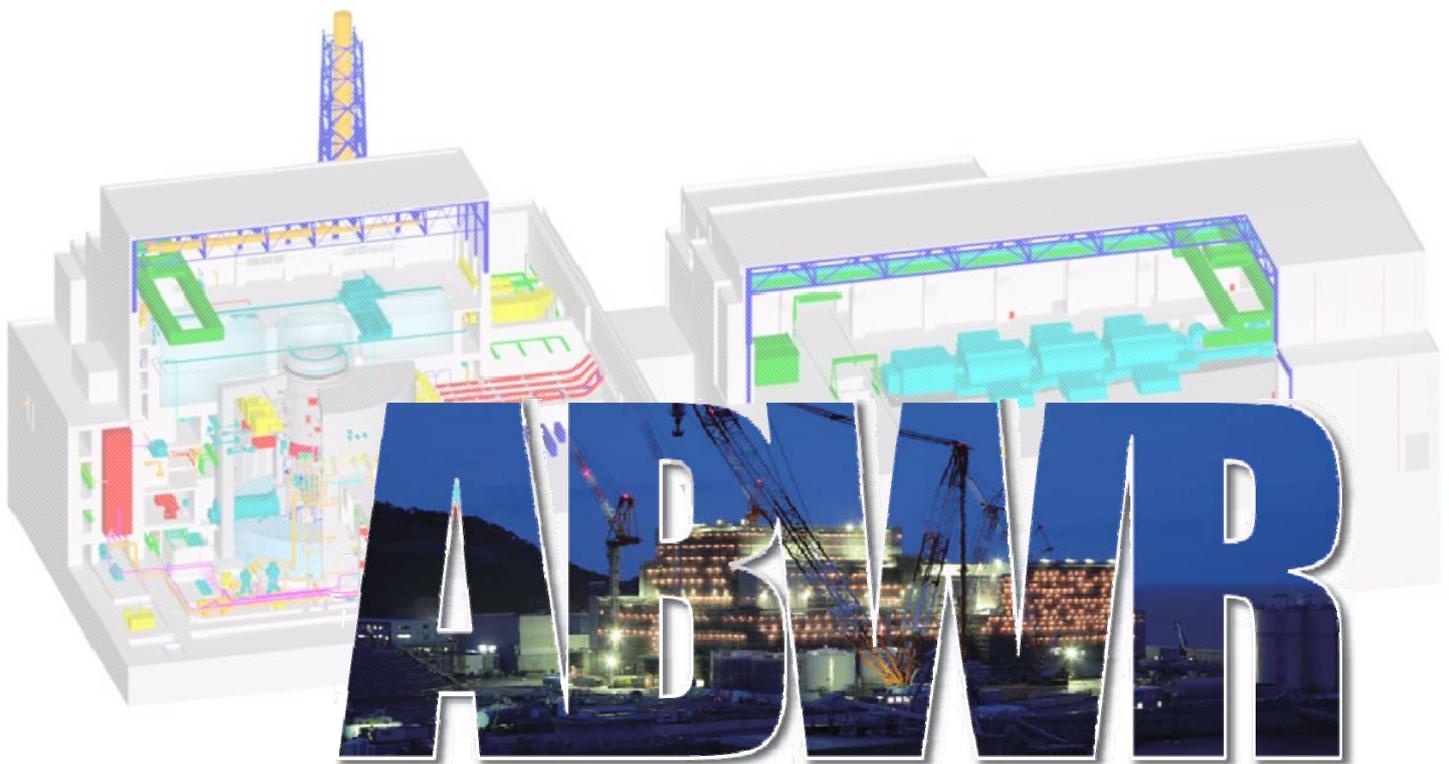


**UK ABWR**

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# **UK ABWR Generic Design Assessment**

