GE Hitachi Nuclear Energy

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BWRX-300 UK Generic Design Assessment (GDA) Chapter E2: Generic Site Description

US Protective Marking: Non-Proprietary Information
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NEDO-34219 Revision B

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EXECUTIVE SUMMARY

This chapter of the Preliminary Environmental Report presents a generic site description for the United Kingdom BWRX-300 Small Modular Reactor. The BWRX-300 is the tenth evolution of the Boiling Water Reactor (BWR) design and represents an evolution of both the Economic Simplified BWR and the Advanced BWR.

The chapter supports the overall claim that “The BWRX-300 is capable of being constructed, operated and decommissioned in accordance with the standards of environmental, safety, security and safeguard protection required in the UK,” and provides information to support the environmental Level 1 claim that “The design of the BWRX-300 Small Modular Reactor has been optimised to reduce environmental impacts to As Low As Reasonably Achievable throughout the whole lifecycle (construction, commissioning, operation and decommissioning)”.

With regards to the generic site description, the chapter provides more detailed information in support of the additional environmental Level 2 claim that the “BWRX-300 has been designed and can be operated to minimise the impact of radioactive discharges on members of the public and the environment”.

This chapter describes the current regulatory context for considerations that should be made within the description of the generic site for a new nuclear power station. Furthermore, alignment to Environment Agency methodology is introduced which defines the selection of parameters relevant to prospective radiological assessments.

This chapter forms part of an integrated demonstration in support of the above claims and as such provides support to Preliminary Environmental Report Chapter E9: “Prospective Radiological Assessment” and Chapter E10: “Other Environmental Regulations”. The chapter also interfaces with the Preliminary Safety Report Chapter 2: “Site Characteristics” and Chapter 20: “Environmental Aspects”.

ACRONYMS AND ABBREVIATIONS

Acronym	Explanation
ABWR	Advanced Boiling Water Reactor
BWR	Boiling Water Reactor
DPUR	Dose Per Unit Release
EA	Environment Agency
EPR16	Environmental Permitting (England and Wales) Regulations 2016 (as amended)
ERICA	Environmental Risks from Ionising Contaminants: Assessment and Management
ESBWR	Economic Simplified Boiling Water Reactor
GDA	Generic Design Assessment
GEH	GE-Hitachi Nuclear Energy, Americas, LLC
GSD	General Site Description
GSR	General Safety Requirements
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IRAT	The Initial Radiological Assessment Tool
NPS	National Policy Statement
PER	Preliminary Environmental Report
PSR	Preliminary Safety Report
RPDP	Radiological Protection Developed Principle
RSR	Radioactive Substances Regulation
SEDP	Site Evaluation Developed Principle
SMR	Small Modular Reactor
TLD	Thermoluminescent Detector
UK	United Kingdom
U.S.	United States

SYMBOLS AND DEFINITIONS

Symbol	Definition
Bq/y	Becquerel per year
µGy/h	Micro Gray per hour
h/y	Hours per year
Kg/y	Kilograms per year
m	Metres (SI unit)
m^3	Metres cubed
m^3/h	Metres cubed per hour
m/s	Metres per second
m^2/y	Metres squared per year
m^3/y	Metres cubed per year
Per s	Per second
µSv/h	Micro Sieverts per hour
µSv/y	Micro Sieverts per year
t/m^3	Tonnes per metre cubed
$t/m^2/y$	Tonnes per metre squared, per year

Term	Definition
Gray	One Gray is equal to the adsorption of one joule of radiation energy per kilogram of matter
Sievert	SI unit of radiation adsorption

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REVISION SUMMARY

Revision #	Section Modified	Revision Summary
A	All	Initial Issuance
B	All	Update for end of GDA Step 2 consolidation

2 GENERIC SITE DESCRIPTION

Introduction

The GEH BWRX-300 is a Boiling Water Reactor (BWR) that has been designed as a Small Modular Reactor (SMR). As the tenth generation of the BWR design, the BWRX-300 incorporates the lessons learned from worldwide programs and operational experience of GEH BWRs, inclusive of the Economic Simplified Boiling Water Reactor (ESBWR) and Advanced Boiling Water Reactor (ABWR).

