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## **UK ABWR Generic Design Assessment**

Alignment 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
GDA	Generic Design Assessment
GEP	Generic Environmental Permit
HF	Human Factors
HVAC	Heating Ventilating and Air Conditioning System
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 Principles
RSR	Radioactive Substances Regulation
RWMA	Radioactive Waste Management Arrangements
SSCs	Structures, Systems and Components
SQEP	Suitably Qualified and Experienced Person (UK)
UK	United Kingdom

**2. References**

- [Ref-1] Environment Agency , “Process and Information Document for the Generic Assessment of Candidate Nuclear Power Plant Designs”, version 2, March 2013
- [Ref-2] Environment Agency, “Radioactive Substances Regulation – Environmental Principles”, version 2, April 2010
- [Ref-3] Hitachi-GE Nuclear Energy Ltd., “Genesis of ABWR Design”, GA91-9901-0034-00001 (XE-GD-0136), Rev. A, January 2014
- [Ref-4] Hitachi-GE Nuclear Energy Ltd., “Summary of the Generic Environmental Permit Applications”, GA91-9901-0019-00001 (XE-GD-0094), Rev. H, August 2017
- [Ref-5] Hitachi-GE Nuclear Energy Ltd., “Generic PCSR Chapter 31: Decommissioning”, GA91-9101-0101-31000 (DCE-GD-0007), Rev. C, August 2017
- [Ref-6] Hitachi-GE Nuclear Energy Ltd., “Radioactive Waste Management Arrangements”, GA91-9901-0022-00001 (WE-GD-0001), Rev.H, August 2017
- [Ref-7] Hitachi-GE Nuclear Energy Ltd., “Integrated Waste Strategy”, GA91-9201-0003-00425 (WE-GD-0050), Rev.3, July 2017
- [Ref-8] Hitachi-GE Nuclear Energy Ltd., “Approach to Optimisation”, GA91-9901-0021-00001 (XE-GD-0096), Rev. F, August 2017
- [Ref-9] Hitachi-GE Nuclear Energy Ltd., “Demonstration of BAT”, GA91-9901-0023-00001 (XE-GD-0097), Rev. G, August 2017
- [Ref-10] Hitachi-GE Nuclear Energy Ltd., “Approach to Sampling and Monitoring”, GA91-9901-0029-00001 (3E-GD-K002), Rev. H, August 2017
- [Ref-11] Hitachi-GE Nuclear Energy Ltd., “Quantification of Discharges and Limits”, GA91-9901-0025-00001 (HE-GD-0004), Rev.G, August 2017
- [Ref-12] Hitachi-GE Nuclear Energy Ltd., “Prospective Dose Modelling”, GA91-9901-0026-00001 (HE-GD-0005), Rev.G, August 2017
- [Ref-13] Department of Energy & Climate Change UK government, “The Justification of Practices Involving Ionising Radiation Regulations”, 2004
- [Ref-14] Hitachi-GE Nuclear Energy Ltd., “Description of Hitachi-GE Organisation Capability, Systems and Management Arrangements”, GA91-9901-0016-00001 (XE-GD-0085), Rev.A, October 2013
- [Ref-15] Hitachi-GE Nuclear Energy Ltd., “Quality Management Plan (For UK ABWR GDA Project)”, GA70-1501-0007-00001 (GNQA13-0066), Rev.6, April 2015
- [Ref-16] Hitachi-GE Nuclear Energy Ltd., “Generic PCSR Chapter 18:Radioactive Waste Management”, GA91-9101-0101-18000 (XE-GD-0651), Rev. C, August 2017
- [Ref-17] Hitachi-GE Nuclear Energy Ltd., “Generic PCSR Chapter 20:Radiation Protection”, GA91-9101-0101-20000 (XE-GD-0652), Rev. C, August 2017
- [Ref-18] Hitachi-GE Nuclear Energy Ltd., “Generic Site Description”, GA91-9901-0020-00001 (XE-GD-0095), Rev. F, August 2017
- [Ref-19] Hitachi-GE Nuclear Energy Ltd., “Generic PCSR Chapter 27: Human Factors” GA91-9101-0101-27000 (HFE-GD-0057), Rev. C, August 2017
- [Ref-20] Hitachi-GE Nuclear Energy Ltd., “Generic PCSR Chapter 5: General Design Aspects”, GA91-9101-0101-05000 (XE-GD-0645), Rev. C, August 2017
- [Ref-21] Hitachi-GE Nuclear Energy Ltd., “Generic PCSR Chapter 24: Design Basis Analysis”, GA91-9101-0101-24000 (UE-GD-0208), Rev. C, August 2017