## **Generic Site Description**



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## **1. Acronyms**

ABWR	Advanced Boiling Water Reactor
EIA	Environmental Impact Assessment
ERICA	Environmental Risk from Ionising Contaminants: Assessment and Management
EU	European Union
GDA	Generic Design Assessment
GEP	Generic Environmental Permit
IRA	Initial Radiological Assessment
ONR	Office for Nuclear Regulation
P&ID	Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Design
PCSR	Pre-Construction Safety Report
REP	Radioactive Substances Regulation – Environmental Principle
UK	United Kingdom

## 2. References

- [Ref-1] Process and Information Document for the Generic Assessment of Candidate Nuclear Power Plant Designs, version 2, March 2013, Environment Agency.
- [Ref-2] Radioactive Substances Regulation - Environmental Principles, version 2, Environment Agency, April 2010.
- [Ref-3] Consideration of and Compliance with the REPs, GA91-9901-0028-00001, XE-GD-0099, Rev D, Hitachi-GE, August 2014.
- [Ref-4] Initial Radiological Assessment Methodology – Part 1 User Report, Science Report: SC030162/SR1, Environment Agency, May 2006.
- [Ref-5] Initial Radiological Assessment Methodology – Part 2 Methods and Input Data, Science Report: SC030162/SR2, Environment Agency, May 2006.
- [Ref-6] Prospective Dose Modelling, GA91-9901-0026-00001, HE-GD-0005, Rev D, Hitachi-GE, August 2014.
- [Ref-7] Genesis of ABWR design, GA91-9901-0011-00001, XE-GD-0083, Rev A, Hitachi-GE, 4<sup>th</sup> October 2013.
- [Ref-8] A Model for Short and Medium Range Dispersion of Radionuclides Released to the Atmosphere, The First Report of a Working Group on Atmospheric Dispersion, R. H. Clarke (Chairman), NRPB-R91, National Radiological Protection Board, Harwell, Oxon. 1979.
- [Ref-9] ERICA Assessment Tool, v1.0, November 2012.
- [Ref-10] Generalised habit data for radiological assessments, Smith, K.R. and Jones, A.L., NRPB-W41, National Radiological Protection Board, Harwell, Oxon. 2003.
- [Ref-11] The Methodology for Assessing the Radiological Consequences of Routine Releases of Radionuclides to the Environment Used in PC-CREAM08, J G Smith and J R Symmonds (Eds), HPA-RPD-058, Health Protection Agency, November 2009.

### 3. Introduction

The Environment Agency has identified the information they require to assess the environmental impacts of the UK ABWR at a generic site in the Process and Information Document for the Generic Assessment of Candidate Nuclear Power Plant Designs (P&ID) [Ref-1]. The P&ID requires that the characteristics of the generic site which have been used in the assessments that form part of Hitachi-GE's Generic Design Assessment (GDA) submission are clearly identified. This report satisfies that requirement by presenting the parameters that are used in the radiological assessments of the Generic Environmental Permit (GEP) submission.

This information is provided to fulfil the P&ID requirement identified above, in order to allow the Environment Agency (and other interested parties) to determine the basis of Hitachi-GE's GDA submission, and carry out their own modelling or assessments, as required. Should the need arise, the Generic Site Description will be expanded to include additional parameters and data used in assessments in later GDA stages.

The sections below identify the generic site characteristics used in Hitachi-GE's assessments. These assessments include:

- Radiological dose assessment – including short-term, annual and collective dose assessments to humans and dose assessments on non-human biota;
- 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.

This report will be updated as the Generic Site Envelope (the basis of certain assessments in the Pre-Construction Safety Report [PCSR]) is developed, in order to ensure consistency in the data submitted and used in assessments across the GDA submission. Similarly, if any of the assessments undertaken to support the GEP require changes to the assumptions made here, this document will be updated to reflect them.

