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UK ABWR

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UK ABWR Generic Design Assessment

Summary of the Generic Environmental Permit Applications

Hitachi-GE Nuclear Energy, Ltd.

HITACHI

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1. Acronyms

ABWR	Advanced Boiling Water Reactor
AC	Atmospheric Control System
ALARA	As Low As Reasonably Achievable
ALARP	As Low As Reasonably Practicable
BAT	Best Available Technique
BPEO	Best Practicable Environmental Option
BPM	Best Practicable Means
Bq	Becquerel
BSS	Basis Safety Standards Directive
BWR	Boiling Water Reactor
C&I	Control and Instrumentation
CAD	Controlled Area Drain
CCI	Commercially Confidential Information
CD	Condensate Demineraliser
CDL	Calculated Detection Limit
CF	Condensate Filter
COMAH	Control of Major Accident Hazards
CONW	Concentrated Waste System
CP	Corrosion Product
CSG	Combustion Sector Guidance note
CST	Condensate Storage Tank
CUW	Reactor Water Clean-up system
CW	Circulating Water System
CWP	Circulating Water Pump
D/W	Dry well
DAW	Dry Active Waste
DCD	Design Control Document
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DF	Decontamination Factor
DORIS	The marine dispersion model used in PC-CREAM 08®
DPUR	Dose Per Unit Release

EIA	Environmental Impact Assessment
EMCLs	Environmental Media Concentration Limits
EPR/EPR10	Environmental Permitting (England and Wales) Regulations 2010
EQS	Environment Quality Standards
ERICA	Environmental Risk from Ionising Contaminants: Assessment and Management
ESE	Environmentally Sensitive Equipment
EU	European Union
f-value	Fuel leakage rate
F/D	Filter-Demineraliser
FAP	Forward Action Plan
FDP	Funded Decommissioning Programme
FDW	Feedwater System
FP	Fission Product
FPC	Fuel Pool Cooling and Clean-up System
GDA	Generic Design Assessment
GDF	Geological Disposal Facility
GEP	Generic Environmental Permit
GNF	Global Nuclear Fuel
GSD	Generic Site Description
HAW	Higher Activity Waste
HCEP	How to Comply with your Environmental Permit
HCW	High Conductivity Waste System
HEPA	High Efficiency Particulate Air (Filter)
HFE	Human Factors Engineering
HFF	Hollow Fibre Filter
HLW	High Level Waste
HNCW	HVAC Normal Cooling Water System
HOP	Hydrazine, Oxalic acid, Potassium permanganate
HS	Heating Steam System
HSCR	Heating Steam and Condensate Water Return System
HSD	Hot Shower Drain
HSE	Health and Safety Executive (UK)
HVAC	Heating Ventilation and Air Conditioning System
HWC	Hydrogen Water Chemistry
I&C	Instrumentation and Control
IA	Instrument Air System

IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IEX	Ion-exchange (demineraliser) system
ILW	Intermediate Level Waste
IPPC	Integrated Pollution Prevention and Control
IRA	Initial Radiological Assessment
IWS	Integrated Waste Strategy
J ABWR	Japanese ABWR
KK-6	Kashiwazaki-Kariwa Nuclear Power Station Unit 6
KK-7	Kashiwazaki-Kariwa Nuclear Power Station Unit 7
LCW	Low Conductivity Waste System
LD	Laundry Drain System
LLW	Low Level Waste
LLWR	Low Level Waste Repository
LoC	Letter of Compliance
LOCA	Loss of Coolant Accident
LPRM	Local Power Range Neutron Monitor
LS	Laundry System
LWR	Light Water Reactor
MCERTS	Monitoring Certification Scheme
MS	Main Steam System
NDA	Nuclear Decommissioning Authority
NHS	Non Human Species
NMCA	Noble Metal Chemical Addition
NPP	Nuclear Power Plant
NRW	Natural Resources Wales
NUREG	Nuclear Regulatory Commission Regulation (US)
OG	Off-gas
ONR	Office for Nuclear Regulation
OSPAR	Oslo and Paris Convention on Protection of the Marine Environment of the North East Atlantic
P&D	Plumbing and Drainage System
P&ID	Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Design
P/C	Power Centre
PCI	Pellet Cladding Interaction
PCSR	Pre-Construction Safety Report

PI	Personal Information
ppb	Parts per billion
PWR	Pressurised Water Reactor
QA	Quality Assurance
QAP	Quality Assurance Plan
QC	Quality Control
QMP	Quality Management Plan
QMS	Quality Management System
R/B	Reactor Building
RCLEA	Radioactively Contaminated Land Exposure Assessment
RCW	Reactor Building Cooling Water system
REP	Radioactive Substances Regulation – Environmental Principle
RGP	Relevant Good Practice
RP	Requesting Party
RPDP	Radiation Protection Developed Principle
RQ	Risk Quotient
RSA	Radioactive Substances Act
RSR	Radioactive Substances Regulation
RSW	Reactor Building Service Water System
RW/B	Radwaste Building
RWMA	Radioactive Waste Management Arrangement
RWMD	Radioactive Waste Management Directorate
S/B	Service Building
S/P	Suppression Pool
SA	Station Service Air System
SAM	Sampling System
SAP	Safety Assessment Principle
SF	Spent Fuel
SFAIRP	So Far As Is Reasonably Practicable
SFP	Spent Fuel Pool
SGTS	Standby Gas Treatment System
SJAE	Steam Jet Air Ejector
SLC	Standby Liquid Control System
SoDA	Statement of Design Acceptability
SPCU	Suppression Pool Clean-up System
SQEP	Suitably Qualified and Experienced Person (UK)

SRNM	Start-up Range Neutron Monitor
SS	Spent Sludge System
Sv	Sievert
T/B	Turbine Building
TIP	Traversing In-core Probe
TCW	Turbine Building Cooling Water System
TSW	Turbine Building Service Water System
TV	Tank Vent Treatment System
UF	Uncertainty Factor
UK	United Kingdom
US	United States
VLLW	Very Low Level Waste
WENRA	Western European Nuclear Regulators' Association

2. References

1 Process and Information Document for the Generic Assessment of Candidate Nuclear Power Plant Designs, version 2, March 2013, Environment Agency.

2 Description of Hitachi-GE Organisational Capability, Systems and Management Arrangements, GA91-9901-0016-0001, XE-GD-0085, Rev A, Hitachi-GE, 04 December 2013

3 Generic Site Description, GA91-9901-0020-00001, XE-GD-0095, Rev C, Hitachi-GE, March 2014

4 Hitachi-GE UK ABWR Concept Design, GA91-9901-0033-00001, XE-GD-0135, Rev A, Hitachi-GE, 06 January 2014

5 Quality Management Plan (For UK ABWR GDA Project), GA70-1501-0007-00001, GNQA13-0066, Rev 2, Hitachi-GE, 24 December 2013

6 Genesis of ABWR Design, GA91-9901-0034-00001, XE-GD-0136, Rev A, Hitachi-GE, 06 January 2014

7 Resilience of design against Fukushima type events, GA91-9901-0035-00001, XE-GD-0137, Rev A, Hitachi-GE, 06 January 2014

8 US ABWR Design Control Document (Revision 4)

9 Approach to Optimisation, GA91-9901-0021-00001, XE-GD-0096, Rev C, Hitachi-GE, March 2014

10 Demonstration of BAT, GA91-9901-0023-00001, XE-GD-0097, Rev C, Hitachi-GE, March 2014

11 Radioactive Waste Management Arrangements, GA91-9901-0022-00001, WE-GD-0001, Rev C, Hitachi-GE, March 2014

12 Approach to Sampling and Monitoring, GA91-9901-0029-00001, 3E-GD-K002, Rev C, Hitachi-GE, March 2014

13 Quantification of Discharges and Limits, GA91-9901-0025-00001, HE-GD-0004, Rev C, Hitachi-GE, March 2014

14 Prospective Dose Modelling, GA91-9901-0026-00001, HE-GD-0005, Rev C, Hitachi-GE, March 2014

15 Other Environmental Regulations, GA91-9901-0027-00001, XE-GD-0098, Rev C, Hitachi-GE, March 2014

16 Regulatory Guidance Series, No RSR 1; Radioactive Substances Regulation – Environmental Principles; Version 2; April 2010

17 Consideration of and Compliance with the Radioactive Substances Regulation Environmental Principles (REPs), GA91-9901-0028-00001, XE-GD-0099, Rev C, Hitachi-GE, March 2014

3. Introduction

Hitachi-GE Nuclear Energy, Ltd (Hitachi-GE) is developing a Generic Environmental Permit (GEP) application, for its Advanced Boiling Water Reactor (ABWR, hereafter referred to as UK ABWR) as part of the Generic Design Assessment (GDA) process, overseen by the Office for Nuclear Regulation (ONR) and Environment Agency.