- [Ref-22] Hitachi-GE Nuclear Energy Ltd., “Generic PCSR Chapter 29: Commissioning”, GA91-9101-0101-29000 (QGI-GD-0011), Rev. C, August 2017
- [Ref-23] Hitachi-GE Nuclear Energy Ltd., “Generic PCSR Chapter 7: Internal Hazards”, GA91-9101-0101-07000 (SE-GD-0127), Rev. C, August 2017
- [Ref-24] Hitachi-GE Nuclear Energy Ltd., “Generic PCSR Chapter 6: External Hazards”, GA91-9101-0101-06000 (AE-GD-0168), Rev. C, August 2017
- [Ref-25] Hitachi-GE Nuclear Energy Ltd., “PCSR Chapter 16:Auxiliary Systems”, GA91-9101-0101-16000 (XE-GD-0649), Rev. C, August 2017
- [Ref-26] Hitachi-GE Nuclear Energy Ltd., “Generic PCSR Chapter 22: Emergency Preparedness”, GA91-9101-0101-22000 (HE-GD-0044), Rev. C, August 2017

### **3. Introduction**

The Environment Agency has identified the information it requires to assess the environmental impacts of the UK ABWR at a generic site in its 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 party's submission (Hitachi-GE in the case of the UK ABWR) will be guided by the 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 (including those made on behalf of Natural Resources Wales (NRW)) in relation to radioactive substances regulation, across permitting, compliance and enforcement. Although they are primarily written for use by Environment Agency, they can be used as guidance by operators and so act as references for Hitachi-GE during the GDA process for the UK ABWR. This document has been written to indicate how the UK ABWR design aligns with the relevant REPs.

Certain REPs have been identified as key references by the Environment Agency in the P&ID [Ref-1], however this list is non-exhaustive. This document identifies the REPs which Hitachi-GE believes are relevant to the UK ABWR GDA process, and references the part of the GDA submission where the associated content is provided (including the Generic Environmental Permit (GEP), Pre-Construction Safety Report (PCSR) and Common Documents (e.g. Genesis of ABWR Design [Ref-3] etc). For reference, a summary of the documentation that is included as part of the complete GEP submission is shown in the Summary of the Generic Environmental Permit Applications [Ref-4].

### **4. Applicability of the REPs to GDA**

There are two main types of REP: 'Fundamental Principles' and 'Generic Development Principles' (covering two further sub-categories: Regulatory Process and Regulatory Assessment). The 'Generic Developed Principles: Regulatory Process' REPs solely describe regulatory governance activities and as such are considered out of scope of Hitachi-GE's GDA work.

Hitachi-GE has reviewed the full list of 'Fundamental Principles' and 'Generic Developed Principles: Regulatory Assessment' (or 'Generic REPs') for applicability to the UK ABWR GDA submission, including the GEP, PCSR and the Common Documents. Hitachi-GE considers the Fundamental Principles 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. A description of how the UK ABWR design aligns with each of these principles is provided in Section 4.1. Some elements of the Fundamental Principles may still require continued action from the site operator and these points are highlighted. It is also worth noting that the Fundamental Principles are, where relevant, effectively embodied in the Generic REPs.