## 4. Regulatory Context

### 4.1. P&ID requirements

The Environment Agency has identified the information they require to carry out the GDA process in the P&ID [Ref-1]. The P&ID requirements relating to the description of the Generic Site Description are reproduced below:

*'General information relating to the requesting party and the design.*

*Include:*

*Description and characteristics of the generic site (or sites) that the requesting party will use to provide its dose assessment. 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 ([Ref-1], Table 1, Item 1, bullet 5).'*

### 4.2. Consideration of REPs

This report takes into account the relevant Radioactive Substances Regulation – Environmental Principles (REPs) [Ref-2]. Hitachi-GE's 'Consideration of and Compliance with the Radioactive Substances Regulation Environmental Principles (REPs)' report [Ref-3] details the approach undertaken by Hitachi-GE

to reviewing and showing compliance with each of the relevant REPs within the GDA submission, highlighting the REPs specifically addressed in each report.

The following REPs are considered specifically relevant for this report:

**SEDP1 - General Principle for Siting of New Facilities:** 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.

**SEDP5 - On-Going Evaluation:** 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.

## 5. Characteristics of the Generic Site

### 5.1. Assumptions and exclusions

The parameters outlined in this report are provided at this stage of GDA to describe the generic site. It is limited to those characteristics used in the assessments undertaken up until Step 2 of GDA and will be expanded to include additional parameters should this be required in assessments in later GDA stages.

The majority of the parameters and datasets used are from generic publications or 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 Environment Agency's Initial Radiological Assessment (IRA) methodology use generic datasets, as dictated by the modelling packages referenced within the Environment Agency's dose modelling guidance [Ref-4] [Ref-5]. For Stage 2 of the IRA methodology, generic data sets are also used; however, in order to develop a more realistic assessment, site-specific data can be used to supplement the generic data. For the UK ABWR GDA, the generic dataset used for the Stage 2 of the IRA methodology is augmented by more specific data: the local compartment volumetric exchange rate has been taken to be the volumetric exchange rate applicable to a site on the North Wales coast. This dataset is used because it is more representative of the dispersion in a location at which a UK ABWR may operate in future.

For consistency with the data used in Stage 2 modelling, the Stage 3 radiological assessment defined the corresponding regional marine compartment as Irish Sea West. The overall public dose due to all sources (liquid and gaseous discharges, direct radiation) is relatively insensitive to the selected regional or local marine compartment, because the proportion of the dose due to liquid discharges is small [Ref-6]. Other potential new build sites in the UK may not have such a high local compartment volumetric exchange rate as those used in Stages 2 and 3 of the radiological assessment; however, the Stage 1 assessment methodology bounds all possible scenarios and shows that the doses are very low regardless of volumetric exchange rate used. Table 5.5-1: Geographical Information Used in the Radiological Dose Assessments summarises what refined datasets are used as well as their sources.

More detailed descriptions of the settings of proposed UK ABWR sites and detailed impact assessments will be provided at the 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.

An overview of the characteristics of the generic site adopted by Hitachi-GE for the GDA is given in section 5.2. These descriptive characteristics have been utilised in assessments as part of GDA. Should the need arise, the Generic Site Description will be expanded to include additional parameters and data used in assessments in later GDA stages.

## **5.2. Generic Site setting overview**

The layout of the UK ABWR nuclear power station as considered at GDA is shown in the figure below (this information is described in PCSR chapter 9). A description of the main components and operation of the UK ABWR is provided in the Genesis of ABWR design report of the GDA submission [Ref-7].

The generic site is coastal, in common with all likely new build sites in the UK which are either located on the by the sea or large estuaries. 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.