The GEP is the suite of documents developed by Hitachi-GE to provide the information requested within the Process and Information Document for the Generic Assessment of Candidate Nuclear Power Plant Designs (P&ID) (1) for both the ONR and Environment Agency. The P&ID is the Environment Agency guidance and process for assessing the suitability of new nuclear power station in the UK, and outlines what information is needed from the requesting party (Hitachi-GE in the case of the UK ABWR) in order to obtain a Statement of Design Acceptance (SoDA).

This summary document describes the overall purpose and scope of the GEP submission, outlining the structure and layout of the reports, and indicating how each addresses the requirements outlined in the P&ID.

This document complements the overall submission made to both the ONR and Environment Agency, and should be read in conjunction with the Step 1b and supporting documents (i.e. Step 1a documents, Preliminary Safety Case Report (PCSR), Common Documents), to gain a full appreciation of the GEP submission for the UK ABWR at this point in the GDA process.

4. The Requesting Party

Hitachi-GE was founded on July 1st, 2007 as a strategic global alliance between Hitachi, Ltd. and General Electric Co. Hitachi-GE offers nuclear power plant construction and maintenance services in partnership with its US counterpart GE-Hitachi Nuclear Energy. It is majority owned by Hitachi (80.01%), with General Electric Co. holding the minority stake (19.99%), and is headquartered in Hitachi City, Ibaraki Prefecture, Japan.

Together Hitachi, Ltd. and General Electric Co. have experience in the nuclear sector reaching back over half a century; they have been co-operating on and contributing to the development and constructions of the Boiling Water Reactors (BWR) since 1967. Since the introduction of BWR technology in the US in the 1960s, Hitachi has participated in the design, development and construction of over 20 nuclear power plants within Japan.

There are three operating ABWR sites within Japan and four more under construction worldwide, as shown in Table 4-1.

Table 4-1: Global ABWR presence

Operating ABWR	ABWR under construction
Kashiwazaki-Kariwa Nuclear Power Plant (Japan)	Shimane Nuclear Power Plant (Japan)
Hamaoka Nuclear Power Plant (Japan)	Lungmen Nuclear Power Plant (Taiwan)
Shika Nuclear Power Plant (Japan)	Higashidori Nuclear Power Plant (Japan)
	Ohma Nuclear Power Plant (Japan)

Further details on Hitachi-GE are contained within other documents as part of the Step 1a submission for GDA and the Description of Hitachi-GE Organisation Capability, Systems and Management Arrangements document (2).

5. Overview of the Design

The term 'UK ABWR' includes not only the reactor itself but also all buildings which are dedicated exclusively or primarily to housing systems and equipment related to the nuclear system, or which control access to those equipment and systems. There are five such buildings within the scope of the UK ABWR, namely the:

- Reactor Building (including containment);
- Service Building;
- Control Building;
- Turbine Building; and,
- Radioactive waste ('Radwaste') Building.

Further information on the layout of these buildings on a generic site is provided in section 7.2.1 of this document and the Generic Site Description (GSD) document (3).

The major supporting system of particular relevance to the GEP submission is the the Radioactive Waste Management System. This functionally consists of three main sub-systems, namely the:

- Off-gas Treatment System;
- Liquid Waste Treatment System; and,
- Solid Waste Management System.

Figure 5-1 shows the outline of Radioactive Waste Management Systems. In summary, the UK ABWR Radioactive Waste Management System has been developed to significantly reduce the generation of radioactive waste, to adopt advanced technologies to manage and treat those wastes that do arise, as well as support the efficient operation of the reactor.

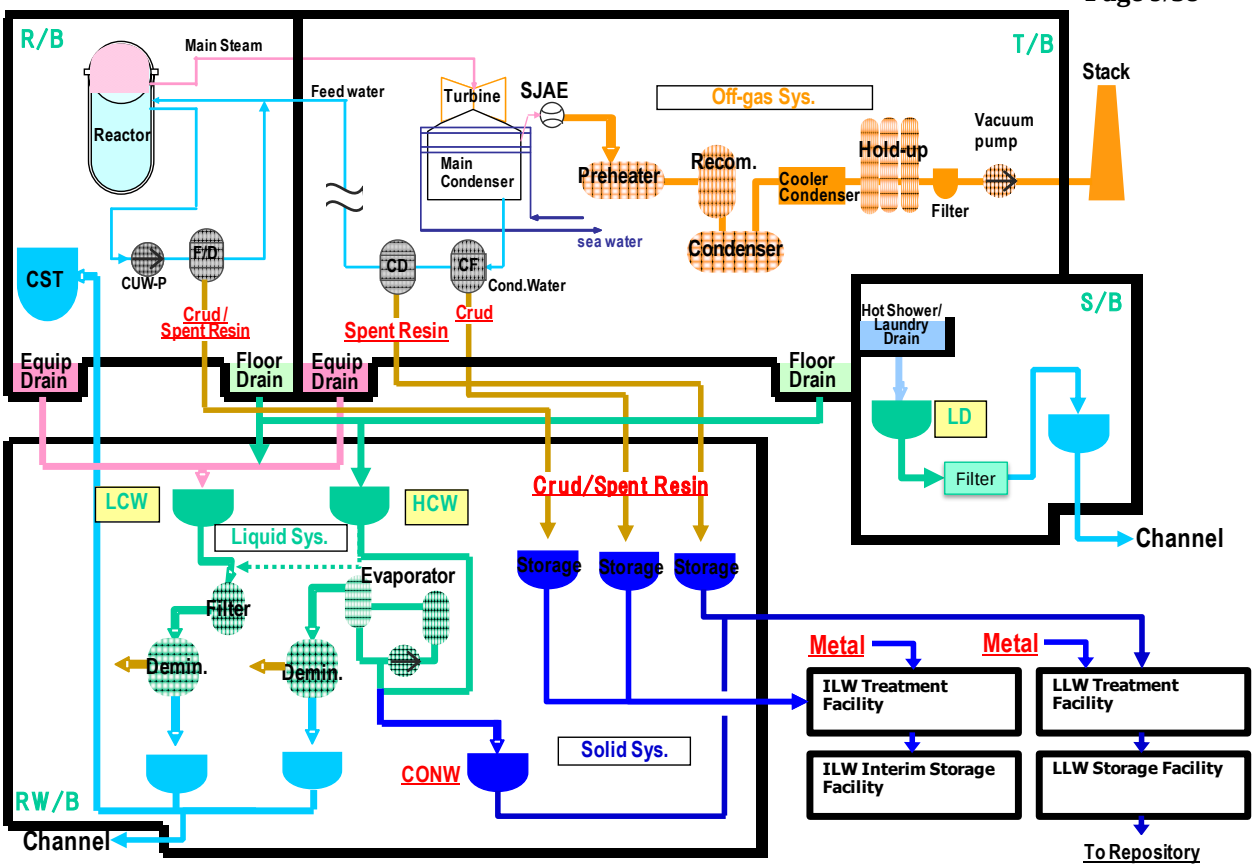


Figure 5-1: Outline of Radioactive Waste Management System

Channel: Main marine channel	LCW: Low Conductivity Waste System
CD: Condensate Demineraliser	LD: Laundry Drain System
CF: Condensate Filter Facility	LLWR: Low Level Waste Repository, Ltd.
CST: Condensate Storage Tank	R/B: Reactor Building
CUW: Reactor Water Clean-up System	RW/B: Radwaste Building
Demin: Demineraliser	S/B: Service Building
F/D: Filter Demineraliser	SJAE: Steam Jet Air Ejector
HCW: High Conductivity Waste System	T/B: Turbine Building

An example of such an improvement regarding the management and treatment of radioactive releases is the adoption of the hold-up (delay) system through use of a charcoal adsorber for Off-gas gaseous waste (see the Off-gas Treatment System description in the following section). Full details of the Radioactive Waste Management System will be provided in the Concept Design (4) and wider PCSR however, a short summary of each of the three main sub-systems is described in the following sections.

5.1. Off-gas Treatment System

The Off-gas System (depicted in orange in Figure 5-1) takes gas arising from the main condenser (containing radioactive noble gases and radiolytic hydrogen and oxygen), processes it to reduce its activity and controls the release of the resulting gas to the site environs. Its operation maintains the exposure of individuals at a level that is As Low As Reasonably Achievable (ALARA).

The Off-gas System process equipment is located within the Turbine Building to minimise the length of piping needed to carry the gas from the main condenser, and housed in a reinforced-concrete structure to provide adequate shielding. The hold-up system is installed in a temperature-controlled room to maintain the capability of the charcoal components of the adsorber.

The Off-gas System reduces the possibility of the radiolytic hydrogen and oxygen contained in the off-gas from reacting and causing an explosion. This is accomplished by the catalytic recombination of the radiolytic hydrogen and oxygen in a recombiner within the system.

The moisture in the off-gas is condensed to reduce the volume of off-gas within the Off-gas condenser. The remaining non-condensables (principally air with a slight amount of radioactive krypton and xenon gas) are passed through Off-gas charcoal adsorbers, which provide adequate hold-up volume across activated charcoal beds to allow time for the radioactive krypton and xenon to decay to lower activity levels. After processing, the gaseous waste (whose activity is now reduced to a permitted level) is monitored and released to the environs through the stack.

