GE Hitachi Nuclear Energy

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BWRX-300 UK Generic Design Assessment (GDA)

Chapter 20 – Environmental Aspects

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EXECUTIVE SUMMARY

The GEH Boiling Water Reactor (BWR), 10th Design – 300 MWe (BWRX-300) is designed as a Small Modular Reactor. It incorporates the lessons learned from worldwide programmes and the Operational Experience/programmes of several BWRs, most notably the Economic Simplified Boiling Water Reactor and the Advanced Boiling Water Reactor.

The BWRX-300 design has focused on:

- Preventing/eliminating the generation of radioactive waste.
- Where the generation of radioactive waste cannot be avoided, then minimising the generation of that waste (activity and volume).
- Treating/abating radioactive waste generated so that it is concentrated/contained or minimised before release to the environment.

This chapter of the Preliminary Safety Report captures the environmental aspects associated with the BWRX-300 plant. It provides an overview of the plant design features that contribute to minimising impact on the environment. It also covers the environmental aspects associated with all stages of the lifecycle of the BWRX-300.

A dedicated Preliminary Environmental Report is the key source of environmental information. The purpose of this Preliminary Safety Report chapter is to provide a brief overview of the Preliminary Environmental Report, including environmental aspects related to the construction, operation and decommissioning of the BWRX-300.

It 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)”.

ACRONYMS AND ABBREVIATIONS

Acronym	Explanation
ABWR	Advanced Boiling Water Reactor
ALARA	As Low As Reasonably Achievable
AOO	Anticipated Operational Occurrence
BAT	Best Available Technique
BSSD	Euratom Basic Safety Standards Directive
BWR	Boiling Water Reactor
CFD	Condensate Filters and Demineralizers System
DWMP	Decommissioning & Waste Management Plan
EA	Environment Agency
ESBWR	Economic Simplified Boiling Water Reactor
EUST	End User Source Terms
FDP	Funded Decommissioning Programme
FP	Fission Products
FPC	Fuel Pool Cooling and Cleanup System
GDA	Generic Design Assessment
GEH	GE Hitachi Nuclear Energy Americas, LLC
GNF	Global Nuclear Fuel
HEPA	High Efficiency Particulate Air
ICC	ICS Pool Cooling and Cleanup System
ICS	Isolation Condenser System
IRAT2	Initial Radiological Assessment Tool 2
LWM	Liquid Waste Management
MCERTS	Monitoring Certification Scheme
NRW	Natural Resources Wales
OGS	Offgas System
ONR	Office for Nuclear Regulation
OPEX	Operational Experience
PER	Preliminary Environmental Report
PREMS	Process Radiation and Environmental Monitoring System
PSR	Preliminary Safety Report
PST	Primary Source Term
RGP	Relevant Good Practice
RO	Reverse Osmosis
RP	Requesting Party
SMR	Small Modular Reactor
SWM	Solid Waste Management

Acronym	Explanation
UK	United Kingdom
U.S.	United States

SYMBOLS AND DEFINITIONS

Symbol	Definition
mSv/y	Millisieverts per year
MW(e)	Megawatts electrical

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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

20 ENVIRONMENTAL ASPECTS

This chapter of the Preliminary Safety Report (PSR) forms part of the Generic Design Assessment (GDA) submission to the United Kingdom (UK) regulatory bodies for the GEH Boiling Water Reactor (BWR), BWRX-300 Small Modular Reactor (SMR).

GEH as the Requesting Party (RP) are only undertaking Steps 1 and 2 of the GDA process at this time. This chapter forms part of the suite of documents that support Step 2, which enables an assessment of the fundamentals of the design by the regulatory bodies against the regulatory requirements and expectations.

A brief overview of the site characteristics including relevant meteorological data, environmental impacts of construction, normal operation, accidents, and decommissioning are summarised. This is to ensure that there are no environmental protection shortfalls that could prevent the SMR from being acceptable for deployment at sites in England and Wales.

