of human health and the environment.	The UK ABWR will be shown to comply with RSMDP12 during GDA. Limits and levels commensurate with UK legislation and regulation are outlined in the Proposed Limits section of the Prospective Dose Modelling report [Ref-11] and Quantification of Discharges and Limits report [Ref-7].

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
RSMDP13 - Monitoring and Assessment	6. A description of the sampling arrangements, techniques and systems for measurement and assessment of discharges and disposals of radioactive waste.	The best available techniques, consistent with relevant guidance and standards, should be used to monitor and assess radioactive substances, disposals of radioactive wastes and the environment into which they are disposed.	The UK ABWR will be shown to comply with RSMDP13 during GDA. The monitoring information and techniques used will be provided in the Approach to Sampling & Monitoring report [Ref-8] of the GEP submission. The assessment information will be provided in Prospective Dose Modelling report [Ref-11].
RSMDP14 - Record Keeping	3. Detailed information relating to the design 4. A detailed description of the radioactive waste management arrangements	Sufficient records relating to radioactive substances and associated facilities should be made and managed so as: to facilitate the subsequent management of those substances and facilities; to demonstrate whether compliance with requirements and standards has been achieved; and to provide information and continuing assurance about the environmental impact and risks of the operations undertaken, including waste disposal.	The UK ABWR will be shown to comply with RSMDP14 during GDA. The RWMA document [Ref-3] outlines the processes that will be undertaken to safely manage radioactive waste. Records associated with all radioactive substances and associated facilities will be properly documented in accordance with the management system outlined in Hitachi-GE's Document Control Manual.
RSMDP15 - Requirements and Conditions for Disposal of Wastes	4. A detailed description of the radioactive waste management arrangements	Requirements and conditions that properly protect people and the environment should be set out and imposed for disposal of radioactive waste. Disposal of radioactive waste should comply with imposed requirements and conditions.	The UK ABWR will be shown to comply with RSMDP15 during GDA. Disposability assessments and Radioactive Waste Management Cases for significant waste streams will be provided in the RWMA document [Ref-3]. The information provided in these sections will meet all relevant UK legislation and regulatory guidance.

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
RPDP1 - Optimisation of Protection	7. A prospective radiological assessment at the proposed limits for discharges and for any on-site incineration	All exposures to ionising radiation of any member of the public and of the population as a whole shall be kept as low as reasonably achievable (ALARA), economic and social factors being taken into account.	The UK ABWR will be shown to comply with RPDP1 during GDA. Demonstration that the UK ABWR design as a whole reduces exposure to ionising radiation ALARA is provided in the wider PCSR submission. Waste management processes and discharge and disposal systems will be designed to ensure public exposure to ionising radiation is ALARA. UK ABWR design will consider the appropriate application of BAT. Evidence of this is provided by the Approach to Optimisation [Ref-4] and the Demonstration of BAT [Ref-5], as well as the results of the Prospective Dose Modelling [Ref-11].
RPDP2 - Dose Limits and Constraints	7. A prospective radiological assessment at the proposed limits for discharges and for any on-site incineration	Radiation doses to individual people shall be below the relevant dose limits and in general should be below the relevant constraints.	The UK ABWR will be shown to comply with RPDP2 during GDA. Radiation exposure from the UK ABWR (including individual dose) is compliant with the relevant dose limits and constraints. This is demonstrated in Prospective Dose Modelling [Ref-11] as well as PCSR Chapter 20 Radiation Protection.
RPDP3 - Protection of Non-Human Species	7. A prospective radiological assessment at the proposed limits for discharges and for any on-site incineration	Non-human species should be adequately protected from exposure to ionising radiation.	The UK ABWR will be shown to comply with RPDP3 during GDA. Local flora and fauna in the surrounding environment are adequately protected from the effects of radiation, with any exposure within required limits. This is achieved through the use of BAT, shown in the Demonstration of BAT [Ref-5] and Prospective Dose Modelling [Ref-11].
RPDP4 - Prospective Dose Assessments for Radioactive Discharges into the Environment	7. A prospective radiological assessment at the proposed limits for discharges and for any on-site incineration	Assessments of potential doses to people and to non-human species should be made prior to granting any new or revised permit for the discharge of radioactive wastes into the environment.	The UK ABWR will be shown to comply with RPDP4 during GDA. It can be confirmed that the potential doses to people and non-human species is sufficiently low to allow application for a new discharge permit to be progressed by the prospective operator. This is demonstrated by the Prospective Dose Modelling [Ref-11].