Information to be provided during the GDA process will show that activity in gaseous discharges will be reduced to a very low level, in line with the application of Best Available Technique (BAT). The Environment Agency will set limits as part of the GDA process. These limits will be reviewed as part of subsequent site permitting based on any additional information provided by future UK ABWR operators.

5.2. Liquid Waste Treatment System

The Liquid Waste Treatment System (depicted in green in Figure 5-1) is designed to control, collect, process, handle, store, and dispose of liquid radioactive waste generated as the result of normal operations, including anticipated operational occurrences. All potentially radioactive liquid wastes are collected in sumps or drain tanks at various locations in the plant and transferred to collection tanks in the Radwaste Building.

System components are designed and arranged in shielded enclosures to minimise exposure to plant personnel during operation, inspection, and maintenance. Tanks, processing equipment, pumps, valves, and instruments that may contain radioactivity are located in access-controlled areas, again to minimise exposure to plant personnel.

The Liquid Waste Treatment System normally operates on a batch basis. Provision is made for sampling at important process points. Protection against accidental discharge is provided by detection of abnormal conditions and subsequent alarms, as well as by administrative controls.

The Liquid Waste Treatment System is divided into several further sub-systems, so that the liquid wastes from various sources can be segregated and processed separately, based on the most efficient and economical process for the type of impurity and chemical content in each waste stream.

The Liquid Waste Treatment System has been designed and operated to recycle as much of the resulting treated liquid waste as possible, except for liquid waste arising from the laundry drain which contains detergent impurities making it unsuitable for re-use. Despite this innovation, there may be times when liquid discharges may be necessary due to reaching capacity limits for on-site storage of treated liquid waste. Information to be provided during the GDA process will show that such liquid discharges will be reduced to a very low level, in line with the application of BAT. The activity and impurities of all liquid discharges would be checked to confirm that they are indeed very low and that the activity is within the permit limits set by the Environment Agency.

5.3. Solid Waste Management System

The Solid Waste Management System (depicted in dark blue in Figure 5-1) is designed to control, collect, handle, process, package, and temporarily store wet and dry solid radioactive waste prior to shipment or on-site interim storage. This waste is generated as a result of normal operation and anticipated operational occurrences (i.e. due to outage). These wastes are categorised as wet solid wastes (such as spent ion exchange resin beads and filter backwash arising from the operation of the Liquid Waste Treatment System etc) or dry solid wastes (such as HEPA filters, protective clothing, tissue paper etc). Both Low Level Waste

(LLW) and Intermediate Level Waste (ILW) are processed by the Solid Waste Management System.

The Solid Waste Management System functionally consists of the following four sub-systems:

- The wet solid waste collection sub-system;
- The wet solid waste processing sub-system;
- The dry solid waste accumulation and conditioning sub-system; and,
- The container storage sub-system, utilised until the packaged waste is sent off-site for disposal.

Figure 5-1 depicts solid waste treatment and storage facilities in the bottom right (black boxes containing red text). These are areas where management options are being reviewed as part of GDA. Further information will be made available in subsequent GDA Steps.

It is worth noting that the management of spent fuel (SF) is the subject of ongoing work to determine the nature of its interim, on-site storage following removal from the reactor. The system is described as part of the PCSR submission. The nature of its interim storage will influence its management beforehand; following the conclusion of the ongoing assessments, further information on the nature of the SF management and on-site storage system will be submitted as part of GDA.

A single UK ABWR operating for 60 years is estimated to generate approximately 20m^3/yr of wet LLW plus miscellaneous LLW (quantity yet to be determined). It will also produce approximately 10m^3/yr of wet ILW plus irradiated metal (quantity yet to be determined). The actual volumes of waste generated by an operating UK ABWR depends upon a number of site-specific factors, for example the waste strategy (including optimisation of treatment) adopted by the utility and the operating cycle selected (i.e. the period between outages). In all cases waste volumes will be minimised.

6. Purpose of the GEP

Figure 6-1 shows the indicative programme associated with the different steps of the GDA process contained within the P&ID (1).

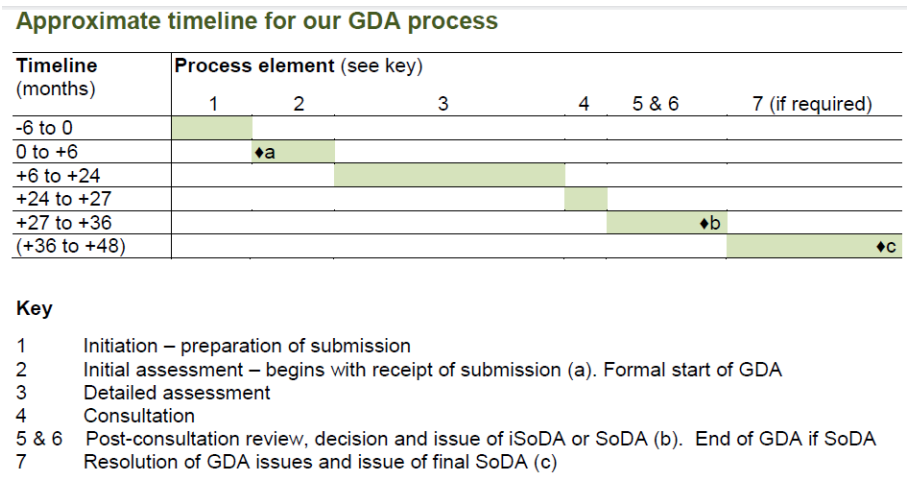


Figure 6-1: Indicative GDA timeline - from P&ID (1)

For this submission, the GEP presents the currently available information to support the UK ABWR GDA process. As shown above, at this stage of the GDA the Environment Agency require sufficient information

to allow them to undertake their Initial Assessment, which is described in the P&ID as:

"…when we (the Environment Agency) receive the submission and examine it at an outline level, to identify whether:

- *further information is required;*
- *there are any matters that are obviously unacceptable;*
- *any significant design modifications are likely to be required."*

The Environment Agency go on to state that they will look in detail at the requesting party's management arrangements for production of the submission, and they may look in more detail at:

- *the generic site description, to ensure it appropriately reflects the relevant constraints of potential sites; and*
- *the assessment of the impact of proposed discharges to give early assurance that dose constraints will be complied with.*

Hitachi-GE has provided the requested information in line with the requirements above to enable the Environment Agency to undertake their Initial Assessment. Hitachi-GE has also provided additional information to meet other P&ID requirements, support the wider GDA submission and enable meaningful discussion with the Environment Agency during Step 2.

It is recognised that some of the submitted information is considered 'generic' to both the ONR and the Environment Agency and will be presented in either the PCSR or the GEP suite of documents. There will be clear signposting between the submissions where this occurs. A significant example is the information relating to the Hitachi-GE Management Systems which is provided to both regulators. This is information is therefore not contained within the GEP and can be found within the Description of Hitachi-GE Management Arrangements document (2).

It should be noted that there are gaps identified in this submission and plans have been put in place to provide the necessary information in later GDA Steps, as set out in the Forward Action Plan (FAP) outlined in section 9 of this document. It is also recognised that subsequent versions of the documents outlined in section 6.1 will develop to include this more detailed information as it becomes available, in order to allow the Environment Agency to undertake more detailed assessment later in the GDA process.

6.1. Structure of the GEP Reports

The major components of Hitachi-GE's GEP submission and its structure has been guided by the layout of the P&ID (1); however, some adjustments to this structure have been made to aid the presentation of information and information availability within Hitachi-GE. Table 6.1-1 gives a high level indication of the contents of each GEP document submitted by Hitachi-GE.

In addition, information that is relevant in addressing the requirements of the P&ID and highly relevant to the GEP is presented in other submitted documents, including the PCSR and Common Documents. In these instances, there is clear signposting to ensure clarity.

Table 6.1-1: Hitachi-GE GEP core documents

GEP Number	Document ID/ Document Number	Document Name
E1b	GA91-9901-0019-00001 XE-GD-0094	Summary of the Generic Environmental Permit Applications (this document)
E2b	GA91-9901-0020-00001 XE-GD-0095	Generic Site Description
E3b	GA91-9901-0021-00001 XE-GD-0096	Approach to Optimisation
E4b	GA91-9901-0022-00001 WE-GD-0001	Radioactive Waste Management Arrangements
E5b	GA91-9901-0023-00001 XE-GD-0097	Demonstration of BAT
E6b	GA91-9901-0029-00001 3E-GD-K002	Approach to Sampling and Monitoring
E7b	GA91-9901-0025-00001 HE-GD-0004	Quantification of Discharges and Limits
E8b	GA91-9901-0026-00001 HE-GD-0005	Prospective Dose Modelling
E9b	GA91-9901-0027-00001 XE-GD-0098	Other Environmental Regulations
E10b	GA91-9901-0028-00001 XE-GD-0099	Consideration of and Compliance with the Radioactive Substances Regulation Environmental Principles (REPs)

6.1.1. Coverage of P&ID requirements

Appendix A maps the P&ID requirements against the report structure laid out in Table 6.1-1 above to give in understanding how the Environment Agency's P&ID requirements have been addressed. Where the full scope of requirements is met within the initial submission this is stated. Similarly, where information has not been submitted at this stage of the GDA process this is also stated. As stated above, the FAP is included within section 9 to highlight how any current gaps in information are being addressed.