Purpose

The Environment Agency (EA) and Natural Resources Wales (NRW) have outlined guidance about the information that should be provided to be able to assess the environmental impacts of this proposed SMR during its lifecycle. This information is contained within the Preliminary Environmental Report (PER). The purpose of this PSR chapter is to provide a brief overview of the PER, including environmental aspects related to the construction, operation and decommissioning of the BWRX-300.

Scope

It is noted that the overall environmental assessment is covered by a dedicated PER. Whilst interfacing with other chapters in the PSR, namely NEDO-34164, “BWRX-300 UK GDA, Chapter 2: Site Characteristics,” (Reference 20-1), NEDO-34174, “BWRX-300 UK GDA Chapter 11: Management of Radioactive Waste,” (Reference 20-2) and NEDO-34193, “BWRX-300 UK GDA Chapter 21: Decommissioning and End of Life Aspects,” (Reference 20-3), this chapter will mainly be referencing PER, capturing its key elements and conclusions. Therefore, the scope of this chapter is to summarise the findings with regards to environmental aspects across the lifecycle of the reactor. Further details of the PER can be found in its respective chapters and NEDC-34141P, “BWRX-300 UK GDA Environmental Strategy,” (Reference 20-4).

This chapter focuses on radiological environmental aspects. It is important to note that non--radiological environmental aspects are intentionally excluded from this discussion and can be found in NEDO-34227, “BWRX-300 UK GDA Chapter. E10: Other Environmental Regulations,” (Reference 20-5).

20.1 General Aspects of the Environmental Impact Assessment

The overall environmental assessment can be found in the PER. The PER provides confidence that it can be demonstrated that the BWRX-300 meets the requirements and expectations of UK regulators and uses Best Available Techniques (BAT) to prevent or minimise harm to people and the environment.

Given that the PER scope is for GDA Step 1 (Initiation) and 2 (Fundamental Assessment), the submission will discuss claims and arguments and will provide confidence that evidence can support these in future site-specific assessment. This will include high-level identification of aspects that a developer will need to address for site-specific permitting.

GEH will incorporate experience of the UK GDA process gained with the submissions for the UK Advanced Boiling Water Reactor (ABWR) and the Economic Simplified Boiling Water Reactor (ESBWR).

An environmental impact assessment will be undertaken at site-specific stage, assessing the:

- Impact of the preparation of the site
- Construction of a currently unspecified number of reactors, and associated facilities
- Operation and maintenance of the reactors and related facilities for approximately 60 years
- Management of conventional and radioactive waste
- Decommissioning of the nuclear reactors and associated facilities

20.2 Site Characteristics that are Important in Terms of Environmental Impact

NEDO-34219, “BWRX-300 UK GDA Chapter E2: Generic Site Description,” (Reference 20-6) describes the set of environmental characteristics that define the envelope within which radiological assessments have been carried out within NEDO-34226, “BWRX-300 UK GDA Chapter E9: Prospective Radiological Assessment,” (Reference 20-7). Assumptions on the generic site characteristics as described in PER Chapter E2 (Reference 20-6) are summarised below. Additional site characteristics and their future evaluation in support of the design, safety assessment and periodic safety review of the BWRX-300 can be found in PSR Chapter 2 (Reference 20-1).

The BWRX-300 generic site is coastal and assumed to be seawater abstraction for the purposes of GDA. 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 reviewed by the Office for Nuclear Regulation (ONR). Further consideration of geology and seismology in the context of the BWRX-300 design are presented within PSR Chapter 2 (Reference 20-1).

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 large buildings, other than the BWRX-300 nuclear power plant, in the immediate vicinity.

Assumptions regarding geographical information for dispersion calculations are outlined in PER Chapter E2 (Reference 20-6), which utilises values from the UK Health Security Agency's PC-CREAM 08 Modelling tool within the Initial Radiological Assessment Tool 2 (IRAT2) framework.

The impact of releases of radioactivity to estuarine or coastal waters considers the impact to a generic, hypothetical fishing family. The family are assumed to be exposed to radionuclides through shoreline sediment deposition and consumption of foodstuff incorporating radionuclides from the surrounding water. Detailed site-specific data forms part of the site specific environmental permitting process and would be considered as part of a future development stage.