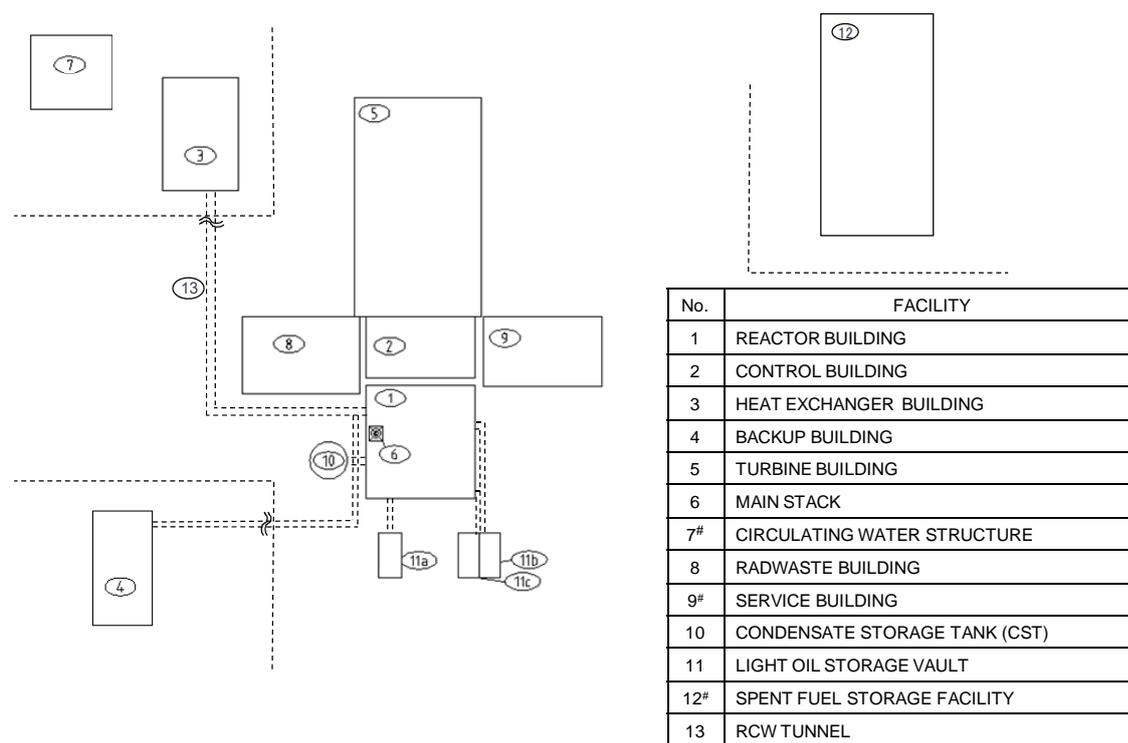
The geology at the generic site is assumed to be stable with no active faults. It should be noted that the seismic activity of potential sites is assessed on a site-specific basis by the Office for Nuclear Regulation (ONR) at the time of site licensing; the effects of seismic activity on the UK ABWR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

The following 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 to rivers or streams; and,
- There is no ground or groundwater contamination present.

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. Surface roughness (an air dispersion modeling parameter) is therefore assumed to be 0.3m, a generic value typical of agricultural areas [Ref-8]. With all possible new build sites in the UK being adjacent to the sea or large estuaries, this surface roughness value is deemed to be representative at this stage. The actual effects of how neighbouring buildings are laid out and local terrain will be considered at the site-specific permitting stage.

Further specific characteristics of the site are provided in the following sections.



# Structures NOT included in the GDA scope

**Figure 5.2-1: UK ABWR Power Station GDA Site Layout**

N.B. Final locations of buildings, stacks and vents depend on site specific conditions and will be addressed as part of future building layout design activities.

### 5.3. Human and non-human receptors

The relevant Environment Agency IRA guidance, Part 2 [Ref-5] includes details of the exposure groups that should be considered for radiological dose assessment. For the GDA dose assessment it is assumed that there will be radioactive discharges to air and to coastal waters, and that there will not be any radioactive discharges to rivers nor off-site sewage treatment plant, therefore only the exposure groups relevant for releases to air and coastal sites are considered.

Table 5.3-1 shows the selected most exposed population groups used in the dose modelling for the GDA. The relevant exposure pathways are taken from habits data contained in the IRA Guidance, Part 2 [Ref-5], presented in Table 5.3-2 and Table 5.3-3, and are further discussed in the Prospective Dose Modelling report of the GDA submission [Ref-6]. Radiological impacts on non-human biota are assessed using the ERICA tool [Ref-9]; the reference organisms considered for the GDA are identified in Table 5.3-4.