7. Summary of Submission

What follows is a summary of the documentation that is included as part of the GEP submission, covering the core documents outlined in Table 6.1-1 above and other supporting documentation in the PCSR and Common Documents.

7.1. Supporting Documentation

7.1.1. Management Arrangements

The management arrangements that support the delivery of the GDA process form an integral part of the GEP. The information requested in the P&ID regarding management arrangements is presented in the Description of Hitachi-GE Organisational Capability, Systems and Management Arrangements (2). This document summarises the management system arrangements that are founded in Hitachi-GE's Quality

Management Plan (For UK ABWR GDA Project) (QMP) (5) and its suite of supporting procedures.

The purpose of these quality assurance arrangements for GDA is to:

- Ensure nuclear safety as the first priority
- Ensure conformity to all applicable laws, codes, standards, regulations and the UK Licensing Conditions, to fulfil regulatory expectations
- Successfully complete the GDA process.

The Description of Hitachi-GE's Management Arrangements document is also the main document by which Hitachi-GE can demonstrate to the Environment Agency that their management arrangements are adequate to take the UK ABWR through the GDA process.

The Description of Hitachi-GE's Management Arrangements document identifies that the QMP has been prepared in accordance with ISO9001-2008, ISO 14001-2004 for which Hitachi-GE has certification, and IAEA Safety Requirement No. GS-R-3.

Appendix A of the QMP ('Management for Environmental Protection'), specifically considers the Environmental Agency's expectations during GDA activities related to radioactive substances, waste management and compliance with environmental permits. The Description of Hitachi-GE's Management Arrangements document and the QMP signpost to where and how important elements of the arrangements are addressed in supporting procedures, as described below:

- Information on how the management of the GDA project is arranged, the organisational structure and the associated roles and responsibilities is within the 'Communication, Reporting Lines and Distribution of Information in the GDA Organization' procedure.
- The development of the design and methods for controlling change to the design of the UK ABWR are in the 'Generic Design and Development Control' and 'Design Change Control and Documentation' procedures.
- The capability of the organisation by way of the assessment of competency of individuals, including key environmental roles, within the Hitachi-GE GDA organisation and of consultants supporting the organisation is delivered through the 'SQEP Requirements for Hitachi-GE and Supplier Personnel' procedure.
- Document control procedures, including document numbering and the methods used for formal communication within the GDA project and with the ONR/Environment Agency are detailed in the 'GDA Document Control Manual'. The particular arrangements and agreements between Hitachi-GE and both regulators are provided in 'Generic Design Assessment Interface Arrangements Office for Nuclear Regulation/Environment Agency and Hitachi-GE Nuclear Energy Ltd (Revision 0 September 2013)'. This document has been adopted as a supporting procedure to the management arrangements.
- Management arrangements shall be subject to self-assessment, auditing and checking by Hitachi-GE in accordance with "Assessment of GDA arrangements (Internal Audits, Self-assessment).

7.1.2. Technical description of Hitachi-GE activities

The full technical description of Hitachi-GE activities is provided as the entire submission to the ONR and Environment Agency. Particularly relevant documents in the wider submission include:

- Hitachi-GE UK ABWR Concept Design (C1a) (4)
- Genesis of ABWR design (C2a) (6)
- Resilience of design against Fukushima type events (C3a) (7)

- Description of Hitachi-GE Organisational Capability, Systems and Management Arrangements (C4a) (2)
- US ABWR Design Control Document (C5a) (8) (for information purposes only).

7.2. The GEP Submission

7.2.1. The Generic Site Description (E2)

7.2.1.1. Site characteristics

The GSD (3) describes the characteristics of the generic site which have been used in the assessments in Hitachi-GE's GDA submission. 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 modelling or assessments, as required, for both radiological and conventional impact assessments. Hitachi-GE believes that the information provided in this submission adequately represents a generic site.

The assessments which will form part of the GDA submission include:

- Initial radiological dose assessment – including short-term, annual and collective dose assessments to humans and dose assessments on non-human biota (the only assessment completed as part of Step 1b of the GDA);
- Initial marine dispersion and impact assessment; and,
- Initial assessment of the dispersion of gaseous and particulate emissions to air from on-site combustion sources and their impact on human health and ecological receptors.

Hitachi-GE will extend the scope of the GSD beyond that requested in the P&ID to include consideration of site characteristics used in assessing the environmental impacts of non-radioactive emissions, as required in future GDA Steps. Relevant characteristics for these assessments will therefore also be included in the GSD.

In common with all likely new build sites in the UK, the generic site selected by Hitachi-GE is coastal. For the purposes of GDA the UK ABWR will be once-through sea-water cooled, drawing cooling water from the adjacent sea and returning the cooling water (now 12°C warmer) to the sea.

The geology at the generic site is assumed to be stable with no active faults. It should be noted that the seismic activity of potential sites is assessed on a site-specific basis by the ONR at the time of site licensing; the effects of seismic activity on the UK ABWR design itself is assessed elsewhere in the GDA submission as part of the PCSR.

The generic site and surrounding area is assumed to be a flat plain, with no large buildings, other than the UK ABWR nuclear power plant, in the immediate vicinity. In reality, all likely new build sites in the UK are situated adjacent to existing power stations. The actual effects of how neighbouring buildings are laid out and local terrain will be considered at the site specific permitting stage.

The following additional general assumptions are also in place regarding the generic site:

- The site is not located on an aquifer;
- There is no standing water at the site;
- No water bodies or watercourses cross the site;
- There are no discharges made to rivers or streams; and,
- There is no ground or groundwater contamination present.

7.2.1.2. Data used

The actual figures, as opposed to the descriptive characteristics above, provided in the GSD document are limited only to those required in the assessments undertaken during step 1b of GDA (specifically, the initial radiological assessment). The GSD will be expanded to include additional data should this be required in assessments in later GDA stages.

The majority of the data used in the radiological assessment are from generic publications/guidance and would be the same for any of the potential UK nuclear new build sites. In some instances additional site specific data has been used and this is described below.

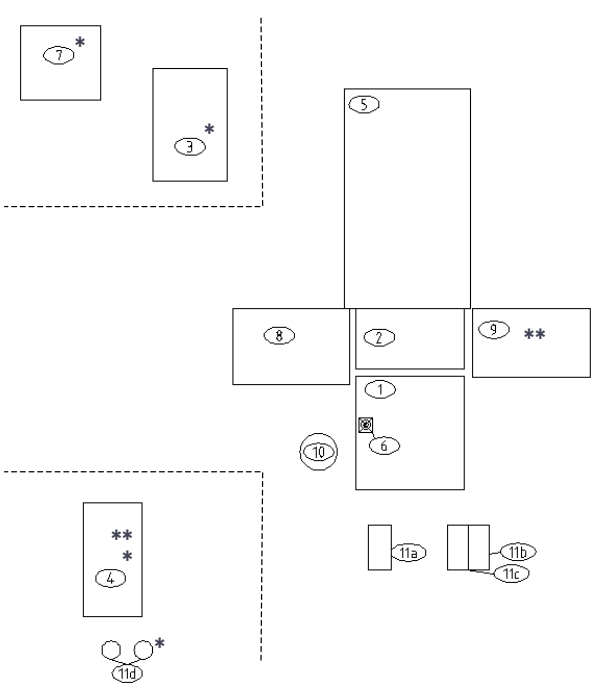
The parameters required for stage 1 of the initial radiological dose assessment uses generic datasets as dictated by the modelling packages recommended for use by the regulator. For stage 2 of the initial radiological dose assessment, generic data sets are also used; however, in places, more refined data is conventionally used to deliver a realistic assessment. For the UK ABWR GDA, the dataset used for the stage 2 of the initial radiological assessment uses generic data augmented by real data from the North Wales coast. For stage 3 of the initial radiological dose assessment, additional refined data from the Irish Sea has also been used to augment the main generic dataset.

This limited use of real data in stage 2 of the initial radiological assessment has been analysed to make sure that it is representative of all likely new build sites in the UK, as well as to understand the extent of its influence on the dose assessment results. Following analysis, it has been shown to have limited influence on the resulting assessment. Similar analysis of the use of real data in the stage 3 assessment will be carried out in Step 2. The GSD document itself is able to show these limited uses of real data in context.

More detailed descriptions of the settings of proposed UK ABWR sites and detailed impact assessments will be provided at site-specific permit application stage to fully assess the differences in individual sites characteristics. Such site-specific information will be used in subsequent assessments supporting the production of Environmental Statements (the product of the Environmental Impact Assessment [EIA] process), as well as Environmental Permit applications for radioactive substance activities, combustion activities and discharges to surface waters.