Local meteorological data is not required for assessments carried out at Step 2 of the GDA process.

20.3 Plant Features that Minimise the Environmental Impact

A key feature of the adopted design methodology is the integration of BAT into the engineering design process alongside safety and security principles, to achieve holistic optimisation of the BWRX-300 nuclear power plant. The methodology takes into account applicable regulatory requirements and associated guidance, as well as Relevant Good Practice (RGP).

NEDO-34223, "BWRX-300 UK GDA Chapter E6: Demonstration of BAT Approach," (Reference 20-8) presents claims and arguments, and confidence that evidence can be provided in the future, to demonstrate that the BWRX-300 meets the requirements and expectations of UK regulators, and uses BAT to prevent or minimise harm to members of the public and the environment.

As discussed in PER Chapter E6 (Reference 20-8), an example of a design feature that minimises environmental impact is the design and manufacture of fuel to achieve a low rate of fuel failure. The fuel assemblies present the largest source of radionuclides that are created as a result of nuclear fission in the reactor. A release of Fission Products (FP) from the fuel into the steam circuit or cooling pool water has the potential to create radioactive waste that will ultimately require treatment and/or discharge to the environment. Ensuring that FP remain in the fuel and its cladding is a key element of the design and operation of the BWRX-300, and a highly significant factor in preventing the generation of radioactive wastes.

Other design features incorporated into the BWRX-300 design to further reduce radioactivity in waste streams are described in NEDO-34222, "BWRX-300 UK GDA Chapter E5: Radioactive Waste Management Arrangements," (Reference 20-9):

- Increased use of stainless steel throughout the design

  This is anticipated to result in reduced corrosion and erosion particulate generation throughout the plant. This will both reduce wet solid waste volumes and result in fewer particles undergoing irradiation in the core, reducing the overall radioactivity of the filter backwash sludges produced. Reduced presence of particles in the RPV should also lead to a reduction in fuel cladding failures.

- Reduced cobalt inventory

  The BWRX-300 material selection strategy focusses on reducing cobalt inventory wherever practicable throughout the plant design.

- Enhanced water chemistry regime

  This is anticipated to result in further reduction of corrosion and erosion particulate and minimise cobalt deposition on coolant facing surfaces.

The radioactive waste management systems are designed to minimise the activity and quantity of radioactive waste where it is not practicable to prevent generation. Further description of these measures and controls to limit adverse impact during operation are discussed in Section 20.5.3. These include:

- Gaseous radwaste management

  The document, 006N7899, "BWRX-300 Offgas System (OGS) Design Description," (Reference 20-10), describes how the OGS holds up the release of noble gases, enabling them to decay to low permissible levels before being released to the environment.

- Liquid Waste Management (LWM) system

  The document, 006N7729, "BWRX-300 Liquid Waste Management System Design Description," (Reference 20-11), describes how the LWM system processes liquid effluents to minimise release into the environment, supporting a maximum recirculation philosophy.

- Reactor coolant cleanup systems

  The document, 006N7741, “BWRX-300 Condensate Filters and Demineralizers System Design Description,” (Reference 20-12), describes how the Condensate Filters and Demineralisers system captures contamination and lowers effluent releases.

- Solid Waste Management (SWM) system

  The document, 006N7733, “BWRX-300 Solid Waste Management System (SWM) System Design Description,” (Reference 20-13), describes how the SWM system collects and processes solid (dry and wet) and oily wastes generated across the plant. It minimises the mixing of solid waste streams, which allows for targeted treatment and reduces the requirements for subsequent waste management and disposal.

- Process Radiation and Environmental Monitoring System (PREMS)

  This system provides continuous and periodic monitoring to allow determination of the content of radioactive material in various gaseous, liquid process, and effluent streams, as described in 006N7938, “BWRX-300 Process and Radiation Monitoring System Design Description,” (Reference 20-14).