Note that no data on local population distribution is required for radiological dose assessment at GDA. Collective dose assessment for the UK, EU and world population is based on the population figures shown in Table 5.3-5. The assessment of human health impacts from combustion source emissions is out of scope of GDA and will be undertaken in future site-specific assessments.

**Table 5.3-1: Most Exposed Population Group by Source of Release**

Source of release	Most exposed population group
Releases to air	Local resident family
Releases to coastal water	Fisherman family
Releases to river	Not considered
Releases to sewer	Not considered

Source: [Ref-5][Ref-1], Section 4.1.

**Table 5.3-2: Habit data of Local Resident Family Exposure Group**

Food consumption rates (kg/y)	Values used in IRA Stage 1 & 2 assessments			Values used in Stage 3 assessment		
	Infant	Child	Adult	Infant	Child	Adult
Green vegetables	15	35	80	5	15	35
Root vegetables	45	95	130	15	50	60
Fruit	35	50	75	9	15	20
Sheep meat	3	10	25	0.8	4	8
Sheep liver	2.75	5	10	0.5	1.5	2.75
Cow meat	10	30	45	3	15	15
Cow liver	2.75	5	10	0.5	1.5	2.75
Milk	320	240	240	320	240	240
Milk products	--	--	--	45	45	60
Breathing rates (m <sup>3</sup> /h)	0.22	0.64	0.92	0.22	0.64	0.92
Occupancy at habitation (h/y)	8,760	8,760	8,760	8,760	8,760	8,760
Fraction of time spent indoors	0.9	0.8	0.5	0.9	0.8	0.5
Cloud shielding factor	0.2	0.2	0.2	0.2	0.2	0.2
Shielding factor for deposited radionuclides	0.1	0.1	0.1	0.1	0.1	0.1

Source: Stage 1&2 [Ref-5], Appendix D, Table D1: Stage 3 - follows Top Two methodology, [Ref-10].

**Table 5.3-3: Habit Data for Fisherman Family Exposure Group**

Food consumption rates (kg/y)	Values used in Stage 1-3 assessments			Fraction in compartment	
	Infant	Child	Adult	Local	Regional
Fish	5	20	100	0.5	0.5
Crustaceans	0	5	20	1	0
Molluscs	0	5	20	1	0
Seaweed (only for Stage 3 assessment)	0	0	0.5	1	0
Occupancy on beach (h/y)	30	300	2,000	1	0

Source: Seaweed consumption rate (section 3.5, [Ref-10]), Table 6: All other data [Ref-5], Appendix E, Table E1.

**Table 5.3-4: Reference Organisms Considered in the Vicinity of the Generic Site**

<b>Terrestrial</b>	<b>Marine</b>
Amphibian	Zooplankton
Bird	Vascular plant
Bird egg	(Wading)bird
Detritivorous invertebrate	Benthic fish
Flying insect	Benthic mollusc
Gastropod	Crustacean
Grasses and herbs	Marcroalgae
Lichen and bryophytes	Mammal
Mammal (rat)	Pelagic fish
Mammal (deer)	Phytoplankton
Reptile	Polychaete worm
Shrub	Reptile
Soil invertebrate (worm)	Sea anemones/true corals - colony
Tree	Sea anemones/true corals - polyp

Source: [Ref-9]

**Table 5.3-5: UK, EU and World Population Figures**

<b>Country/Region</b>	<b>Population</b>
UK	5.96 10 <sup>7</sup>
EU25	4.56 10 <sup>8</sup>
World	1.00 10 <sup>10</sup>

Source: [Ref-11], Table 5.12

#### 5.4. Meteorological data

Local meteorological data is not required for any of the assessments carried out at GDA. The radiological dose assessment at GDA follows the IRA methodology, and so adopts a uniform wind rose together with the atmospheric conditions given in Table 5.4-1.