The Generic REPs are more relevant to the GDA process. Individual REPs in this category are highlighted as key REPs in the third column of Table 1 in the Environment Agency's P&ID document [Ref-1] for use as references to guide the development of the content of the requesting party's GDA submission. Hitachi-GE has assessed which Generic REPs they believe to be applicable to the UK ABWR design and GDA process and has provided a signpost to the relevant part of the GDA submission documentation where alignment with the Generic REP is demonstrated. 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 in Table 4.2-1. It is important to note that this exercise does not preclude consideration of these REPs by any future UK ABWR operator at the site-specific permitting or operational stage.

## 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.*

Fundamentally, the UK ABWR design supports sustainability through the generation of low-carbon electricity. More specifically, the reactor design promotes minimisation of radioactive substances at source, a major input into the waste management process. The UK ABWR decommissioning strategy presented in PCSR Chapter 31: Decommissioning [Ref-5], which will underpin the Funded Decommissioning Plan developed by any future operator, establishes the sustainable principle of seeking to ensure all anticipated radioactive waste arisings associated with the operation and decommissioning of the UK ABWR can be safely managed and disposed of.

### 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 NRW, and is supporting the process with the ongoing and timely provision of required information. The Hitachi-GE GDA website is live and will continue to assist the engagement of stakeholders on the Hitachi-GE submissions.

### 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) [Ref-6] and Integrated Waste Strategy (IWS) [Ref-7] submitted as part of the GEP deliver a comprehensive overarching strategy under which specific waste management activities and plans for the UK ABWR are to be co-ordinated. The RWMA and IWS documents also pave the way for effective interfacing with subsequent operator-led work, including 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-8] [Ref-9] [Ref-10]. 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 Demonstration of BAT document [Ref-9] and the Approach to Sampling & Monitoring [Ref-10] 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 ABWR Design [Ref-3] and its refinement through operational experience. The proposed UK ABWR discharge limits and consequent radiological dose impacts described within the GEP [Ref-11] [Ref-12] are under the dose limit and constraints, and the sampling and monitoring system [Ref-10] has been designed to take account of UK regulatory requirements. Site-specific environmental monitoring programmes will be developed by future operators.

#### **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 supports 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 underpinned by many 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.*

The design of the reactor and its associated radioactive waste management systems fully accounts 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 as a Requesting Party in the GDA process 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 fulfil 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.*

The Justification of Practices Involving Ionising Radiation Regulations 2004 (Justification Regulations) [Ref-13] require that before any new class or type of practice involving ionising radiation can be introduced in the UK, it must be assessed and a determination made as to whether it is justified (i.e. that economic or social benefits associated with the class or type of practice outweigh the radiological detriments). The UK ABWR practice received the justification decision in December 2013. This was given effect in The Justification Decision (Generation of Electricity by the UK ABWR Nuclear Reactor) Regulations 2015.

#### 4.2. Generic Developed Principles: Regulatory Assessment

The columns in the following table set out: i. each Generic REP; ii. whether the REP is identified by Hitachi-GE as relevant (whether wholly or partially) to the information requested in the P&ID; iii. the content of each REP; and, iv. how the UK ABWR GDA submission aligns with the relevant REPs.

**Table 4.2-1: Review of Generic REP Applicability and Demonstration of Alignment in GDA**

Generic REP	Related P&ID item (Table 1 in [Ref-1])	REP Principle	How alignment is demonstrated as part of GDA
<b>MLDP1 - Establishing and Sustaining Leadership and Management</b>	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.	Hitachi-GE's management systems are outlined in the Description of Hitachi-GE Organisation Capability, Systems and Management Arrangements document [Ref-14]. This is supported by the GDA project's own Quality Management Plan (QMP) [Ref-15], 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.
<b>MLDP2 - High Standards of Environment Protection</b>	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 environmental responsibilities of all levels of management staff are described in the Management Commitment sub-section of the QMP [Ref-15] and the relevant organisational policies.
<b>MLDP3 - Capability</b>	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.	Hitachi-GE's management systems are outlined in the Description of Hitachi-GE Organisation Capability, Systems and Management Arrangements document [Ref-14]. Resource management is described in the QMP [Ref-15]; the capability of the organisation through its resource skills, competencies and knowledge is maintained via the documented SQEP procedure. The technical provisions made to secure protection of people and environment are described across the PCSR and GEP documents.