GEH are a requesting party presenting an Environmental Case submission to the United Kingdom (UK) regulators for Generic Design Assessment (GDA) at the Step 2 level for the BWRX-300. This chapter sits within the Preliminary Environmental Report (PER) which comprises the suite of documents that make up the safety case.

This chapter provides a description of a generic site for the UK BWRX-300 as part of the requirements of the GDA process outlined in LIT 7998, “Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant Designs,” (Reference 2-1). In conjunction with NEDO-34164, “BWRX-300 UK GDA Chapter 2: Site Characteristics,” (Reference 2-2), this chapter supports prospective radiological assessments required by “The Environmental Permitting (England and Wales) Regulations 2016” (as amended), (EPR16) (Reference 2-3) as part of the regulatory process described in Section 2.1.

The Generic Site Description (GSD) for the UK BWRX-300 does not represent any particular location in the UK but considers the envelope of characteristics of potential UK site conditions. At this stage of the GSD, a representative coastal site has been chosen, noting that as future site-specific decisions are made, other site options are available and can be considered for an individual BWRX-300 site. This chapter provides specific information concerning the following parameters that have been considered within radiological assessments:

- Geographical information
- Marine data
- Meteorological data
- Human and non-human receptors
- Locations of sites of special scientific interest, areas of outstanding natural beauty and areas of significance to cultural heritage

There is currently no specific site proposed for the development and operation of a UK BWRX-300. However, the radiological assessment of the generic site description presented here has utilised the opportunity to consider a single generic site based on multiple candidate sites within the site envelope.

The GSD describes the set of environmental characteristics that defines the envelope for the radiological assessments which have been carried out and documented in NEDO-34226, “BWRX-300 UK GDA Chapter E9: Prospective Radiological Assessment,” (Reference 2-4).

Additional site characteristics and their future evaluation in support for the design, safety assessment and periodic safety review can be found in PSR Chapter 2 (Reference 2-2).

Scope

This report presents the current status of the GSD for the deployment of a BWRX-300 in the UK. Whilst specific characteristics will form a future development stage of the BWRX-300, the scope of the Step 2 submission will include:

- A description of the generic site characteristics that envelope suitable sites for new nuclear power plants in the UK
- Descriptions of environmental characteristics and constraints of the generic site(s) that the requesting party will use to provide its dose assessment

Purpose

The purpose of this chapter is to provide the envelope of characteristics used to support the radiological assessment provided in PER Chapter E9 (Reference 2-4).

Claims, Arguments and Evidence

At this stage, the BWRX-300 is presented as a generic design, capable of deployment anywhere in the world. To integrate into the UK context and align with regulatory expectations, some design aspects will form part of a future development stage, likely involving input from the UK developer/operator of the BWRX-300. More detailed consideration, justification and substantiation of these elements will therefore be made at the site-specific development stage.

This document provides information in support of the following environmental Level 2 claim:

- “The BWRX-300 has been designed and can be operated to minimise the impact of radioactive discharges on members of the public and the environment”.

Interfaces with other Chapters

The document interfaces with the following PER chapters:

- PER Chapter E9 (Reference 2-4)
- NEDO-34227, “BWRX-300 UK GDA Chapter E10: Other Environment Regulations,” (Reference 2-5)

The document interfaces with the following PSR chapters:

- PSR Chapter 2 (Reference 2-2)
- NEDO-34192, “BWRX-300 UK GDA Chapter 20: Environmental Aspects,” (Reference 2-6)