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
SEDP1 - General Principle for Siting of New Facilities	1. General information relating to the requesting party and the design	When evaluating sites for a new facility, account should be taken of the factors that might affect the protection of people and the environment from radiological hazards and the generation of radioactive waste.	The UK ABWR will be shown to comply with SEDP1 during GDA. The generic UK ABWR plant is designed to protect people and the environment from radiological hazards and the generation of radioactive waste. The assumed parameters used to assess any radiological impact from operations or waste disposal are outlined in the Generic Site Description [Ref-12].
SEDP2 - Migration of Radioactive Material in the Environment	1. General information relating to the requesting party and the design	Data should be provided to allow the assessment of rates and patterns of migration of radioactive materials in the air and the aquatic and terrestrial environments around sites.	The UK ABWR will be shown to comply with SEDP2 during GDA. The UK ABWR will be shown to comply with this requirement during GDA; the necessary data will be provided during a later step.
SEDP3 - Ambient Radioactivity	1. General information relating to the requesting party and the design	Levels of ambient radioactivity around the sites of new facilities should be assessed.	The UK ABWR will be shown to comply with SEDP3 during GDA. This requirement will be addressed in full during the licensing process as it is a site-specific issue. The Prospective Dose Modelling [Ref-11] uses generic assumed parameters commensurate with UK regulatory guidance, which will enable this subsequent step by any future licensee.
SEDP4 - Multi-Facility Sites	1. General information relating to the requesting party and the design	In the case of nuclear and other sites on which there are already one or more facilities, the radiological impact of the whole site on people and the environment should be assessed when considering the suitability of the site for any new facility.	The UK ABWR will be shown to comply with SEDP4 during GDA. This requirement will be addressed in full during the licensing process as it is a site-specific issue. The Prospective Dose Modelling [Ref-11] uses generic assumed parameters commensurate with UK regulatory guidance, which will enable this subsequent step by any future licensee.

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
SEDP5 - On-Going Evaluation	1. General information relating to the requesting party and the design	The characteristics of the site and its surrounding area should be kept under review and assessments made of the effects of natural and man-made changes.	<p>The UK ABWR will be shown to comply with SEDP5 during GDA.</p> <p>The Generic Site Description [Ref-12] defines the parameters of the radiological and environmental modelling which will remain consistent throughout GDA; however, following site licensing, any changes to site characteristics will be monitored and any necessary additional assessment managed.</p>
ENDP1 - Inherent Environmental Protection	3. Detailed information relating to the design	The underpinning environmental aim for any facility should be that the design inherently protects people and the environment, consistent with the operational purpose of the facility.	<p>The UK ABWR will be shown to comply with ENDP1 during GDA.</p> <p>The generic UK ABWR plant is designed to protect people and the environment from radiological hazards and the generation of radioactive waste; this will be demonstrated during the entirety of the GDA process with specific evidence detailed in the Demonstration of BAT report [Ref-5].</p>
ENDP2 - Avoidance and Minimisation of Impacts	<p>5. Quantification of radioactive waste disposals</p> <p>7. A prospective radiological assessment at the proposed limits for discharges and for any on-site incineration</p>	Radiological impacts to people and the environment should be avoided and where that is not practicable minimised commensurate with the operations being carried out.	<p>The UK ABWR will be shown to comply with ENDP2 during GDA.</p> <p>Demonstration that the UK ABWR design as a whole reduces exposure to ionising radiation as a whole is ALARA is provided in the wider PCSR. Waste management process, discharge and disposal systems will be designed to ensure public exposure to ionising radiation is ALARA, through appropriate application of BAT. Demonstration of this is provided by the Approach to Optimisation [Ref-4] and Demonstration of BAT [Ref-5], as well as the Prospective Dose Modelling [Ref-11]. Systems descriptions are provided in PCSR Chapter 18 Radioactive Waste Management.</p>