20.4 Environmental Impact of Construction

The EN-6 “National Policy Statements for Energy Infrastructure,” (Reference 20-15) sets out the potential locations within the UK which are suitable sites for a nuclear power plant. These sites have all previously accommodated nuclear power plants, namely the following candidate sites:

- Bradwell
- Hartlepool
- Heysham
- Hinkley Point
- Oldbury
- Sizewell
- Sellafield
- Wylfa

The only significant potential source of radiological impacts from the construction phase may be through disruption and excavation of contaminated soil. However, no sites have been selected currently so detailed assessment of the environmental impact of construction is out of the scope of this GDA and will be considered during a future site-specific phase.

20.5 Environmental Impact of Normal Operation

20.5.1 Authorised Limits and Operational Targets for Discharges and Releases

RSMDP 12 of the Radioactive Substances Management: Generic Developed Principles sets out the requirement to establish limits and levels of radioactivity that can be discharged to the environment.

UK strategy does not set individual limits within the “UK Strategy on Radioactive Discharges,” (2018 review) (Reference 20-16). Dose limits are derived from international recommendations from the International Commission on Radiological Protection and International Atomic Energy Agency. Limits are specified and regulated in accordance with Schedule 23 Part 4 1(b) of “The Environmental Permitting (England and Wales) Regulations 2016” (as amended), (Reference 20-17).

The UK is no longer a member state of the EU, which includes the European Atomic Community (Euratom). Therefore, the UK is no longer required to strictly comply with the total body of EU/Euratom Regulation, Directive or Recommendation. However, the UK retains the connection to the Euratom Basic Safety Standards Directive (BSSD) (Reference 20-18) in its generic developed principles for “Radiological Protection of People and the Environment: Generic Developed Principles,” (Reference 20-19). Article 12 of the BSSD sets a limit on the effective dose for public exposure at 1 mSv/y, and Article 66 requires that arrangements are made for the estimation of doses to members of the public from authorised practices and requires that this dose assessment must be carried out in a realistic way.

The UK strategy aligns to the UK’s requirements as signatory to the OSPAR convention. The minimisation of discharges is considered within the Engineering Principles outlined within the ONR “Safety Assessment Principles for Nuclear Facilities,” (Reference 20-20), where UK policy is to apply BAT to minimise discharges and effects on the environment.

20.5.2 Radiological Impacts of Normal and Abnormal Operations

This subsection deals with the sources and parameters required to evaluate radiological airborne and liquid releases during normal and abnormal plant operation. During operation, effluent and gaseous releases must be below release limits identified.

Annual average gaseous and liquid effluent releases for long-term normal operation of the BWRX-300, including Anticipated Operational Occurrences (AOOs), are found in PER Chapter E9 (Reference 20-7). This reports that the public dose from gaseous and liquid effluent releases during normal operation (and AOOs) is expected to be within regulatory limits.

As the operating methodology for liquid discharges has not yet been determined, three scenarios are presented in the PER for liquid and gaseous discharges under normal operations. This range provides the basis for a future operator to develop specific operating plans for site-specific application. The methodology used can be found in NEDO-34224, “BWRX-300 UK GDA Chapter E7: Radioactive Discharges,” (Reference 20-21).

It is recognised that discharge assessments will require further refinement (after Step 2 of the GDA) to generate a refined model Primary Source Term (PST) and End User Source Terms (EUST). Once refined PST and EUST are determined, then updated assessments of gaseous and aqueous liquid discharges and proposed discharge limits can be presented. GEH fully expect the discharge activities to reduce once refined EUST and the aqueous liquid discharge volume are confirmed. This future work has been captured as a forward action (FAP.PER7-196).

20.5.3 Measures and Controls to Limit Adverse Impact during Operation

Design measures to control gaseous and liquid radioactive discharges to the environment during normal operation are described in PER Chapter E7 (Reference 20-21), PSR Chapter 11 (Reference 20-2) and NEDO-34171, “BWRX-300 UK GDA Chapter 9A: Auxiliary Systems,” (Reference 20-22). Measures are summarised below.

The OGS processes and controls the release of gaseous radioactive effluents to the site environment. This ensures exposure of members of the public and environment to radioactive gaseous effluents is As Low As Reasonably Achievable (ALARA) and within prescribed limits during operation.