2.1 Regulatory Context

For environmental discharges of radioactivity to take place in England and Wales, an application must be approved under EPR16 (Reference 2-3). “UK Strategy for Radioactive Discharges: 2018 Review of the 2009 Strategy,” (Reference 2-7) does not set out individual limits for radioactive discharges and instead dose limits are derived from international recommendations from the International Commission on Radiological Protection (ICRP) “Dose Limits,” (Reference 2-8) and the International Atomic Energy Agency (IAEA) General Safety Requirements (GSR) Part 3, “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards,” (Reference 2-9). Limits are therefore specified and regulated in accordance with Schedule 23 Part 4 of EPR16 (Reference 2-3):

Schedule 23 Part 4 1(b) - the sum of the doses resulting from the exposure of any member of the public to ionising radiation does not exceed the dose limits set out in Article 12 of the Basic Safety Standards Directive subject to the exclusions set out in Article 5(c) of that Directive.

Part 4 2(1) In exercising those relevant functions in relation to the planning stage of radiation protection, the regulator must have regard to the following maximum doses to individuals which may result from a defined source:

- *0.3 millisieverts per year from any source or*
- *0.5 millisieverts per year from the discharges from any single site*

The Environment Agency (EA) outlines the environmental issues that an operator of a nuclear power station should consider in site selection in their Radioactive Substances Regulation (RSR) guidance for site evaluation “Site Evaluation: Generic Developed Principles,” (Reference 2-10) which are underpinned by five generic developed principles. These principles are deemed to be relevant to both generic and specific sites proposed for new nuclear facilities, such as the UK BWRX-300, the five principles are:

- *Site Evaluation Developed Principle (SEDP)1 – When evaluating sites for a new facility, account should be taken of the factors that might affect the protection of people and the environment from radiological hazards and the generation of radioactive waste.*
- *SEDP2 – Data should be provided to allow the assessment of rates and patterns of migration of radioactive materials in the air and the aquatic and terrestrial environments around sites.*
- *SEDP3 – Levels of ambient radioactivity around the sites of new facilities should be assessed.*
- *SEDP4 – In the case of nuclear and other sites on which there are already one or more facilities, the radiological impact of the whole site on people and the environment should be assessed when considering the suitability of the site for any new facility.*
- *SEDP5 – 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.*

Of the principles described above, SEDP1 and SEDP2 are considered relevant to the Step 2 GDA submission. Within this chapter, the considerations outlined in SEDP1 form the basis for the description of the generic site alongside additional characterisation provided within PSR Chapter 2 (Reference 2-2). The regulatory expectation is that the following factors are taken into account within assessments:

- *Locations and habits of people, especially those likely to be most exposed as a result of releases of radionuclides into the environment from the facility (potential critical groups)*

- *Locations where terrestrial, freshwater and marine foodstuffs are produced and obtained*
- *Locations of surface and underground water supplies used by people and animals and the vulnerability of those water supplies*
- *Potential effects of coastal erosion and sea level rise*
- *Presence of radioactively contaminated land or groundwater*
- *Locations of land and water bodies used for recreational and amenity purposes*
- *Locations of sites of special scientific interest, areas of outstanding natural beauty and areas of significance to cultural heritage*

SEDP2 outlines the data requirements for the applicants to carry out prospective dose assessments. These data requirements are presented across differing environmental media, namely air; marine, surface freshwater bodies; soils and rock. In addition, the principle requires concentration factors or transfer parameters to be considered for movement through food chains and for the concentration of radionuclides in non-human species.

These environmental media and considerations subsequently feed into the RSR generic developed principles for the radiological protection of people and environment. Specifically, Radiological Protection Developed Principle (RPDP) 4 which requires the applicant of a permit to carry out prospective dose assessments to include within their application, “Radiological Protection of People and the Environment: Generic Developed Principles,” (Reference 2-11).

Presently, it is expected that GEH will exit the GDA process at the end of Step 2. However, for subsequent future development and progression to site-specific designs, it would be expected that review of the site would take place to satisfy the requirements of SEDP5.