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
ENDP3 - Defence in Depth	4. A detailed description of the radioactive waste management arrangements	A facility should be designed as to allow for defence in depth against the occurrence of radiological impacts to people and the environment.	<p>The UK ABWR will be shown to comply with ENDP3 during GDA.</p> <p>The UK ABWR contains multiple systems to protect against radiological impacts; compliance with ENDP3 will be shown during GDA. The configuration of the Off-gas adsorption and supporting HVAC system, which minimise activity and quantity of radioactive discharge to air are described in PCSR Chapter 18 Radioactive Waste Management.</p> <p>Processed water will be reused to the maximum possible extent within the plant to reduce the quantity of possible activity release. The system is outlined in PCSR Chapter 18 Radioactive Waste Management.</p>
ENDP4 - Environment Protection Functions and Measures	4. A detailed description of the radioactive waste management arrangements	Environment protection functions under normal and fault conditions should be identified, and it should be demonstrated that adequate environment protection measures are in place to deliver these functions.	<p>The UK ABWR will be shown to comply with ENDP4 during GDA.</p> <p>This information will be provided in the RWMA document [Ref-3]. Furthermore, radiation monitoring system arrangements are described in the Approach to Sampling & Monitoring [Ref-8].</p>
ENDP5 - Human Factors	4. A detailed description of the radioactive waste management arrangements	Human actions should be taken into account in the design of a facility and in operating procedures.	<p>The UK ABWR will be shown to comply with ENDP5 during GDA.</p> <p>The effect of human actions will be considered in the design of each facility and in operating procedures, addressing all REPs where the importance of human actions is indicated. The further details are presented in PCSR Chapter 27 Human Factors (HF), including considerations for the environmentally significant systems. Review and assessment of HF integrations across the GDA submissions are an ongoing process.</p> <p>Specifically the design of Radioactive Waste Management systems is also taken such requirements into consideration and is designed to prevent incorrect operations (outlined in Chapter 18 of the PCSR). Similarly, these considerations are integrated into the Sampling and Monitoring systems.</p>

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
ENDP6 - Engineering Codes and Standards	4. A detailed description of the radioactive waste management arrangements	Environment protection measures should be designed, manufactured, constructed, installed, commissioned, quality assured, maintained, tested and inspected to the appropriate standards.	<p>The UK ABWR will be shown to comply with ENDP6 during GDA.</p> <p>The UK ABWR will consider appropriate regulations, codes and standards to deliver environment protection in every aspect of the design, manufacture, construction, installation, commissioning, quality assuring, maintenance, testing and inspection phase. The process by which equipment is categorised and classified is outlined in PCSR Chapter 5 General Design Aspects.</p> <p>The GEP provides more detailed information on the individual environment protection measures across the different reactor support systems.</p>
ENDP7 - Reliability	4. A detailed description of the radioactive waste management arrangements	A facility should be so designed and operated that the environment protection measures are reliable.	<p>The UK ABWR will be shown to comply with ENDP7 during GDA.</p> <p>The UK ABWR design will consider the robustness and reliability of the facilities that deliver environment protection, and their design will consider the implication of system failure. In some areas this may be evidenced once the design reference point is set. The GEP submission will provide information on the design and operation of all facilities relating to environment protection.</p>
ENDP8 - Ageing and Degradation	4. A detailed description of the radioactive waste management arrangements	The working life of an environment protection measure that is intended to deliver an environment protection function should be assessed to ensure that the measure will be effective during its intended lifetime.	<p>The UK ABWR will be shown to comply with ENDP8 during GDA.</p> <p>The major systems such as the Off-gas system, Liquid Waste Management system, Solid Waste Management arrangements (including interim measures) address this principle (PCSR Chapter 18 Radioactive Waste Management provides systems descriptions). However, some aspects may only be defined during later GDA stages once the design reference point has been set. Holding time measurement tests will be described to demonstrate consideration of this REP for the major systems.</p> <p>The RWMA document [Ref-3] also provides information on the environmental protection offered by waste packages and their associated storage.</p>