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Generic REP	Related P&ID item (Table 1 in [Ref-1])	REP Principle	How alignment is demonstrated as part of GDA
<b>MLDP4 - Decision Making</b>	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 Hitachi-GE decision-making process gives full consideration to potential environmental effects. For the GDA, this is achieved through internal design development procedures as well as adherence to the SQEP process stipulated in the QMP [Ref-15].
<b>MLDP5 - Learning from Experience</b>	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 Measurement, Assessment and Improvement process detailed in the QMP [Ref-15] 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.
<b>RSMDP1 - Radioactive Substances Strategy</b>	4. A detailed description of the radioactive waste management arrangements	A strategy should be produced for the management of all radioactive substances.	A comprehensive waste management strategy is provided in the RWMA and IWS documents [Ref-6] [Ref-7].
<b>RSMDP2 - Justification</b>	No directly related P&ID item in Table 1	Radioactive wastes shall not be created unless the practice giving rise to the waste has been justified (in advance for new practices).	This principle is outside the scope of the GDA process; however, the UK ABWR has been through the UK Justification Regulations process [Ref-13].
<b>RSMDP3 - Use of BAT to minimise waste</b>	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 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 [Ref-8] of the GEP submission with the results shown in the Demonstration of BAT document [Ref-9].

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Generic REP	Related P&ID item (Table 1 in [Ref-1])	REP Principle	How alignment is demonstrated as part of GDA
<b>RSMDP4 - Methodology for Identifying BAT</b>	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.	The methodology for identifying BAT is provided in the Approach to Optimisation [Ref-8].
<b>RSMDP5 - Actions having Irreversible Consequences</b>	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.	The RWMA document [Ref-6] outlines the thorough and considered philosophy underpinning all radioactive waste management decisions, including principles such as leak prevention and concentrate and contain. The Approach to Optimisation [Ref-8] 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.
<b>RSMDP6 - Application of BAT</b>	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.	The methodology for identifying BAT is provided in the Approach to Optimisation [Ref-8]. Hitachi-GE understands what is meant by BAT and the requirement for demonstrating BAT.
<b>RSMDP7 - BAT to Minimise Environmental Risk and Impact</b>	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.	All decision-making regarding the management of radioactive substances for the UK ABWR will comply with the process outlined in the Approach to Optimisation [Ref-8] to ensure that any resulting environmental risk and impact are minimised, with the results provided in the Demonstration of BAT document [Ref-9].

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Generic REP	Related P&ID item (Table 1 in [Ref-1])	REP Principle	How alignment is demonstrated as part of GDA
<b>RSMDP8 - Segregation of Wastes</b>	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 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-6] demonstrates the philosophy underpinning waste management arrangements, including appropriate emphasis on the waste hierarchy. The Approach to Optimisation [Ref-8] demonstrates how the most suitable equipment and management techniques are assessed and applied. Systems descriptions are provided in PCSR Chapter 18: Radioactive Waste Management [Ref-1] [Ref-16].
<b>RSMDP9 - Characterisation</b>	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.	Radioactive substances should be characterised using the best available techniques so as to facilitate their subsequent management, including waste disposal.	Each radioactive waste stream will be characterised and managed in accordance with best available techniques to ensure most appropriate handling and disposal. This approach is outlined in the RWMA document [Ref-6] for solid waste streams, and the Approach to Sampling & Monitoring document [Ref-10] for radiation measurements in liquid and gaseous streams.
<b>RSMDP10 - Storage</b>	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.	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 take account of all requirements in terms of being passively safe and enabling future treatment options (where applicable) and disposal. Information on the proposed storage practices is outlined in the RWMA document [Ref-6].