2.2 Methodology

The initial radiological assessment methodology provides a system for carrying out simple and cautious prospective assessment of doses arising from discharges to the environment. It is published by the EA to support permit applications. The Initial Radiological Assessment Tool v2 (IRAT2), as detailed in “Initial Radiological Assessment Tool 2: Part 1 User Guide,” (Reference 2-12) and “Initial Radiological Assessment Tool 2: Part 2 Methods and Input Data,” (Reference 2-13), is intended to enable a simple and robust method of calculation of the radiological consequences associated with normal operation discharges. The selection and suitability of the IRAT2 tool is outlined in PER Chapter E9 (Reference 2-4).

The IRAT2 methodology that has been used to support GEH’s Step 2 GDA submission is based upon a staged approach which is described in detail in PER Chapter E9 (Reference 2-4). In the case of both Stage 1 and 2, generic datasets have been used. It is anticipated that for a future development stage, site-specific data will be used to supplement the generic data.

At Stage 1 and Stage 2, the reference screening dose thresholds are 20 μSv/y for the representative person and 1 μGy/h for wildlife. At Stage 2 a combined dose rate of 40 μGy/h can additionally be applied for habitats. IRAT2 uses Dose Per Unit Release (DPUR) factors which can be scaled using information about the disposal or discharge being assessed.

2.3 Characteristics of the Generic Site

2.3.1 Overview

An illustrative layout of the BWRX-300 nuclear power station buildings is shown in Figure 2-1, from "BWRX-300 Design Specification for Radwaste Building Structure," (Reference 2-14). Further to this, an overview of the relevant systems of the BWRX-300 are comprehensively described in NEDO-34221P, "BWRX-300 UK GDA Chapter E4: Information about the Design," (Reference 2-15).

Subject to UK government proposals to be implemented on the selection of nuclear sites, all potential nuclear new build sites in the UK are either located by the sea or large estuaries, as described in "National Policy Statement for Nuclear Power Generation (EN-6)," (Reference 2-16). The BWRX-300 generic site is coastal and assumed to be seawater abstraction for the purposes of GDA.

The design intent of the BWRX-300 is to operate on the basis of a 'maximum recirculation' philosophy, whereby process fluids are retained within the plant to the maximum extent possible, and radioactive aqueous liquid discharges to the aquatic environment are minimised. Details on this capability are described in DBR-0060900, "BWRX-300 Zero Release Plan," (Reference 2-17) which makes reference to zero discharges as this is what is used in other regulatory regimes.

Three scenarios have been considered across radiological assessments presented in PER Chapter E9 (Reference 2-4). These can be briefly summarised as:

- No aqueous liquid effluent discharge, in line with operation to a maximum recirculation philosophy
- Maximum aqueous liquid effluent release volume of 5,968 m^3/y
- Nominal annual aqueous liquid discharge, proposed as a discharge volume of 600 m^3/y, representative of the second scenario (above) activities scaled by a factor of 0.101

A future developer/operator of the BWRX-300 will be responsible for decisions concerning the aqueous effluent discharge strategy and an alternative to the three scenarios described could also be considered.

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 by the Office for Nuclear Regulation. Further consideration of geology and seismology in the context of the generic site are presented in PSR Chapter 2 (Reference 2-2).

The following assumptions are also in place regarding the generic site and its proximity to water:

- The site is not located on an aquifer from which water is extracted
- There is no standing water at the site
- There are no freshwater bodies or watercourses on the site
- There are no discharges to rivers or streams on or adjacent to the site
- There is no ground or groundwater contamination present

The generic site and surrounding area are assumed to be a flat plain, with no other large buildings, other than the BWRX-300 nuclear power plant, in the immediate vicinity. The effects of neighbouring buildings and local terrain on the gaseous discharge will not be considered until the site-specific design.