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
ENDP9 - Fault Sensitivity	4. A detailed description of the radioactive waste management arrangements	The sensitivity of the facility to potential faults that could have radiological impacts to people and the environment should be minimised.	<p>The UK ABWR will be shown to comply with ENDP9 during GDA.</p> <p>The identification of potential faults to be considered that could have radiological impacts on people and the environment will be addressed in PCSR Chapter 24 Design Basis Analysis and also Chapter 27 Human Factors. The UK ABWR will be designed to minimise the radiological impacts of these potential faults.</p>
ENDP10 - Quantification of Discharges	6. A description of the sampling arrangements, techniques and systems for measurement and assessment of discharges and disposals of radioactive waste.	Facilities should be designed and equipped so that best available techniques are used to quantify the gaseous and liquid radioactive discharges produced by each major source on a site.	<p>The UK ABWR will be shown to comply with ENDP10 during GDA.</p> <p>Systems descriptions of the Off-gas and Liquid Waste Treatment systems are provided in PCSR Chapter 18 Radioactive Waste Management. Demonstration of BAT is shown through the design of each system and its proposed operation [Ref-5].</p> <p>Arrangements to deliver adequate sampling and monitoring arrangements for discharges and will be provided in the Approach to Sampling & Monitoring [Ref-8].</p>
ENDP11 - Maintenance, Inspection and Testing	No directly related P&ID item	Structures, systems and components that are, or comprise part of, environment protection measures should receive regular and systematic examination, inspection, maintenance and testing.	<p>The UK ABWR will be shown to comply with ENDP11 during GDA.</p> <p>As the designer of the UK ABWR, Hitachi-GE has a duty to ensure that the design facilitates adequate inspection, maintenance and testing by any subsequent operator. HF requirements are considered as part of this process. (PCSR Chapter 27 details HF considerations in more detail)</p>
ENDP12 - Commissioning	No directly related P&ID item	Before operating any facility or process, commissioning tests should be defined and carried out to demonstrate that, as built, the facility or process will be capable of delivering the environment protection functions.	<p>The UK ABWR will be shown to comply with ENDP12 during GDA.</p> <p>As the designer of the UK ABWR, Hitachi-GE has a duty to ensure that the design facilitates adequate commissioning tests by any subsequent operator.</p>

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
ENDP13 - External and Internal Hazards	No directly related P&ID item	External and internal hazards that could affect the delivery of an environment protection function should be identified and the best available techniques used to avoid or reduce any impact.	The UK ABWR will be shown to comply with ENDP13 during GDA. Identification of internal hazards to be considered will be provided as part of the PCSR (Chapter 7 Internal Hazards). The PCSR will show design principles for countermeasures against internal fire, internal flooding, internal explosions, dropped loads, pipe work protection, and internal missiles and so on. Each hazard will be treated as a potential initiating event in fault studies.
ENDP14 - Control and Instrumentation - Environment Protection Systems	4. A detailed description of the radioactive waste management arrangements 6. A description of the sampling arrangements, techniques and systems for measurement and assessment of discharges and disposals of radioactive waste.	Best available techniques should be used for the control and measurement of plant parameters and releases to the environment, and for assessing the effects of such releases in the environment.	The UK ABWR will be shown to comply with ENDP14 during GDA. The best available techniques will be summarised in the Demonstration of BAT [Ref-5]. Information on monitoring and assessment will be provided in the Approach to Sampling & Monitoring [Ref-8] and Prospective Dose Modelling [Ref-11] reports, respectively. The usability of the systems and processes will be underpinned by the process outlined in PCSR Chapter 27 Human Factors.
ENDP15 - Mechanical Containment Systems for Liquids And Gases	4. A detailed description of the radioactive waste management arrangements	Best available techniques should be used to prevent and/or minimise releases of radioactive substances to the environment, either under routine or accident conditions.	The UK ABWR will be shown to comply with ENDP15 during GDA. The UK ABWR employs several systems that will assist with compliance with ENDP15, specifically the Off-gas and Standby Gas Treatment systems. The associated system descriptions are provided in PCSR Chapter 18 Radioactive Waste Management whilst the Demonstration of BAT [Ref-5] will provide the necessary evidence of optimisation. The RWMA document [Ref-3] also demonstrates compliance through the system and practices adopted.