*Consideration of the Radioactive Substances Regulation Environmental Principles (REPs)*

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Generic REP	Related P&ID item (Table 1 in [Ref-1])	REP Principle	How alignment is demonstrated as part of GDA
<b>RSMDP11 - Storage in a Passively Safe State</b>	4. A detailed description of the radioactive waste management arrangements <i>[Note: not listed as a key REP in Table 1]</i>	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.	This REP relates to existing wastes on operating sites, and so is not directly within the scope of GDA. However, as part of the UK ABWR design, mobile solid wastes and liquid wastes that require conditioning to a passively safe condition will be managed as soon as is reasonably practicable. The approach to be taken is outlined in the RWMA [Ref-6].
<b>RSMDP12 - Limits and Levels on Discharges</b>	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.	Limits and levels commensurate with UK legislation and regulation are outlined in the Quantification of Discharges and Limits document [Ref-11].
<b>RSMDP13 - Monitoring and Assessment</b>	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 radiation monitoring techniques used on the UK ABWR are described in the Approach to Sampling & Monitoring document [Ref-10] of the GEP submission, which also demonstrates that the approach to radiation monitoring represents BAT. Environmental monitoring is not covered in the GEP as it is a site-specific issue.

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Generic REP	Related P&ID item (Table 1 in [Ref-1])	REP Principle	How alignment is demonstrated as part of GDA
<b>RSMDP14 - Record Keeping</b>	4. A detailed description of the radioactive waste management arrangements <i>[Note: not listed as a key REP in Table 1]</i>	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 RWMA [Ref-6] outlines the processes that will be undertaken to safely manage radioactive waste. The Approach to Sampling & Monitoring document [Ref-10] of the GEP submission also outlines the approach to record making for radioactive liquid and gaseous discharges. The actual making and keeping of records associated with all radioactive substances and associated facilities will be the responsibility of future operators.
<b>RSMDP15 - Requirements and Conditions for Disposal of Wastes</b>	4. A detailed description of the radioactive waste management arrangements <i>[Note: not listed as a key REP in Table 1]</i>	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.	Disposability Assessments and Radioactive Waste Management Cases for significant waste streams are referenced by the RWMA document [Ref-6]. Compliance with actual disposal requirements as detailed in the Environmental Permit will be the responsibility of future operators.
<b>RPDP1 - Optimisation of Protection</b>	7. A prospective radiological assessment at the proposed limits for discharges and for any on-site incineration <i>[Note: not listed as a key REP in Table 1]</i>	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.	Demonstration that public exposure to ionising radiation through direct shine from the UK ABWR design is kept ALARA is provided in PCSR Chapter 20: Radiation Protection [Ref-17]. Waste management processes and discharge and disposal systems are designed to ensure public exposure to ionising radiation is also ALARA through the appropriate application of BAT. Evidence of this is provided in the Approach to Optimisation [Ref-8] and Demonstration of BAT document [Ref-9] as well as the results of the Prospective Dose Modelling [Ref-12].



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Generic REP	Related P&ID item (Table 1 in [Ref-1])	REP Principle	How alignment is demonstrated as part of GDA
<b>RPDP2 – Dose Limits and Constraints</b>	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.	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-12] as well as PCSR Chapter 20: Radiation Protection [Ref-17].
<b>RPDP3 - Protection of Non-Human Species</b>	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.	Local flora and fauna in the surrounding environment are adequately protected from the effects of radiation, with any exposure within required limits. This is shown in the Prospective Dose Modelling document [Ref-12].
<b>RPDP4 - Prospective Dose Assessments for Radioactive Discharges into the Environment</b>	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.	An assessment of the potential doses to people and non-human species is provided in the Prospective Dose Modelling document [Ref-12].
<b>SEDPI - General Principle for Siting of New Facilities</b>	No directly related P&ID item in Table 1	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.	Sites suitable for new nuclear build have been identified by the UK Government in the National Policy Statement for Nuclear (2011). Site-specific licensing will take into account the detailed characteristic of each site, in relation to the specific design being considered. This is a site-specific issue and so outside the scope of GDA.