7.2.1.3. Generic site layout

The layout of the generic UK ABWR nuclear power station considered at GDA is shown in Figure 7.2.1-1 below. A description of the main components and operation of the UK ABWR is provided in the GDA UK ABWR Concept Design (4).



No.	FACILITY (***)
1	REACTOR BUILDING
2	CONTROL BUILDING
3	HEAT EXCHANGER BUILDING
4	BACK-UP BUILDING
5	TURBINE BUILDING
6	STACK
7	CIRCULATING WATER STRUCTURE
8	RADWASTE BUILDING
9	SERVICE BUILDING
10	CONDENSATE STORAGE TANK
11	LIGHT OIL STORAGE TANK
12	SPENT FUEL STORAGE FACILITY

Figure 7.2.1-1: UK ABWR Power Station GDA Site Layout

* Final location depends on site specific conditions.
** The location of stacks and vents is yet to be set – this will be addressed as part of future building layout design activities.
*** To be developed to a level of detail sufficient to support the PCSR and GEP RSR

As shown in Figure 7.2.1-1, there is a single discharge point to air for radioactive gaseous discharges on the roof of the reactor building. There will be separate gaseous discharge points for combustion plant (diesel generators etc). There will also be a single outlet for radioactive releases to sea (not shown in figure).Once determined there may be additional discharge points from interim storage facilities for ILW and SF. These will be incorporated in due course.

7.2.2. Optimisation Techniques (E3 and E5)

The requirement to undertake environmental optimisation for discharges of radioactivity and to demonstrate the application of BAT is defined for the GDA submission within the P&ID. These requirements are consistent with the conditions included in the Environment Agency's standard permit template and which would apply to any future operator of a UK ABWR. To ensure compatibility of the GEP application with all future site specific permit applications Hitachi-GE has elected to use the BAT conditions contained within the standard permit template. These conditions have been used to form the claims that are a key part of the approach adopted to demonstrate the application of BAT.

Hitachi-GE has developed a methodology that sets out the approach to environmental optimisation and the application of BAT. This approach is described in Approach to Optimisation (9). In summary, the approach uses the Claim-Argument-Evidence model to demonstrate the UK ABWR has been optimised.

The objectives of the approach are to:

- Protect members of the public from exposure to potentially harmful ionising radiation;
- Prevent damage to the adjacent environment;
- Operate the nuclear power station efficiently;

- Enhance Hitachi-GE's reputation as a 'good neighbour'; and
- Comply with regulations.

The approach that Hitachi-GE has adopted is guided by the following principles:

- **Evolution of the UK ABWR design:** Boiling water reactors benefit from a long operational history enabling operational feedback to inform the design. Safety, environment and operability have all influenced how the design has evolved at each design iteration. What will be provided through the application of this methodology will be a demonstration of how the design has evolved resulting in very low discharges to the environment.
- **Integration of the BAT methodology into decision making:** Ensure that optimisation is integrated into the project programme and forms part of the 'big picture'.
- **Opportunity:** Identify the best time to deliver elements of the programme to ensure that opportunities to further optimise the UK ABWR can be realised.

The Demonstration of BAT report (10) presents the Claims and Arguments which demonstrate the application of BAT in support of the GDA submission. At this stage of the GDA process, Hitachi-GE has developed the Claims and Arguments and is currently developing the Evidence for their substantiation. This will be presented in future submissions in subsequent GDA steps. Once completed, the Demonstration of BAT report (10) will show that the environmental performance associated with the practice of generating electricity from the UK ABWR is optimised and that BAT is applied in:

- Preventing and minimising (in terms of radioactivity) the creation of radioactive waste
- Minimising (in terms of radioactivity) discharges of gaseous and aqueous radioactive wastes;
- Minimising the impact of those discharges on people, and adequately protecting other species;
- Minimising (in terms of mass/volume) solid and non- aqueous liquid radioactive wastes and spent fuel; and,
- Selecting optimal disposal routes (taking account of the waste hierarchy and the proximity principle) for those wastes.

7.2.3. Radioactive Waste Management Arrangements (E4)

The Radioactive Waste Management Arrangements (RWMA) report (11) describes how radioactive wastes and spent fuel will arise throughout the UK ABWR's lifecycle (including decommissioning) and how they will be managed and disposed of. The document will encompass:

- Sources of radioactivity and matters which affect waste arisings; and,
- Gaseous, aqueous and other wastes (to be incorporated during Step 2).

The RWMA document will cover all such waste arisings but currently concentrates upon those which will be treated and packaged in some way either for immediate disposal or on-site interim storage as 'solid' waste, pending disposal at a later date, including spent fuel (SF). For solid wastes, the RWMA document establishes the quantities and types of radioactive waste that a single UK ABWR unit will produce. Further information on the waste volumes arising through decommissioning, along with the approach undertaken to decommissioning, is explained in full in the decommissioning chapter of the PCSR.

The systems in place for the management and treatment of gaseous and liquid radioactive discharges are described in the suite of documents provided as part of the PCSR (to be provided in Step 2 GDA) and will be underpinned by Demonstration of BAT (10). As indicated by Figure 7.2.1-1, there is a single discharge point to air for radioactive gaseous discharges on the roof of the reactor building and there will be a single outlet for radioactive releases to sea. Once determined, there may be additional discharge points from interim storage facilities for ILW and SF. Consideration of these discharge points will be incorporated in

due course. Correspondingly, details of gaseous, aqueous and other wastes will be incorporated into the next issue of the RWMA document at the end of Step 2.

Sources of radioactivity are generated within the reactor via different mechanisms and processes. These will be described in full in the Demonstration of BAT report (10) and other supporting documentation, including the RWMA document and the Reactor Chemistry chapter of the PCSR. Examples of the sources of the radioactive species to be examined are:

- Fission of tramp Uranium;
- Fission of fuel fissile material;
- Fission of structural Uranium;
- Activation of structural component;
- Activation of coolant substance or impurity;
- Activation of fuel component or impurity;
- Ternary fission in fuel;
- Secondary neutron sources; and
- Boron in control rods.

The RWMA document has been developed for the UK ABWR with the UK regulatory system in mind. Where UK practice differs from the standard Japanese approach this is noted and management options will be discussed for the specific waste stream (i.e. ILW). In such circumstances an outline of the 'next steps' is included.

The RWMA document has been produced with potential site operators in mind to ensure that the site specific Integrated Waste Strategy (IWS) can follow on from these generic arrangements without major changes to the fundamental arrangements. The approach to this is described in the RWMA document.

7.2.4. Approach to Sampling and Monitoring (E6)

Hitachi-GE recognises that the description of the sampling arrangements, techniques and systems for measurement and assessment of discharges and disposals of radioactive waste is an important aspect of the GDA process. The approach adopted and the commitment to undertake further assessment is included in the Approach to Sampling and Monitoring report (12).

At this moment in time it is difficult to be certain about the actual monitoring arrangements that will be deployed in a UK ABWR because the technology selection is influenced by the demonstration of BAT, the selection of radionuclides for limits, the need for information on plant performance and the final plant design/layout. However, at this stage of the process, Hitachi-GE is able to make a series of commitments and ensure that they are adhered to as the Safety Case and Design progresses. These high level design requirements are:

1. The design allows for data (regarding radioactivity, radionuclide composition, and volume) to be measured and collected to ensure permit condition compliance, during both operation and maintenance.
2. All routes for radioactive discharges under normal operations (e.g. main stack and main outfall) to the environment are identified and monitored to obtain entire discharge data. Non-radioactive discharge points or paths where radioactive substances are not found are not monitored, unless required for demonstrating plant performance.
3. The need for continuous monitoring is incorporated into the design in order to record

temporal fluctuations of the discharge levels.

4. Provision for grab sampling is made, allowing detailed analyses to supply relevant nuclide-specific data which is essential for demonstrating compliance.
5. For batch discharge points, provision is made for samples to be collected for analysis prior to discharge. Additionally, the provision for continuous monitoring is included within the design to prevent human error.
6. The design allows for various radiation detectors to be used so that those considered BAT can be selected at the time with sufficient sensitivity to support permit condition compliance.
7. The system is designed to obtain representative samples whose radioactive concentration is equivalent to the process fluid.
8. Locations for in-process monitoring and sampling arrangements are included to allow equipment to be installed that can help identify when operations deviate away from that considered to be BAT.
9. Transfer of on-site stored radioactive wastes (e.g. solid wastes) to the proper authorities is allowed once the levels have been reviewed and approved as suitable for acceptance.
10. Automatic interlocks are designed based on Human Factors engineering (HFE). An unexpected radioactive release sequence is faster than human judgments and operations and is therefore automatically stopped upon detecting the high radiation level.

7.2.5. Quantification of Discharges and Limits (E7)

The Quantification of Discharges and Limits document (13) establishes the approach that Hitachi-GE is adopting to estimate the radioactive discharges from the UK ABWR and to propose limits for a single UK ABWR unit. The approach for estimating discharges is based on the technique that is used for estimating discharges in Japan and has been extended to make use of actual discharge data available for operating Japanese ABWR units where available and applicable. Additional estimation techniques have been developed for a number of radionuclides that must be considered in the European Union but which are not typically considered in Japan.