Containment exhaust flow is directed to the plant vent stack via the Heating, Ventilation and Cooling System documented in 006N7948, “BWRX-300 Containment Inerting System,” (Reference 2-18). The plant vent stack is situated on top of the turbine building which is the primary release point for any radioactive gaseous discharges. The height of the plant vent stack is subject to a future development stage but is expected to be 35 m above grade as per 005N9751, “BWRX-300 General Description,” (Reference 2-19). For the Stage 2 refined assessment, an effective release height of 11.7 m has been used on application of the one - third reduction rule, which is derived from NRPB-R157 “The Fifth Report of a Working Group on Atmospheric Dispersion, ‘Models to Allow for the Effects of Coastal Sites, Plume Rise and Buildings on Dispersion of Radionuclides and Guidance on the Value of Deposition Velocity and Washout Coefficients,” (Reference 2-20)

2.3.2 Geographical Information

Assumptions relating to the geographical information used for dispersion calculations are provided in Table 2-1, these values are utilised within the IRAT2 tool, and are pre-calculated from the UK Health Security Agency PC-CREAM 08 Modelling tool, as described in HPA-RPD-058, “The Methodology for Assessing the Radiological Consequences of Routine Releases of Radionuclides to the Environment Using in PC-CREAM 08,” (Reference 2-21).

The UK government identified and published sites in England and Wales that are “potentially suitable” for the deployment of new nuclear power stations by the end of 2025 within its National Policy Statement (NPS) (Reference 2-16). Although a specific site for the UK BWRX-300 has not yet been selected, local compartment volumetric exchange rates of the sites identified in the NPS have been considered in subsequent calculations. These characteristics are presented in Table 2-2 and are derived from LIT 15793, “Initial Radiological Assessment Tool – estuary coast,” (Reference 2-22).

On 11 January 2024, the UK government launched a nuclear siting consultation to begin the process of designating a new NPS applicable to power stations expected to deploy beyond 2025. It would be expected therefore that any future dose assessments would take into consideration this next iteration of the NPS when available.

2.3.3 Marine Data

The impact of releases of radioactivity to estuarine or coastal waters considers the impact to a generic, hypothetical fisherman family. The family are assumed to be exposed to radionuclides through shoreline sediment deposition and consumption of foodstuff incorporating radionuclides from the surrounding water. These exposures are further detailed in Section 2.3.7.

Stage 1 of the IRAT2 calculations uses conservative generic assumptions. If the first stage assessment identifies that the potential exposure to the fisherman family exceeds the screening level, then parameter values specific to the estuary or coastal water body receiving the discharge are required at Stage 2. In the model, this is referred to as the ‘local compartment’, as stated in SC060080, “Parameter values used in coastal dispersion modelling for radiological assessments,” (Reference 2-23).

The marine data relevant to the local compartment for assessments concerning an estuary or coastal water body have been included in Table 2-1, presented alongside geographical information. Detailed site-specific data forms part of the site-specific environmental permitting process and would therefore be considered as part of a future development stage.

2.3.4 Meteorological Data

Local meteorological data is not required for assessments carried out at Step 2 of the GDA process. Relevant meteorological characteristics that may be of consideration for radiological impact assessment are presented in PSR Chapter 2 (Reference 2-2). The radiological dose assessment follows the IRAT methodology assuming a uniform wind rose, together with the

atmospheric conditions outlined in Table 2-3. For Stage 1 and 2 calculations, the IRAT2 methodology has assumed Category D conditions (neutral stability, typically overcast persisting for 50% of the time) that are derived from "Parameter values used in coastal dispersion modelling for radiological assessments," (Reference 2-23).

2.3.5 Consideration of Climate Change

Given that the UK BWRX-300 is expected to have an operational period of 60-years, as stated in "BWRX-300 Small Modular Reactor," (Reference 2-24), erosion, weathering and exposure may affect the assumed geographical characteristics during this period. The evaluation of these characteristics, in support of the design are presented in PSR Chapter 2 (Reference 2-2). UK National Climate Projection 2018 data has been utilised to estimate appropriate climate change adjustment factors and their usage is described in PSR Chapter 2 (Reference 2-2).