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Generic REP	Related P&ID item (Table 1 in [Ref-1])	REP Principle	How alignment is demonstrated as part of GDA
<b>SEDP2 - Migration of Radioactive Material in the Environment</b>	7. A prospective radiological assessment at the proposed limits for discharges and for any on-site incineration <i>[Note: not listed as a key REP in Table 1]</i>	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.	Information relating to the impact of radioactive discharges on the surrounding environment is provided in the Prospective Dose Modelling document [Ref-12] and Generic Site Description [Ref-18]. The data provided is sufficient to allow other parties to undertake prospective dose assessments.
<b>SEDP3 - Ambient Radioactivity</b>	7. A prospective radiological assessment at the proposed limits for discharges and for any on-site incineration <i>[Note: not listed as a key REP in Table 1]</i>	Levels of ambient radioactivity around the sites of new facilities should be assessed.	Site-specific licensing will take into account the detailed characteristic of each site. This is a site-specific issue and so addressed in the scope of GDA.
<b>SEDP4 - Multi-Facility Sites</b>	7. A prospective radiological assessment at the proposed limits for discharges and for any on-site incineration <i>[Note: not listed as a key REP in Table 1]</i>	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.	Site-specific licensing will take into account the detailed characteristic of each site. This is a site-specific issue and so addressed in the scope of GDA.
<b>SEDP5 - On-Going Evaluation</b>	1. General information relating to the requesting party and the design <i>[Note: not listed as a key REP in Table 1]</i>	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.	A generic site is assumed for GDA with the parameters used outlined in the Generic Site Description [Ref-18].

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<b>ENDP1 - Inherent Environmental Protection</b>	4. A detailed description of the radioactive waste management arrangements <i>[Note: not listed as a key REP in Table 1]</i>	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.	The generic UK ABWR plant is designed to protect people and the environment from radiological hazards and the generation of radioactive waste. Specific evidence detailing this is provided in the Demonstration of BAT document [Ref-9] and PCSR Chapter 20: Radiation Protection [Ref-17].
<b>ENDP2 - Avoidance and Minimisation of Impacts</b>	4. A detailed description of the radioactive waste management arrangements <i>[Note: not listed as a key REP in Table 1]</i>	Radiological impacts to people and the environment should be avoided and where that is not practicable minimised commensurate with the operations being carried out.	Waste management processing, discharge and disposal systems are designed to ensure public exposure to ionising radiation is ALARA, through appropriate application of BAT (as detailed in the Approach to Optimisation[Ref-8]). Demonstration of this is provided in the Demonstration of BAT document [Ref-9] and in PCSR Chapter 20: Radiation Protection [Ref-17].
<b>ENDP3 - Defence in Depth</b>	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.	The UK ABWR contains multiple systems to protect against radiological impacts. 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 [Ref-16] and PCSR Chapter16 Auxiliary Systems [Ref-25] along with descriptions of the liquid and solid waste management systems shown in PCSR Chapter18 Radioactive Waste Management [Ref-16].
<b>ENDP4 - Environment Protection Functions and Measures</b>	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.	The scope of the GEP as part of GDA covers normal operating conditions only. The RWMA document [Ref-6] describes the environmental protection function of the radioactive waste management systems of the UK ABWR. Furthermore, radiation monitoring system arrangements are described in the Approach to Sampling & Monitoring document [Ref-10].

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<b>ENDP5 - Human Factors</b>	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.	Human Factors (HF) considerations are incorporated in the design of each facility and operating procedure of the UK ABWR under the HF Integration Plan. The process by which specific human actions claimed are assessed will be presented in PCSR Chapter 27: Human Factors [Ref-19], including those for environmentally significant radioactive systems from radioactive view point. Review and assessment of HF integrations across the GDA submissions is an ongoing process.
<b>ENDP6 - Engineering Codes and Standards</b>	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.	The UK ABWR design 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. Execution of operating procedures will be the responsibility of the future operator.  The process by which equipment is categorised and classified is outlined in PCSR Chapter 5: General Design Aspects [Ref-20] using the standards outlined in the same PCSR Chapter.
<b>ENDP7 - Reliability</b>	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.	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. Operation decisions relating to environmental protection measures will be the responsibility of the future operator.
<b>ENDP8 - Ageing and Degradation</b>	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.	The UK ABWR design will consider the robustness, reliability and lifespan of the facilities that deliver environment protection. Descriptions of the major radioactive waste management systems are provided in PCSR Chapter 18: Radioactive Waste Management [Ref-16], whilst the RWMA document [Ref-6] provides information on the environmental protection offered by waste packages and their associated storage.