The OGS minimises the release of radioactive material into the atmosphere by delaying release of the offgas process stream. This delay, using activated charcoal adsorber beds, is sufficient to achieve adequate decay before the process offgas stream is discharged from the plant. The OGS is designed with redundant components to ensure system operation continues in the event of failure of in-use components and for accessibility for maintenance, as discussed in the Offgas System Design Description (Reference 20-10).

The Station Heating, Ventilation, and Cooling System serves various areas of the power block during normal operation. The High Efficiency Particulate Air (HEPA) filters from the Exhaust Air Handling Units at each building assist in ensuring radioactive material entrained in gaseous effluent will not exceed expected limits for normal operations and AOOs. All radiologically designated areas vent to the Continuous Exhaust Air Plenum which collects, mixes, and dilutes potentially radioactive air from various buildings and releases the mixed air to atmosphere via the Plant Vent Stack. The Plant Vent Stack is monitored by PREMS as discussed in PSR Chapter 11 (Reference 20-2).

The LWM system collects process fluids circulating throughout the plant as a result of normal operation, separates and filters the waste, then returns the filtered water to the plant systems for reuse. The BWRX-300 is designed such that, under normal conditions, the need to release aqueous liquid waste to the environment is minimised (and can be operated on a maximum recirculation basis). In cases where aqueous liquid waste is released, the PREMS monitors the effluent stream sending a signal to automatically isolate the discharge line if it senses radioactivity above action levels.

The SWM system comprises both engineered systems (for wet solid wastes management) and management arrangements (for dry solid wastes). It controls, collects, handles, processes, packages, and temporarily stores solid waste generated by the plant prior to transferring the waste into on-site storage or transporting the waste offsite. It also processes the LWM filtering skid spent resins and filter backwash, lab waste, oily sump waste, filter backwash sludges, Reverse Osmosis (RO) concentrates, charcoal media, and bead resins generated by the Fuel Pool Cooling and Cleanup System (FPC), Isolation Condenser System, (ICS) Pool Cooling and Cleanup System (ICC) and Condensate Filters and Demineralizers System (CFD).

20.6 Environmental Impact of Postulated Accidents involving Radioactive Releases

Assessment of the current ‘fault list’ for the BWRX-300 has not resulted in the identification of AOOs leading to environmental impacts. The safety analysis primarily assesses reactor faults and, as such, faults that could primarily result in fuel damage. All of the faults listed present adequate mitigation through design and therefore do not give rise to environmental impact consequences within AOO frequency.

Further work is required at the site-specific stage to assess for faults that could give rise to environmental consequences at frequencies that would define them as AOOs. A forward action has been raised in PER Chapter E5 (Reference 20-9) (FAP.PER5-110).

Environmental impact from accidents is not within the scope of GDA.

20.7 Environmental Impact of Plant Decommissioning

The consideration of decommissioning requirements is now an integral part of new nuclear build requirements. Prospective operators of new nuclear power plants are required to develop a Decommissioning & Waste Management Plan (DWMP) as part of the Funded Decommissioning Programme (FDP), and a Site Wide Environmental Safety Case to obtain relevant consents to achieve commercial operation.

GEH will develop a DWMP and in doing so develop estimates for the quantities of radioactive and conventional wastes that are anticipated to arise during the decommissioning phase.

The information related to decommissioning available at this time is preliminary with no significant assessment of potential environmental effects of decommissioning activities related to BWRX-300 undertaken. PSR Chapter 21 (Reference 20-3) addresses the decommissioning and end-of-life considerations for the plant. It outlines that the preferred decommissioning strategy is prompt decommissioning; however, the plant design does not preclude the option of deferred decommissioning. A UK-specific Preliminary Decommissioning Plan (PDP) is scheduled to be developed during the subsequent phase of design development. Furthermore, PSR Chapter 21 (Reference 20-3) states that the final determination of the site end-state will be made following confirmation of site-specific characteristics and in consultation with relevant future stakeholders. The current baseline assumption is that the site will be restored to an industrial end-state, commonly referred to as a “brownfield” condition.