2.3.6 Exposure Groups

The EA IRAT2 guidance (Reference 2-13) includes details of exposure groups that should be considered for radiological dose assessment. The design intent of the BWRX-300 is to operate according to a maximum recirculation philosophy with retention and recirculation of process fluids to the maximum extent possible. For the purposes of the GDA dose assessment in line with the scenarios presented in Section 2.3.1, it is assumed that there will be radioactive discharges to air and to coastal waters, and that there will not be any radioactive aqueous liquid discharges to freshwater bodies nor to off-site sewage treatment plants. Therefore, only the exposure groups relevant for releases to air and coastal sites are considered.

In the case of gaseous discharge, it is assumed the exposure groups are 100 m away from the release point 100% of the time, and that food is produced 500 m from the release point. Radionuclides with a half-life of less than three hours are not considered as radioactive decay will have occurred prior to consumption.

For Stage 1 IRAT2 coastal discharge assessments, a coastal exchange rate of 30 m^3/s is assumed. Within Stage 2 dose assessments, a coastal exchange rate of 231 m^3/s has been selected as a pessimistic value based upon suitable sites identified in Table 2-2. Radionuclides with a half-life of less than three hours are not considered, all shellfish and 50% of fish are from the local compartment, and coastal wildlife is assumed to dwell in the sea immediately offshore from the point of release.

2.3.7 Human Exposure Groups

This section concerns the human exposure groups relevant to releases to air and coastal waters, a description of these groups based on the proposed discharges are described below.

Releases to air

This assumes a local resident family (one adult, one child and one infant), who are exposed via inhalation of radionuclides via:

- The effluent plume
- External radiation from radionuclides in the effluent plume deposited to the ground
- Consumption of terrestrial food incorporating radionuclides that have been deposited to the ground following gaseous discharge

Releases to coastal water

This assumes a fisherman family (one adult, one child and one infant), who are exposed to radioactive discharge via:

- External radiation from radionuclides deposited in shore sediments
- The consumption of seafood incorporating radionuclides

The habit data associated with the first exposure group, the local resident family are presented in Table 2-4 and derived from EA IRAT2 guidance (Reference 2-13), and those for the fisherman family exposure group are presented in Table 2-5. Reference organisms are also impacted by exposure to gaseous effluent plume (through inhalation and ground deposition) and the radionuclides deposited in shore sediments. These reference organisms are described in Table 2-5.

Direct Radiation

This assumes that a member of the public is exposed to direct external radiation at the site boundary. The assumptions used for the direct radiation calculations are presented in Table 2-6.

For the assessment of doses due to gaseous discharges, the IRAT2 tool assumes that the local resident is located 100 m from the release point and that the food production location is 500 m from the release point, a cautious assumption that is appropriate for the initial early assessment stage. However, for the direct dose assessment, it is considered very unlikely that a local resident would be located at the site boundary for 100% of the time, and instead a scenario based on a regular walker who spends two hours per week at the site boundary has been used.

At Step 1 and Step 2 of the dose assessment, operating experience from 20 operational BWRs in the United States (U.S.) has been used that captures environmental monitoring data associated with the use of Thermoluminescent Detectors (TLD) at the site boundary, as reported in the U.S. Nuclear Regulatory Commission's "Radioactive Effluent and Environmental Reports," (Reference 2-25).

It is noted that the layout of the US BWR sites with respect to the locations of TLD monitoring stations and their proximity to direct radiation sources (such as radioactive waste stores etc.) is unknown. For this reason, the site boundary distance is not specified as part of the Stage 1 and Stage 2 direct dose assessment.

2.3.8 Non-Human Exposure Groups

As part of the regulatory principles there is also a need to model the radiological impact to wildlife to ensure protection from permitted discharges. The terrestrial and marine environments around the generic site are assumed to act as habitats to non-humans. The default reference organisms for terrestrial and marine exposures are defined in "Environmental Risks from Ionising Contaminants: Assessment and Management (ERICA) Assessment Tool Help Documentation," (Reference 2-26) and are presented in Table 2-7. The ERICA tool supports the IRAT calculations via the DPUR.