The estimation of discharges and the proposal of limits has taken account of relevant guidance produced by the Environment Agency. Where practicable, the generation and disposal of radioactive waste and the associated impacts on members of the public and the environment have been minimised by the application of BAT. Operating conditions that could give rise to a short-term increase in the amount of radioactivity discharged from the UK ABWR have been identified. These considerations, combined with the Environment Agency's guidance, have been used to identify the radionuclides that should be subject to limitation and to inform the amount of 'headroom' required for the proposed limits.

Hitachi-GE recognises that, at this stage of the GDA process, there are a number of gaps and that the estimates of discharges and the proposed limits are cautious. Additional assessment will be undertaken at Step 2 to refine the estimation of discharges and review the proposed limits. However, Hitachi-GE is able to demonstrate that prospective doses from the UK ABWR are comparable to other operating nuclear power stations around the world and are within relevant legal limits.

7.2.6. Radiological Assessment (E8)

In accordance with the P&ID, a prospective radiological assessment is required at the proposed limits for discharges to the environment. The prospective dose assessment carried out for the UK ABWR is provided in the Prospective Dose Modelling report (14) and includes:

1. Annual dose to most exposed members of the public for liquid discharges;
2. Annual dose to most exposed members of the public for gaseous discharges (identifying

separately the dose associated with on-site incineration where applicable);

3. Annual dose to the most exposed members of the public for all discharges from the facility;
4. Annual dose from direct radiation to the most exposed member of the public;
5. Annual dose to the representative person for the facility;
6. Potential short-term doses, including via the food chain, based on the maximum anticipated short-term discharges from the facility in normal operation;
7. A comparison of the calculated doses with the relevant dose constraints;
8. An assessment of whether the build-up of radionuclides in the local environment of the facility, based on the anticipated lifetime discharges, might have the potential to prejudice legitimate users or uses of the land or sea;
9. Collective dose truncated at 500 years to the UK, European and world populations; and,
10. Dose-rate to non-human species.

In line with industry practice, this process is broken down into a number of stages:

- Stage 1: uses the IRA methodology and standard generic parameters which enable a cautious assessment of the radiological impact of discharges.

  If the assessed dose is > 20μSv/y, then proceed to Stage 2.

- Stage 2: uses the IRA methodology and refined data with more realistic parameters.

  If the assessed dose is > 20μSv/y, then proceed to Stage 3.

- Stage 3: uses more detailed site-specific data. Stage 3 does not use the IRA methodology but more detailed codes (in the case of Hitachi-GE, PC CREAM 08®). The computer code PC-CREAM 08® comprises of a number of modules that predict the transfer of radionuclides in the environment.

A site-specific radiological assessment should be undertaken if the overall dose remains greater than 20μSv/y at the end of stage 2.

At the current point in GDA, the stage 2 modelling for the UK ABWR has been undertaken and the results are presented in the Prospective Dose Modelling report (14). Should there be any changes to the design or operational philosophy for the UK ABWR the dose modelling will be reviewed accordingly.

7.2.7. Conventional Impact Assessment (E9)

The P&ID details the information Hitachi-GE is required to provide regarding the applicability and impact of other environmental regulations on the design and generic site. The areas in question relate to the non-radioactive regulations such as:

- Water use and abstraction;
- Discharges to surface waters;
- Discharges to groundwater;
- Operation of installations (combustion plant and incinerators); and,
- Substances subject to the Control of Major Accident Hazards Regulations (COMAH).

Within the Other Environmental Regulations report (15), Hitachi-GE have summarised the applicability of

regulations in each of these areas and have established Hitachi-GE's proposed approach to address the P&ID requirements in future GDA submissions. The actual assessments will be undertaken in GDA Step 2 and in doing so, the Environment Agency's information requirements contained in Table 1, part 8 within the P&ID will be met.

7.2.8. Consideration of and Compliance with the REPs (E10)

Hitachi-GE have reviewed the full list of 'Fundamental' and 'Generic Developed Principles: Regulatory Assessment' from the Environment Agency's Radioactive Substances Regulation - Environmental Principles (REPs) document (16). Hitachi-GE's approach to demonstrating compliance is laid out in the Consideration of and Compliance with the REPs document (17). The applicability of each REP to the UK ABWR design process has been assessed, and the document signposts out to other parts of the GDA submission where evidence of compliance can be found.

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 encapsulated in 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. Some elements of the Fundamental Principles may require continued action from the site operator and these points are highlighted; however, it is the duty of Hitachi-GE as the UK ABWR designer to enable compliance so far as possible. Compliance with each of these principles is provided as a statement providing observation in section 4.1 of the document (17).

The 'Generic Developed Principles: Regulatory Assessment' ('Generic REPs') are much more specific. Specific REPs in this category are highlighted in the Environment Agency's P&ID document (1) to guide the development of the content of the requesting party's GDA submission. As a consequence, Hitachi-GE have assessed which Generic REPs are applicable to the UK ABWR GDA submission and provided a signpost to the relevant chapter of the whole GDA submission to demonstrate how the REP has been addressed through the design (17). 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. Where Generic REPs are deemed to not 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. Again, Hitachi-GE's role as the UK ABWR designer means that design activities must enable subsequent operator compliance so far as possible.

8. Links to other GDA documentation

8.1. Summary of Common Documents

The following section summarises the key information contained within other Step 1a documents that have already been provided to both regulators.

8.1.1. Hitachi-GE UK ABWR Concept Design (C1a)

The main technological features of the UK ABWR are as follows:

- Large scale, highly efficient plant;
- Highly economical reactor core;
- Reactor coolant recirculation system driven by internal pumps;

- Advanced control rod drive mechanism;
- Overall digital control and instrumentation; and,
- Reinforced concrete containment vessel.

These features constitute a highly-functional, enhanced-safety nuclear reactor system, with a compact, easy-to-operate, and efficient turbine of excellent performance. For general information of ABWR system design features, the US ABWR Design Control Document (8) (DCD) is available on the US Nuclear Regulatory Commission website (http://www.nrc.gov/reactors/new-reactors/design-cert/abwr.html). This is provided for information only and is not a formal GDA document.

Reference to the Concept Design document (4) and supporting DCD information is a useful way to gain a greater understanding of the UK ABWR.

8.1.2. Genesis of ABWR design (C2a)

The ABWR has been developed in collaboration with various international partners and support from power companies with experience in operating BWR plants. The primary design objectives were:

- Improved safety with multiplex and diversity;
- Improved operation and maintenance;
- Advanced technology employment;
- Construction time reduction;
- Power generation costs reduction; and,
- Environmental impact minimisation.

Focusing on the environmental impact, the evolution of the BWR technology has led to a number of improvements in the environmental performance of the UK ABWR. The range of improvements extends across all disciplines including:

- Preventing and minimising (in terms of radioactivity) the creation of radioactive waste whilst still supporting the operation of the reactor;
- Minimising (in terms of radioactivity) the discharges of gaseous and aqueous radioactive wastes through implementing systems which capture the activity, or allow for natural decay, prior to release;
- Minimising the number of components and the size of material that would ultimately become a radioactive waste; and,
- Allowing for flexibility in the design to have site specific waste management systems for treatment and managing of solid wastes and controlling discharges into the environment.

8.1.3. Resilience of design against Fukushima type events (C3a)

The Resilience of Design against Fukushima type Events document (7) outlines lessons learned and the robustness of the UK ABWR design against extreme events, considering the Great East Japan Earthquake which occurred in March 2011. No specific issues relating to environmental aspects are discussed in this document (7), however it is referred to here for completeness.

8.1.4. Description of Hitachi-GE Organisational Capability, Systems and Management Arrangements (C4a)

A summary of the contents of the Description of Hitachi-GE Organisational Capability, Systems and Management Arrangements (C4a) document (2) is given in section 7.1.1 Management Arrangements, due to its integral role as part of the GEP.

8.1.5. US ABWR DCD Rev.4 (C5a) (for information purpose)

The US ABWR Design Control Document (8) has been provided to the regulators for information only. Within the DCD there are descriptions of the gaseous and liquid waste management systems giving detailed information.

9. Summary of Forward Action Plan (FAP)

The Forward Action Plan (FAP) has been developed to set out the work to be undertaken in Step 2 of the GDA. This is shown in Table 9-1 Forward Action Plan for each GEP document below.