Consideration of and Compliance with the Radioactive Substances Regulation Environmental Principles (REPs)
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REP	Relevant P&ID item	REP Principle	Approach to Compliance
ENDP16 - Ventilation Systems	4. A detailed description of the radioactive waste management arrangements	Best available techniques should be used in the design of ventilation systems.	The UK ABWR will be shown to comply with ENDP16 during GDA. The UK ABWR will design a ventilation system that will treat radioactive gaseous effluent by filtering the effluent prior to discharge into the environment. PCSR Chapter 16 Auxiliary Systems and Demonstration of BAT [Ref-5] provide further information.
ENDP17 - Civil Engineering	No directly related P&ID item	It should be demonstrated that structures which are, or comprise part of, environment protection measures are sufficiently free of defects such that the relevant environment function(s) is not compromised, that identified defects are tolerable, and that the existence of defects that could compromise the environment protection function can be established throughout their life-cycle.	The UK ABWR will be shown to comply with ENDP17 during GDA. The UK ABWR will consider appropriate regulations, codes and standards to deliver environment protection in every aspect of the design, manufacture, construction, installation, commissioning, quality assuring, maintenance, testing and inspection phase. The fault schedule in the PCSR will consider the effects of possible defects.
ENDP18 - Essential Services	No directly related P&ID item	Best available techniques should be used to ensure that loss of essential services does not lead to radiological impacts to people or the environment.	The UK ABWR will be shown to comply with ENDP18 during GDA. The generic UK ABWR plant is designed to protect people and the environment from radiological hazards and the generation of radioactive waste; this will be demonstrated during the entirety of the GDA process.
EPRDP1 - Facility Design	No directly related P&ID item	The design of a facility, in terms of layout, construction, communications and infrastructure, should be such that response arrangements can be enacted in the event of an emergency.	The UK ABWR will be shown to comply with EPRDP1 during GDA. The design of the UK ABWR will take into consideration accident and emergency response requirements, specifically the supply of firewater and secure electricity supplies, with detailed information provided in the PCSR.

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
EPRDP2 - Emergency plans	No directly related P&ID item	Emergency plans should be prepared and should take due account of the need to protect the environment.	The UK ABWR will be shown to comply with EPRDP2 during GDA. UK ABWR emergency plans take into account the need to prevent environmental release, with detail provided in PCSR Chapter 22 Emergency Preparedness.
EPRDP3 - Remediation	No directly related P&ID item	Arrangements should be put in place to ensure that environmental remediation, post-accident, can be carried out quickly and safely.	The UK ABWR will be shown to comply with EPRDP3 during GDA. The UK ABWR will have a ventilation system design that treats radioactive gaseous effluent by filtering the effluent prior to discharge into the environment in the event of LOCA. The UK ABWR will also design the filtered containment venting systems as a countermeasure to containment failure.
DEDP1 - Decommissioning Strategy	4. A detailed description of the radioactive waste management arrangements	Each site should have a decommissioning strategy that is updated and refined at appropriate intervals.	The UK ABWR will be shown to comply with DEDP1 during GDA. The decommissioning strategy will be described in PCSR Chapter 31 Decommissioning. This will be updated and refined with latest techniques at appropriate intervals. Additional detail on the waste volumes and associated management can be found in the RWMA document [Ref-3].
DEDP2 - Decommissioning Plan	4. A detailed description of the radioactive waste management arrangements	There should be a decommissioning plan for each facility and this should be updated and refined throughout its operating life and during decommissioning.	The UK ABWR will be shown to comply with DEDP2 during GDA. The decommissioning plan for each facility will be described in wider decommissioning strategy in PCSR Chapter 31 Decommissioning. This will be updated and refined throughout the plant's operating life and during decommissioning. Additional detail on the waste volumes and associated management can be found in the RWMA document [Ref-3].