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<b>ENDP9 - Fault Sensitivity</b>	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.	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 [Ref-21]. The UK ABWR is designed to minimise the radiological impacts of these potential faults. N.B. The scope of the GEP in GDA covers normal operating conditions only.
<b>ENDP10 - Quantification of Discharges</b>	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.	Detail on the quantification of discharges, including ensuring being able to quantify each major source on site, is provided in the Approach to Sampling & Monitoring document [Ref-10]. Whilst the techniques are described in GDA, the specific equipment will be specified by future operators.
<b>ENDP11 - Maintenance, Inspection and Testing</b>	4. A detailed description of the radioactive waste management arrangements	Structures, systems and components that are, or comprise part of, environment protection measures should receive regular and systematic examination, inspection, maintenance and testing.	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. Such requirements are considered as part of the design process. Details are provided in PCSR Chapter 27: Human Factors [Ref-19] (review and assessment of HF integrations across the GDA submissions is an ongoing process). Execution of examination, inspection, maintenance and testing activities is the responsibility of future operators.
<b>ENDP12 - Commissioning</b>	No directly related P&ID item in Table 1	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.	As the designer of the UK ABWR, Hitachi-GE has a duty to ensure that the design facilitates adequate commissioning tests. Information is provided in PCSR Chapter 29: Commissioning [Ref-22].

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Generic REP	Related P&ID item (Table 1 in [Ref-1])	REP Principle	How alignment is demonstrated as part of GDA
<b>ENDP13 - External and Internal Hazards</b>	No directly related P&ID item in Table 1	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.	Identification of hazards considered is provided as part of the PCSR Chapter 7: Internal Hazards [Ref-23] and PCSR Chapter 6: External Hazards [Ref-24].
<b>ENDP14 - Control and Instrumentation - Environment Protection Systems</b>	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 best available techniques to be used are summarised in the Demonstration of BAT document [Ref-9]. Information on monitoring and assessment of radioactive discharges will be provided in the Approach to Sampling & Monitoring [Ref-10] and Prospective Dose Modelling [Ref-12] documents respectively. In-process monitoring required to underpin the demonstration of BAT is outlined in the Demonstration of BAT document [Ref-9].
<b>ENDP15 - Mechanical Containment Systems for Liquids And Gases</b>	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 employs several relevant systems, for example the Off-gas, HVAC and solid/liquid waste management systems. The associated system descriptions are provided in PCSR Chapter 18: Radioactive Waste Management [Ref-16] and PCSR Chapter 16: Auxiliary Systems [Ref-25] whilst the Demonstration of BAT [Ref-9] will provide the necessary evidence of optimisation. N.B. The scope of the GEP in GDA covers normal operating conditions only.

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<b>ENDP16 - Ventilation Systems</b>	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 incorporates a ventilation system that will treat radioactive gaseous effluent by filtering the effluent prior to discharge into the environment. PCSR Chapter 16: Auxiliary Systems [Ref-25] and Demonstration of BAT [Ref-9] provide further information.
<b>ENDP17 - Civil Engineering</b>	No directly related P&ID item in Table 1	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 design 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 PCSR Chapter 24: Design Basis Analysis [Ref-21] considers the effects of possible defects.
<b>ENDP18 - Essential Services</b>	No directly related P&ID item in Table 1	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 plant is designed to protect people and the environment from radiological hazards and the generation of radioactive waste. Identification of faults (including the loss of essential services) is provided in PCSR Chapter 24: Design Basis Analysis [Ref-21], Chapter 7: Internal Hazards [Ref-23] and PCSR Chapter 6: External Hazards [Ref-24].
<b>EPRDP1 - Facility Design</b>	No directly related P&ID item in Table 1	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 design of the UK ABWR will take into consideration accident and emergency response requirements, including the secure electricity supplies. This is described in PCSR Chapter 22: Emergency Preparedness [Ref-26].
<b>EPRDP2 - Emergency plans</b>	No directly related P&ID item in Table 1	Emergency plans should be prepared and should take due account of the need to protect the environment.	UK ABWR emergency plans take into account the need to prevent environmental releases, with provided in PCSR Chapter 22: Emergency Preparedness [Ref-26].