2.3.9 Locations of Sites of Special Scientific Interest, Areas of Outstanding Natural Beauty, and Areas of Significance to Cultural Heritage

Only the generic site characteristics needed for the GDA process have been included in this site description. The selection of sites in proximity to sites of special scientific interest, areas of outstanding natural beauty or significance to cultural heritage would form part of a future development stage and is beyond the scope of Step 2 of the GDA process.

2.4 Conclusion

This chapter of the PER has outlined the regulatory requirement for the consideration of environmental issues in the process of site selection for a new nuclear power station. In support of these requirements, a description and bounding characteristics of the generic site have been proposed. Where appropriate, national policy concerning site characteristics has been considered.

The environmental characteristics described are intended to support the development of prospective radiological assessments within PER Chapter E9 (Reference 2-4) of the Step 2 GDA submission of the UK BWRX-300. In addition, appropriate consideration of human and non-human impacts has been made in respect of the assumed coastal siting of the BWRX-300.

Environmental factors which affect gaseous and liquid discharges have been described, however, the extent of liquid discharge to the environment will be subject to future decision by the operator of the BWRX-300.

The characteristics outlined in this chapter are intended to inform the PER chapters concerning prospective radiological impacts, PER Chapter E9 (Reference 2-4), and other environmental regulations, PER Chapter E10 (Reference 2-5), of the submission.

Table 2-1: Geographical Information Used for Dispersion Calculations

Item	Unit	Initial Assessment (Stage 1 & 2)
Public receptor point aerial discharges	m	100 from discharge point
Food production receptor point aerial discharges	m	500 from discharge point
Surface roughness	m	0.3
Washout coefficient	Per s	1×10^{-4}, 0 for noble gases
Marine Module	-	Not applicable at Stages 1 & 2
Regional compartment	-	Not applicable at Stages 1 & 2
Local compartment volumetric exchange rate	m^3/y	3.2×10^{9} (Stage 1), 4.0×10^{10} (Stage 2)
Local compartment volume	m^3	10^{8}
Local compartment depth	m	10
Local compartment coastline length	m	10^{4}
Local compartment suspended sediment load	t/m^3	10^{-5}
Local compartment sediment rate	$t/m^2/y$	4.9×10^{-3}
Local compartment sediment density	t/m^3	2.6
Local compartment bioturbation rate	m^2/y	3.6×10^{-5}
Local compartment diffusion rate	m^2/y	3.15×10^{-2}

Table 2-2: Local Compartment Volumetric Exchange Rates and Associated Regional Compartments

Site Location	Coastal Exchange Rate m^3/s (Reference 2-22)
Bradwell	231
Hartlepool	634
Heysham	634
Hinkley Point	634
Oldbury	570
Sizewell	444
Sellafield	3170
Wylfa	1010

Table 2-3: Atmospheric Conditions Considered Within Stage 1 & 2 IRAT Calculations

Pasquill Stability Category	Frequency of Occurrence (%) – IRAT Stage 1 & 2	Wind Speed at 10m Height (m/s)
A	1	1
B	9	2
C	21	5
D	50	5
E	8	3
F	10	2
G	2	1

Table 2-4: Habit Data of Local Resident Family Exposure Group

	Values used in IRAT Stage 1 & 2		
Food Consumption rates (kg/y)	**Infant**	**Child**	**Adult**
Green vegetables	15	35	80
Root vegetables	45	95	130
Fruit	35	50	75
Sheep meat	3	10	25
Sheep liver	2.75	5	10
Cow meat	10	30	45
Cow liver	2.75	5	10
Milk	320	240	240
Breathing rate (m^3/h)	0.22	0.64	0.95
Occupancy at habitation (h/y)	8,760	8,760	8,760
Fraction of time spent indoors	0.9	0.8	0.5
Cloud shielding factor (indoors)	0.2	0.2	0.2
Shielding factor for deposited radionuclides	0.1	0.1	0.1

Table 2-5: Habit Data for Fisherman Exposure Group

	Values used in IRAT Stage 1 & 2		
Food Consumption rates (kg/y)	**Infant**	**Child**	**Adult**
Fish	5	20	100
Crustaceans	0	5	20
Molluscs	0	5	20
Occupancy on beach (h/y)	30	300	2,000