Table 9-1 Forward Action Plan for each GEP document

GEP Report	Action	To be completed
Summary Document (E1)	Update FAP to reflect changes to programme.	Step 2
Generic Site Description (E2)	Determine how representative the site specific data used in IRA stages 2 and 3 is of likely UK new build sites.	Step 2
Generic Site Description (E2)	(If needed) Review of the sensitivity of the initial dose modeling assessments to site-specific data used in IRA stages 2 and 3.	Step 2
Approach to Optimisation (E3)	Further integration of BAT methodology into Hitachi-GE's Management Systems	Step 2
Approach to Optimisation (E3)	Review BAT methodology for opportunities to improve following Evidence gathering exercise.	Step 2
Radioactive Waste Management Arrangements (E4)	Provision of further information on the proposed ILW treatment & Storage Facilities.	Step 2
Radioactive Waste Management Arrangements (E4)	Provision of further information on the proposed spent fuel management option	Step 2
Radioactive Waste Management Arrangements (E4)	Provide further justification that reference to LLWR for GDA is BAT.	Step 2
Radioactive Waste Management Arrangements (E4)	Incorporate further information on gaseous, aqueous and other wastes,	Step 2
Demonstration of BAT (E5)	For each Argument within the current document, provide sufficient Evidence to support the Demonstration of BAT	Step 2
Demonstration of BAT (E5)	Within the relevant Arguments, clarify those aspects of the design that will be subject to further optimisation as part of the site specific assessment.	Step 2
Approach to Sampling & Monitoring (E6)	Undertake further work to supplement the GEP submission regarding the Sampling and Monitoring regime for the UK ABWR.	Step 2

GEP Report	Action	To be completed
Quantification of Discharges and Proposed Limits (E7)	During Step 2 GDA the basis upon which the Measured Data, the Assumed values and the Calculated values are determined will be reviewed and updated to reflect additional information and discharge data for ABWR's. Following this review, the proposed limits and prospective dose modelling will be updated to reflect any changes to the data.	Step 2
Prospective Dose Modelling (E8)	Provide a more in-depth discussion of the differences between the US and Japanese dose assessments.	Step 2
Prospective Dose Modelling (E8)	Provide analysis of the implications of any emerging regulatory issues i.e. discussion of minor exposure pathways, foetal exposure, screening values for non-human species etc .	Step 2
Prospective Dose Modelling (E8)	Provide further clarification on the contribution ABWRs make to the public dose in published data.	Step 2
Other Environmental Regulations (E9)	Completion of assessments related to UKABWR Freshwater requirements and associated generic impact assessment of the related systems.	Step 2
Other Environmental Regulations (E9)	Completion of assessments related to UKABWR Cooling water requirements and associated generic impact assessment of the related systems.	Step 2
Other Environmental Regulations (E9)	Completion of assessments related to UKABWR discharges to surface water and associated generic impact assessment of the related systems.	Step 2
Other Environmental Regulations (E9)	Provision of more information (management systems and design information) on measures to prevent accidental discharges to groundwater.	Step 2
Other Environmental Regulations (E9)	Completion of assessments related to UKABWR combustion activities and associated generic impact assessment of the related systems.	Step 2
Consideration of and Compliance with the REPs (E10)	Continuing detailed review of the main considerations of each REP to ensure compliance with each is demonstrated.	Step 2

Appendix A: Mapping of P&ID requirements against GEP reports

Item	Information required	Included in this submission?	Where in the GEP		Further information source (i.e. C1a, PCSR Strategy)
			Document	Section	
1	**General information relating to the requesting party and the design.**				
	Include:				
	Brief details about the requesting party, including its experience of reactor design and plants in service.	Y	E1: Summary of GEP Submission	4	C1a: Hitachi-GE UK ABWR Concept Design (part of step 1a submission)
	A simple, outline description of the design including schematic diagrams.	Y	E1: Summary of GEP Submission	5	
	A brief history of the design, identifying predecessor plant and the main design changes.	Y	E1: Summary of GEP Submission	8	C2a: Genesis of ABWR design (part of step 1a submission)
	Identification of discharge points to the environment for gaseous and aqueous radioactive wastes.	Y	E1: Summary of GEP Submission	5	
	Description and characteristics of the generic site (or sites) that the requesting party will use to provide its dose assessment (see item 7 below). Any statement of acceptability we issue after our assessment will be on the basis of these characteristics. A range of generic sites might be chosen with coastal, estuarine and inland characteristics.	Y	E1: Summary of GEP Submission	7.2.1	E2: Generic Site Description
	A summary of the proposed discharges of radioactive waste and their potential impact on members of the public and non-human species at the generic site.	Y	E1: Summary of GEP Submission	7.2.5 7.2.6	E4: Radioactive Waste Management Arrangements E7: Quantification of Discharges and Limits
	A summary of the 'conventional' environmental impacts (see item 8 below) of the facility.	Y	E1: Summary of GEP Submission	7.2.7	E9: Other Environmental Regulations

Item	Information required	Included in this submission?	Where in the GEP		Further information source (i.e. C1a, PCSR Strategy)
			Document	Section	
2	**A description of the requesting party's management arrangements and responsibilities for:**				
	Developing the design	N	-	-	This will be covered in the Hitachi-GE Quality Management arrangements for GDA
	Managing the GDA project	N	-	-	This will be covered in the Hitachi-GE Quality Management arrangements for GDA
	Establishing the methodology for identifying the 'best available techniques' (BAT - see 4 below) and ensuring their use in the design	Y	E3: Approach to Optimisation	Whole document	
	Producing and maintaining the submission	N	-	-	This will be covered in the Hitachi-GE Quality Management arrangements for GDA
	Ongoing communications with the regulators and responding to matters raised by them during GDA	N	-	-	This will be covered in the Hitachi-GE Quality Management arrangements for GDA
	Maintaining records of design and construction	N	-	-	This will be covered in the Hitachi-GE Quality Management arrangements for GDA
	Controlling and documenting design modifications, both during and after completion of GDA	N	-	-	This will be covered in the Hitachi-GE Quality Management arrangements for GDA
	Transferring information to potential operators and providing ongoing support to them throughout the reactor's lifecycle.	N	-	-	This will be covered in the Hitachi-GE Quality Management arrangements for GDA
3	**Detailed information relating to the design.**				
	Include:				
	A technical description of the facility's main plants, systems and processes, supported by process diagrams.	N	-	-	This information will be provided in Step 2

Item	Information required	Included in this submission?	Where in the GEP		Further information source (i.e. C1a, PCSR Strategy)
			Document	Section	
	Identification of the plants, systems and processes which have a bearing on: - radioactive waste (solid, liquid and gaseous) generation, treatment, measurement, assessment and disposal - the conventional environmental impacts (see item 8 below) of the facility.	N	-	-	This information will be provided in Step 2
4	**A detailed description of the radioactive waste management arrangements.**				
	Include:				
	Identification of the strategic considerations with respect to radioactive waste management which underpin the design.	Y	E4: Radioactive Waste Management Arrangements	-	Further information will be provided in Step 2 (e.g. ILW management and Spent Fuel management)
	A description of how radioactive wastes and spent fuel will arise throughout the facility's lifecycle (including decommissioning) and your plans for how they will be managed and disposed of, to encompass:	Y	E4: Radioactive Waste Management Arrangements	-	Further information will be provided in Step 2 (e.g. ILW management and Spent Fuel management)
	- sources of radioactivity and matters which affect wastes arising	Y	E4: Radioactive Waste Management Arrangements	-	This will be updated throughout GDA to reflect the design as it evolves through GDA.
	- gaseous, aqueous and other wastes.	N	-	-	This information will be provided in Step 2 (for (off-gas and liquid systems) in System Description Documents
	A description of how the production, discharge and disposal of radioactive waste will be managed to protect the environment and to optimise the protection of people.	Y	E5: Demonstration of BAT	-	The evidence to underpin the Claims and Arguments will be provided in Step 2 GDA.
	You should describe your optimisation process and identify and justify the techniques you are proposing as BAT.	Y	E3: Approach to Optimisation	Whole document	

Item	Information required	Included in this submission?	Where in the GEP		Further information source (i.e. C1a, PCSR Strategy)
			Document	Section	
	In identifying techniques, you should address both the technology you use and the way the facility is designed and will be built, maintained, operated and dismantled.		E5: Demonstration of BAT	-	The evidence to underpin the Claims and Arguments will be provided in Step 2 GDA.
	In justifying techniques as BAT you should address the following, in respect of wastes arising throughout the lifetime of the facility:				
	- Preventing and minimising (in terms of radioactivity) the creation of radioactive waste	Y	E5: Demonstration of BAT	-	The evidence to underpin the Claims and Arguments will be provided in Step 2 GDA.
	- Minimising (in terms of radioactivity) discharges of gaseous and aqueous radioactive wastes	Y	E5: Demonstration of BAT	-	The evidence to underpin the Claims and Arguments will be provided in Step 2 GDA.
	- Minimising the impact of those discharges on people, and adequately protecting other species	Y	E5: Demonstration of BAT	-	The evidence to underpin the Claims and Arguments will be provided in Step 2 GDA.
	- Minimising (in terms of mass/volume) solid and non-aqueous liquid radioactive wastes and spent fuel	Y	E5: Demonstration of BAT	-	The evidence to underpin the Claims and Arguments will be provided in Step 2 GDA.
	- Selecting optimal disposal routes (taking account of the waste hierarchy and the proximity principle) for those wastes	Y	E5: Demonstration of BAT	-	The evidence to underpin the Claims and Arguments will be provided in Step 2 GDA.
	- The suitability for disposal of any wastes and spent fuel for which there is no currently available disposal route and how they will be managed in the interim so as not to prejudice their ultimate disposal. (You should obtain a view from the Nuclear Decommissioning Authority (as the UK authoritative source in providing such advice) on the disposability of such wastes and spent fuel.)	Y	E5: Demonstration of BAT	-	The evidence to underpin the Claims and Arguments will be provided in Step 2 GDA.