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<b>EPRDP3 - Remediation</b>	No directly related P&ID item in Table 1	Arrangements should be put in place to ensure that environmental remediation, post-accident, can be carried out quickly and safely.	The UK ABWR has been designed to minimise environmental releases during normal and accident conditions. Measures relating to post-accident environmental remediation are site-specific and will be addressed by future operators.
<b>DEDP1 - Decommissioning Strategy</b>	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.	Decommissioning of the UK ABWR will not commence for another 60 years, nonetheless, the importance of ensuring the facility is designed for decommissioning is recognised. A decommissioning strategy has been produced and is described in PCSR Chapter 31: Decommissioning [Ref-5].
<b>DEDP2 - Decommissioning Plan</b>	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 decommissioning plans for the main facilities are described in the decommissioning plan in PCSR Chapter 31: Decommissioning [Ref-5]. These plans will be updated and refined throughout the plant's operating life and during decommissioning by any future site licensees.
<b>DEDP3 - Considering Decommissioning during Design and Operation</b>	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.	The 'designed for decommissioning' philosophy will be outlined as part of the design for decommissioning in PCSR Chapter 31: Decommissioning [Ref-5] and will include consideration of radioactivity reduction in dismantling and decontamination. Similarly, the design of facilities will aid operational practices that reduce the spread of radioactive contamination. Evidence of this philosophy will be provided in the Demonstration of BAT document [Ref-9].
<b>DEDP4 - Discharges during Decommissioning</b>	4. A detailed description of the radioactive waste management arrangements. [Note: not listed as a key REP in Table 1]	Aerial or liquid radioactive discharges to the environment during decommissioning should be kept to the minimum consistent with the decommissioning strategy for the site.	Appropriate techniques will be adopted to minimise the aerial or liquid discharges to the environment. This will be outlined in the Decommissioning waste & waste remaining on site at the end of generation in PCSR Chapter 31: Decommissioning [Ref-5]. The associated practices will be developed in more detail following GDA by future operators.

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<b>DEDP5 - Legacy Wastes</b>	No directly related P&ID item in Table 1	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.
<b>CLDP1 - Prevention of Contamination</b>	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.	PCSR Chapter 18 Radioactive Waste Management [Ref-16] provides information on the system design features that prevent, minimise and contain accidental releases of radioactive wastes.
<b>CLDP2 - Strategy for Radioactively Contaminated Land and Groundwater</b>	No directly related P&ID item in Table 1	Each site should have a strategy for the detection and management of radioactively contaminated land and groundwater.	As the designer of the UK ABWR, Hitachi-GE has a duty to ensure that the design adequately protects against possible contamination of groundwater or land. Any operational strategies for the detection of contaminated land or groundwater will be developed by future operators.
<b>CLDP3 - Approach to Management of Radioactively Contaminated Land and Groundwater</b>	No directly related P&ID item in Table 1	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 UK ABWR, Hitachi-GE has a duty to ensure that the design adequately protects against possible contamination of groundwater or land. Any approaches to the management of radioactively contaminated land and groundwater will be developed by future operators if required.
<b>CLDP4 - Justification and Optimisation of Interventions under Part 2A</b>	No directly related P&ID item in Table 1	All interventions that are part of the remediation of radioactive contaminated land should be justified and optimised.	As the designer of the UK ABWR, Hitachi-GE has a duty to ensure that the design adequately protects against possible contamination of groundwater or land. Any necessary intervention strategies will be developed, justified and optimised by future operators if required.

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<b>CLDP5 - Remediation Objectives under Part 2A</b>	No directly related P&ID item in Table 1	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 UK ABWR, 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 specifics of the remediation strategies, including the objectives, will be developed by future operators if required.