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
DEDP3 - Considering Decommissioning during Design and Operation	4. A detailed description of the radioactive waste management arrangements	Facilities should be designed, built and operated using the best available techniques to minimise the impacts on people and the environment of decommissioning operations and the management of decommissioning wastes.	<p>The UK ABWR will be shown to comply with DEDP3 during GDA.</p> <p>The 'designed for decommissioning' philosophy will be outlined as part of the decommissioning strategy in PCSR Chapter 31 Decommissioning and will include consideration of radioactivity reduction in dismantling and decontamination. Similarly, the design of facilities will aid operational practices that reduce radioactivity. Evidence of this philosophy will be provided in the Demonstration of BAT report [Ref-5] and additional detail on the management of wastes can be found in the RWMA document [Ref-3].</p>
DEDP4 - Discharges during Decommissioning	No directly related P&ID item	Aerial or liquid radioactive discharges to the environment during decommissioning should be kept to the minimum consistent with the decommissioning strategy for the site.	<p>The UK ABWR will be shown to comply with DEDP4 during GDA.</p> <p>Appropriate techniques will be adopted to minimise the aerial or liquid discharges to the environment. This will be evidenced in the decommissioning strategy in PCSR Chapter 31 Decommissioning., the Demonstration of BAT report [Ref-5] and the associated practices developed in more detail following GDA by the ultimate operator.</p>
DEDP5 - Legacy Wastes	No directly related P&ID item	Decommissioning strategies and plans should provide for the timely characterisation, retrieval, conditioning and packaging of legacy radioactive wastes.	This REP does not apply to new build and associated waste arisings; therefore it is out of scope of the GDA.
CLDP1 - Prevention of Contamination	4. A detailed description of the radioactive waste management arrangements	The best available techniques should be used to prevent and where that is not practicable minimise radioactive contamination of land and groundwater, whilst allowing permitted disposals of radioactive wastes.	<p>The UK ABWR will be shown to comply with CLDP1 during GDA.</p> <p>The Demonstration of BAT [Ref-5] will demonstrate compliance with this requirement.</p>

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REP	Relevant P&ID item	REP Principle	Approach to Compliance
CLDP2 - Strategy for Radioactively Contaminated Land and Groundwater	No directly related P&ID item	Each site should have a strategy for the detection and management of radioactively contaminated land and groundwater.	As the designer of the UKABWR, Hitachi-GE has a duty to ensure that the design adequately protects against possible contamination of groundwater or land. The UK ABWR will be shown to comply with CLDP2 in this way during GDA. Any operational strategy will be subsequently developed by the operator.
CLDP3 - Approach to Management of Radioactively Contaminated Land and Groundwater	No directly related P&ID item	The approach to the management of radioactively contaminated land and groundwater should have regard to the guidance developed for the SAFEGROUNDS learning network.	As the designer of the UKABWR, Hitachi-GE has a duty to ensure that the design adequately protects against possible contamination of groundwater or land. The UK ABWR will be shown to comply with CLDP3 in this way during GDA. Any operational strategy will be subsequently developed by the operator.
CLDP4 - Justification and Optimisation of Interventions under Part 2A	No directly related P&ID item	All interventions that are part of the remediation of radioactive contaminated land should be justified and optimised.	As the designer of the UKABWR, Hitachi-GE has a duty to ensure that the design adequately protects against possible contamination of land. The UK ABWR will be shown to comply with CLDP4 in this way during GDA. Any necessary intervention strategies will be developed by the operator if required.
CLDP5 - Remediation Objectives under Part 2A	No directly related P&ID item	Remediation objectives should be set for each specific site and should be based on the remediation option or strategy selected for that site.	As the designer of the UKABWR, Hitachi-GE has a duty to ensure that the design adequately protects against possible contamination of land to assist with timely remediation as part of decommissioning. The UK ABWR will be shown to comply with CLDP5 in this way during GDA. The specifics of the remediation strategy will be developed by the future operator.

5. Conclusions

This is an assessment based on the current status of the Hitachi-GE GDA project. Work will continue to address any gaps or uncertainties within this report and within the remainder of the GEP submission, as described in the Forward Action Plan (FAP) outlined in section 9 of the GEP summary document [Ref-14]. It is also recognised that subsequent versions of the documents that make up the entire GDA submission will be developed to include this more detailed information as it becomes available.