A site-specific FDP will include a DWMP which will form the basis for planning for decommissioning and facilitate achieving the desired end-state of a selected site.

Decommissioning operations will require continued operation of some of the coolant and drainage systems. The systems associated with the reactor, spent fuel pool, and associated systems will be operated as appropriate to the requirements for processing and discharge of the water contained within them. These will be gradually phased out and replaced with equipment proportionate to the reducing volume and levels of contamination of the wastes being generated. The effluents arising from the primary circuit decontamination process will either be treated by modifying the installed LWM systems or installing a smaller, more fit-for-purpose system if this proves unfeasible, as discussed in PSR Chapter 21 (Reference 20-3).

It should be noted that the strategy for management of operational radioactive waste arisings is to process the wastes as they arise. In this manner there will be little or no legacy waste requiring processing during the decommissioning phase.

It is anticipated that decommissioning, when properly planned and carried out with effective control and mitigation, will not have an adverse effect on the environment. International Operational Experience (OPEX) has demonstrated that BWRs can be readily decommissioned in compliance with regulations and safety principles, and most likely will be subject to enhanced methods in comparison to ongoing and completed decommissioning projects. Options for decommissioning would be assessed as part of the FDP produced by the future licensee, as discussed in PSR Chapter 21 (Reference 20-3).

20.8 Environmental Measurements and Monitoring Programmes

Based on the current EUST, the radionuclides with the greatest activity are:

- Noble gases, tritium, and C-14 for gaseous discharges
- Tritium for aqueous liquid discharges

However, the significant radionuclides have not yet been fully established for both the gaseous and liquid discharges of the BWRX-300. PER Chapter E7 (Reference 20-21) discusses the gaps in the EUST. It identifies that the current BWRX-300 EUST listed radionuclides for gaseous and aqueous liquid discharges do not exactly match those in the 2004/2 Euratom Recommendation (Reference 20-23), which is recognised in the UK as representing good practice. This has been raised as a forward action (FAP.PER7-196).

Based on the current EUST, the proposed radionuclides for determination in gaseous and liquid aqueous discharges are shown in NEDO-34225, "BWRX-300 UK GDA Chapter E8: Approach to Sampling and Monitoring," (Reference 20-24).

To be able to accurately report the discharge of radioactive material from release points, the volumetric flow of both gaseous and liquid effluent streams needs to be continuously measured using an appropriate Monitoring Certification Scheme (MCERTS) accredited technique.

The type and location of a flow meter(s) for gaseous discharge has not yet been incorporated into the BWRX-300 design, as discussed in PER Chapter E8 (Reference 20-24). This is for the future owner/operator to determine (FAP.PER8.209). It is recognised that selected flow equipment will have to meet MCERTS standards and demonstrated to be BAT.

20.9 Records of Radioactive Releases and Availability of Information to the Authorities and the Public

The BWRX-300 incorporates the lessons learned from worldwide programmes and the OPEX/programmes of several GEH BWRs, most notably the ESBWR and the ABWR. Chapter E7 of the PER (Reference 20-21) provides a conservative assessment of activities for radioactive discharges (gaseous and aqueous liquids) to the environment that will be generated from the normal operation of the GEH BWRX-300 SMR. These discharge activities are considered conservative and the aqueous liquid discharge volumes are yet to be confirmed (by a future owner/operator).

However, the new BWRX-300 design is in licensing in both Canada and United States (U.S.). OPEX from these power plants will be fed back, so that more accurate radioactive releases can be recorded and used to better inform the UK's regulatory assessment processes.

GEH have advised that the design intent for the BWRX-300 is to make it possible to operate on a maximum recirculation basis. It has been shown in NEDC-34279P, "BWRX-300 UK GDA Analysis of Environmental Discharge Data for US Nuclear Power Plants," (Reference 20-25) that it is possible for a BWR to yield zero mixed fission and activation products in aqueous effluents.

For recording radioactive releases, an Environmental Monitoring Programme, developed at the future site-specific stage will outline all requirements including those for record storage and retention. These include higher-level requirements for management of records and documents, including environmental data records.