Item	Information required	Included in this submission?	Where in the GEP		Further information source (i.e. C1a, PCSR Strategy)
			Document	Section	
5	**Quantification of radioactive waste disposals. Provide quantitative estimates for normal operation of:**				
	- Discharges of gaseous and aqueous radioactive wastes	Y	E7: Quantification of Discharges and Limits	-	Further refinement will be provided in Step 2, if required.
	- Arisings of combustible waste and disposals by on-site or off-site incineration	Y	E4: Radioactive Waste Management Arrangements	-	Further refinement will be provided in Step 2, if required.
	- Arisings of other radioactive wastes (by category and disposal route (if any)) and spent fuel; 'Normal operation' includes the operational fluctuations, trends and events that are expected to occur over the lifetime of the facility, such as start-up, shutdown, maintenance, etc. It does not include increased discharges arising from other events, inconsistent with the use of BAT, such as accidents, inadequate maintenance, and inadequate operation. For gaseous and aqueous radioactive wastes, you should estimate your monthly discharges:	Y	E4: Radioactive Waste Management Arrangements & E7: Quantification of Discharges and Limits	-	Further refinement will be provided in Step 2, if required.
	- On an individual radionuclide basis for significant radionuclides;	Y	E7: Quantification of Discharges and Limits	-	Further refinement will be provided in Step 2, if required.
	- On a group basis (for example 'total alpha' or 'total beta') for other radionuclides;	Y	E7: Quantification of Discharges and Limits	-	Further refinement will be provided in Step 2, if required.

Item	Information required	Included in this submission?	Where in the GEP		Further information source (i.e. C1a, PCSR Strategy)
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	- Via each discharge point and discharge route.	Y	E7: Quantification of Discharges and Limits	-	Further refinement will be provided in Step 2, if required.
	Provide your proposed limits for:				
	- Gaseous discharges	Y	E7: Quantification of Discharges and Limits	-	Further refinement will be provided in Step 2, if required.
	- Aqueous discharges	Y	E7: Quantification of Discharges and Limits	-	Further refinement will be provided in Step 2, if required.
	- Disposal of combustible waste by on-site incineration.	Y	E7: Quantification of Discharges and Limits	-	Further refinement will be provided in Step 2, if required.
	Provide your proposals for annual site limits (on a rolling twelve months basis) for gaseous and aqueous discharges, and monthly limits for disposals by on-site incineration, and tell us how you derived these. You may additionally propose limits to reflect an operating cycle, that is, 'campaign' limits.	Y	E7: Quantification of Discharges and Limits	-	Further refinement will be provided in Step 2, if required.
6	**A description of the sampling arrangements, techniques and systems for measurement and assessment of discharges and disposals of radioactive waste.**				
	Include:				

Item	Information required	Included in this submission?	Where in the GEP		Further information source (i.e. C1a, PCSR Strategy)
			Document	Section	
	Details of in-process monitoring arrangements, as well as those for final discharges of gaseous and aqueous wastes, and disposals of non-aqueous liquid and solid wastes	N		-	An indication of approach is contained within this submission (E6) with further information to be provided in Step 2 & 3
	A demonstration that your proposals represent the best available techniques for monitoring	N		-	An indication of approach is contained within this submission (E6) with further information to be provided in Step 2 & 3
	Confirmation that the sensitivity is sufficient to: - Readily demonstrate compliance with the proposed limits;	N		-	An indication of approach is contained within this submission (E6) with further information to be provided in Step 2 & 3
	- Meet the levels of detection specified in reference EU, 2004.	N		-	An indication of approach is contained within this submission (E6) with further information to be provided in Step 2 & 3
7	**A prospective radiological assessment at the proposed limits for discharges and for any on-site incineration.**				
	Include:				
	Annual dose to most exposed members of the public for liquid discharges	Y	E8: UK ABWR prospective Dose Modelling	-	The prospective dose modelling will be updated throughout GDA to reflect changes to data and assumptions used
	Annual dose to most exposed members of the public for gaseous discharges (identifying separately the dose associated with on-site incineration where applicable)	Y	E8: UK ABWR prospective Dose Modelling	-	The prospective dose modelling will be updated throughout GDA to reflect changes to data and assumptions used

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	Annual dose to the most exposed members of the public for all discharges from the facility	Y	E8: UK ABWR prospective Dose Modelling	-	The prospective dose modelling will be updated throughout GDA to reflect changes to data and assumptions used
	Annual dose from direct radiation to the most exposed member of the public	Y	E8: UK ABWR prospective Dose Modelling	-	The prospective dose modelling will be updated throughout GDA to reflect changes to data and assumptions used
	Annual dose to the representative person for the facility	Y	E8: UK ABWR prospective Dose Modelling	-	The prospective dose modelling will be updated throughout GDA to reflect changes to data and assumptions used
	Potential short-term doses, including via the food chain, based on the maximum anticipated short-term discharges from the facility in normal operation	Y	E8: UK ABWR prospective Dose Modelling	-	The prospective dose modelling will be updated throughout GDA to reflect changes to data and assumptions used
	A comparison of the calculated doses with the relevant dose constraints	Y	E8: UK ABWR prospective Dose Modelling	-	The prospective dose modelling will be updated throughout GDA to reflect changes to data and assumptions used
	An assessment of whether the build-up of radionuclides in the local environment of the facility, based on the anticipated lifetime discharges, might have the potential to prejudice legitimate users or uses of the land or sea	Y	E8: UK ABWR prospective Dose Modelling	-	The prospective dose modelling will be updated throughout GDA to reflect changes to data and assumptions used
	Collective dose truncated at 500 years to the UK, European and world populations	Y	E8: UK ABWR prospective Dose Modelling	-	The prospective dose modelling will be updated throughout GDA to reflect changes to data and assumptions used

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			Document	Section	
	Dose-rate to non-human species*.	Y	E8: UK ABWR prospective Dose Modelling	-	The prospective dose modelling will be updated throughout GDA to reflect changes to data and assumptions used
	You should tell us which models you used to calculate these doses and why they are appropriate, and set out all the data and assumptions (with reasoning) that you used as input to the models.	Y	E8: UK ABWR prospective Dose Modelling	-	The prospective dose modelling will be updated throughout GDA to reflect changes to data and assumptions used
8	**Information relating to other environmental regulations**				
	Water use and abstraction				
	Provide details and estimates of fresh water requirements for the design.	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	Provide details and estimates of cooling water requirements for the design relevant to the generic site. Include consideration of:	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	- Seawater or river water abstraction	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	- Use of conventional cooling towers or hybrid cooling towers	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	- Abstraction inlet fish deterrent schemes	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2

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	- Fish return systems.	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	Discharges to surface waters				
	Provide a description of how aqueous waste streams will arise, be managed and be disposed of throughout the facility's lifecycle. Include: - Sources and quantities of contaminants (including disinfectant and biocides), highlighting any priority substances (as specified in the 'Priority Substances' Directive (EU, 2008))	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	- Identification of the effluent and surface water runoff streams contributing to the overall discharge and how they are controlled	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	- Potential options and associated environmental impact for disposal of each individual effluent stream	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	- The means of control in the event of detection of unplanned radioactive or other contamination of the discharge	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	- Options for beneficial use of the waste heat produced	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	- Environmental impact of thermal discharges.	N	–	-	An indication of approach is

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					contained within this submission (E9) with further information to be provided in Step 2
	Discharges to groundwater				
	If there will be discharges to groundwater, describe the nature and quantity of those discharges and provide an assessment of the impact on groundwater. (Note: 1. You should address prevention of accidental discharges of radioactivity to land and groundwater in your response to item 4 above. 2. We do not normally permit discharges to groundwater.)	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	Operation of installations (combustion plant and incinerators)				
	Identify what combustion plant (for example, for standby generation or auxiliary boilers) will be provided.	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	If the aggregate rated thermal input of all combustion plant is greater than 50 MW, provide a comparison of the proposed technology against our sector guidance.	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	If the aggregate rated thermal input of all combustion plant is greater than 20 MW, describe how greenhouse gas emissions will be monitored.	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2
	If the design includes an on-site incinerator with a capacity or 1 tonne or more per hour, provide a comparison of the proposed technology against our sector guidance.	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2

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	Substances subject to the Control of Major Accident Hazards Regulations				
	Identify any need for on-site storage of substances above the qualifying thresholds in COMAH99. If a threshold is exceeded, describe the measures taken in the design to prevent a major accident to the environment.	N	–	-	An indication of approach is contained within this submission (E9) with further information to be provided in Step 2