**Table 5.4-1: Atmospheric Conditions**

<b>Pasquill Stability Category</b>	<b>Frequency of Occurrence (%) – IRA Stage 1 &amp; 2</b>	<b>Frequency of Occurrence (%) - Stage 3</b>	<b>Wind Speed at 10m Height (m/s)</b>
A	1	0.3	1
B	9	4	2
C	21 (10% rain)	14 (10% rain)	5
D	50 (10% rain)	70 (10% rain)	5
E	8	6	3
F	10	5	2
G	2	0.7	1

Sources: IRA Stages 1 & 2 [Ref-5], Appendix D, Table D2; Stage 3 radiological assessment [Ref-8], Figure 11

#### 5.5. Geographical information

The information shown in Table 5.5-1 has been used in the radiological dose assessments whose results are presented in the Prospective Dose Modelling report [Ref-6].

**Table 5.5-1: Geographical Information Used in the Radiological Dose Assessments**

Item	Unit	IRA Stage 1 & 2 Value	Stage 3 Value
Public receptor point aerial discharges	m	100 from discharge point <sup>*</sup>	300
Food production receptor point	m	500 from discharge point <sup>*</sup>	500
Site boundary	m	100	300
Surface roughness	m	0.3	0.3
Washout coefficient	Per s	1E-04, 0 for noble gases <sup>*</sup>	1E-04, 0 for noble gases <sup>*</sup>
Marine Module	-	Not applicable	Wylfa values
Regional compartment	-	Not applicable	Irish sea west <sup>†</sup>
Local compartment volumetric exchange rate	m <sup>3</sup> /y	3.2x10 <sup>9*</sup> s	4x10 <sup>10</sup> <sup>†</sup>
Local compartment volume	m <sup>3</sup>	10 <sup>8*</sup>	2x10 <sup>9</sup> <sup>†</sup>
Local compartment depth	m	10 <sup>*</sup>	20 <sup>†</sup>
Local compartment coastline length	m	10 <sup>4*</sup>	10 <sup>4*</sup>
Local compartment suspended sediment load	t/m <sup>3</sup>	10 <sup>-5*</sup>	10 <sup>-5*</sup>
Local compartment sediment rate	t/m <sup>2</sup> /y	4.9x10 <sup>-3*</sup>	5x10 <sup>-3*</sup>
Local compartment sediment density	t/m <sup>3</sup>	2.6 <sup>*</sup>	2.6 <sup>*</sup>
Local compartment bioturbation rate	m <sup>2</sup> /y	3.6x10 <sup>-5*</sup>	-
Local compartment diffusion rate	m <sup>2</sup> /y	3.15x10 <sup>-2*</sup>	3.15x10 <sup>-2*</sup>

Sources: <sup>\*</sup>[Ref-5] <sup>†</sup>[Ref-11][Ref-11] <sup>s</sup>This value was used for the IRA Stage 1 assessment. A value of 1300m<sup>3</sup>/s was used for the IRA Stage 2 assessment. 1300m<sup>3</sup>/s translates to value of 4x10<sup>10</sup> m<sup>3</sup>/y i.e. it is equivalent to that value used for the Stage 3 assessment.

## 5.6. Designated sites

Only the generic site characteristics needed for the GDA process have been included in this site description. Information on designated sites that may be nearby will be utilised at the appropriate time, during the full assessments that support the licensing process for a specific site.

## 5.7. Marine data

Relevant marine data is already included in the assessments undertaken in the Prospective Dose Modelling report of the GEP submission [Ref-6], summarised in part here in Table 5.5-1. Additional data will be provided if and when more detailed assessment is required as part of the analysis needed for GDA. However, site-specific data will be used in the assessments supporting the site licensing process.

## 6. Conclusions

This chapter has provided the baseline data for the generic site as requested in the P&ID [Ref-1] and forms the basis of all radiological assessments within the GEP. If needed, it will updated or expanded as assessments during future GDA Steps dictate.

At the site permitting stage, the specific characteristics of the site will be fully characterised and taken into account by refining the assessments undertaken here as part of the GDA process.