Further information on how BWRX-300 site radioactive releases will be recorded and the process by which they will be made available to the regulators and public is considered part of the future site-specific assessment phase.

20.10 References

20-1 NEDO-34164, "BWRX-300 UK GDA Chapter 2: Site Characteristics," Rev B, GE-Hitachi Nuclear Energy, Americas, LLC.

20-2 NEDO-34174, "BWRX-300 UK GDA Chapter 11: Management of Radioactive Waste," Rev B, GE-Hitachi Nuclear Energy, Americas, LLC.

20-3 NEDO-34193, "BWRX-300 UK GDA Chapter 21: Decommissioning and End of Life Aspects," Rev B, GE-Hitachi Nuclear Energy, Americas, LLC.

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20-5 NEDO-34227, "BWRX-300 UK GDA Chapter E10: Other Environmental Regulations," Rev B, GE-Hitachi Nuclear Energy, Americas, LLC.

20-6 NEDO-34219, "BWRX-300 UK GDA Chapter E2: Generic Site Description," Rev B, GE-Hitachi Nuclear Energy, Americas, LLC.

20-7 NEDO-34226, "BWRX-300 UK GDA Chapter E9: Prospective Radiological Assessment," Rev B, GE-Hitachi Nuclear Energy, Americas, LLC.

20-8 NEDO-34223, "BWRX-300 UK GDA Chapter E6: Demonstration of BAT Approach," Rev B, GE-Hitachi Nuclear Energy, Americas, LLC.

20-9 NEDO-34222, "BWRX-300 UK GDA Chapter E5 Radioactive Waste Management Arrangements," Rev B, GE-Hitachi Nuclear Energy, Americas, LLC

20-10 006N7899, "BWRX-300 Offgas System Design Description," Rev 1, GE-Hitachi Nuclear Energy, August 2023.

20-11 006N7729, "BWRX-300 Liquid Waste Management System (LWM) System Design Description," Rev 1, GE-Hitachi Nuclear Energy, March 2023.

20-12 006N7741, "BWRX-300 Condensate Filters and Demineralizers System Design Description," Rev 1, GE-Hitachi Nuclear Energy, March 2023.

20-13 006N7733, "BWRX-300 Solid Waste Management System (SWM) System Design Description," Rev 1, GE-Hitachi Nuclear Energy, April 2023.

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20-15 EN-6, "National Policy Statements for energy infrastructure," DECC, Vol 1, July 2011.

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20-17 "The Environmental Permitting (England and Wales) Regulations 2016" (as amended), UK Government, Available at https://www.legislation.gov.uk/uksi/2016/1154/contents

20-18 "Council Directive 2013/59/Euratom of 5 December 2013 Laying Down Basic Safety Standards for Protection Against the Dangers Arising From Exposure To Ionising Radiation, and Repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom," Official Journal of the European Union L13/1, Available at https://www.legislation.gov.uk/eudr/2013/59/contents, January 2014.

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20-20 "Safety Assessment Principles for Nuclear Facilities," Office for Nuclear Regulation, 2014 Editions, Rev 1, January 2020.

20-21 NEDO-34224, "BWRX-300 UK GDA Chapter E7: Radioactive Discharges," Rev B, GE-Hitachi Nuclear Energy, Americas, LLC.

20-22 NEDO-34171, "BWRX-300 UK GDA Chapter 9A: Auxiliary Systems," Rev B, GE-Hitachi Nuclear Energy, Americas, LLC.

20-23 Official Journal of the European Union, "Commission Recommendation of 18 December 2003 on Standardised Information on Radioactive Airborne and Liquid Discharges into the Environment from Nuclear Power Reactors and Reprocessing Plants in Normal Operation," Euratom, February 2004.

20-24 NEDO-34225, "BWRX-300 UK GDA Chapter E8: Sampling and Monitoring," Rev B, GE-Hitachi Nuclear Energy, Americas, LLC.

20-25 NEDC-34279P, "BWRX-300 UK GDA Analysis of Environmental Discharge Data for US Nuclear Power Plants," Rev A, GE-Hitachi Nuclear Energy, Americas, LLC.