Table 2-6: Assumptions Used for Direct Radiation Calculations

Item	Unit	Initial Assessment Stage 1 & 2
Direct radiation dose rate to the public	µSv/h	0.084 based on TLD data for US BWRs
Annual occupancy for direct radiation	h	104 based on two hours a week for a walker
Annual direct radiation dose	µSv/y	8.7

Table 2-7: ERICA Default Reference Organisms

Terrestrial reference organisms	Marine reference organisms
Amphibian	Bird
Annelid	Reptile
Arthropod - detritivores	Benthic fish
Bird	Crustacean
Flying insects	Macroalgae
Grasses and herbs	Mammal
Lichen and bryophytes	Mollusc – bivalve
Mammal - large	Pelagic fish
Mammal – small burrowing	Phytoplankton
Mollusc – gastropod	Polychaete worm
Reptile	Sea anemones and true coral
Shrub	Vascular plant
Tree	Zooplankton

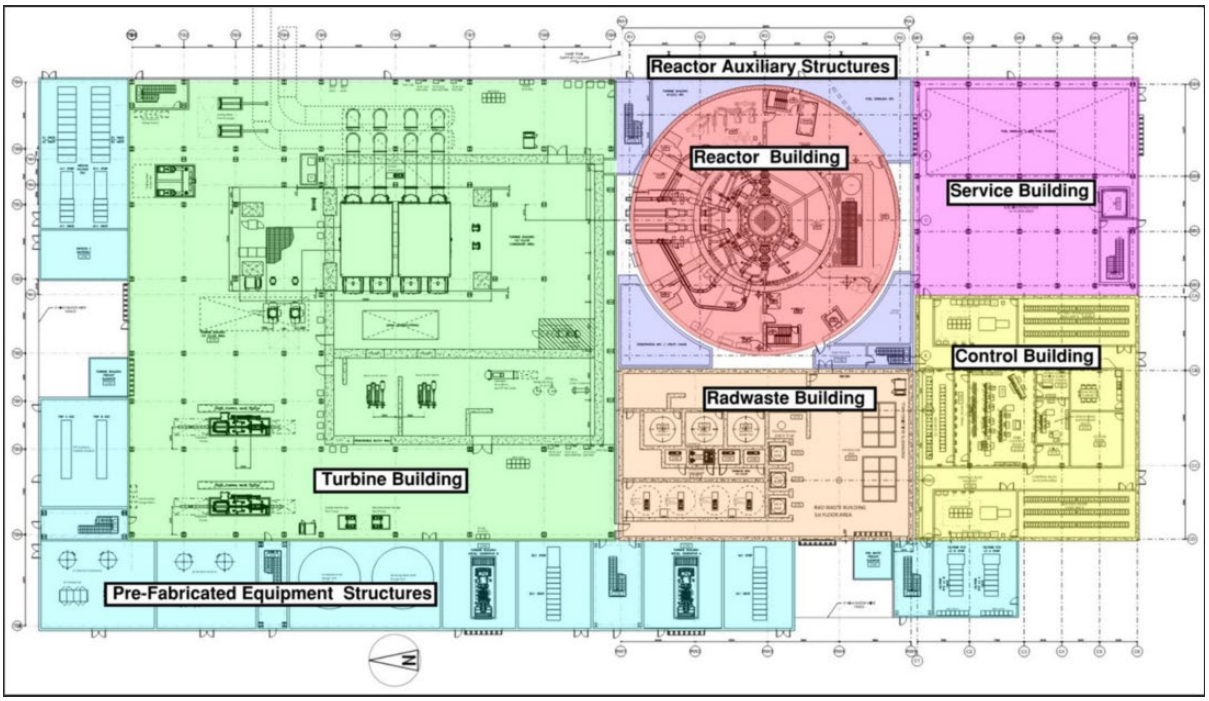

Figure 2-1: Proposed BWRX-300 Plant Buildings Layout

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