GE Hitachi Nuclear Energy

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BWRX-300 UK Generic Design Assessment (GDA) Chapter E10 – Other Environmental Regulations

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EXECUTIVE SUMMARY

GEH is progressing the design and development of the BWRX-300 small modular reactor. The tenth generation BWRX-300 design incorporates the lessons learned from worldwide programmes, building on 60 years of design innovation and operating experience. GEH is the Requesting Party, presenting a Preliminary Environmental Report to the United Kingdom environmental regulators for a Generic Design Assessment (GDA) at the Step 2 for the BWRX-300.

The Environment Agency, working together with Natural Resources Wales, have defined the information they require to assess the generic design of GEH BWRX-300 Small Modular Reactor as part of the Preliminary Environmental Report submission for the GDA process. This Preliminary Environmental Report chapter presents a level of detail proportionate with a two-step GDA and is structured in line with Environment Agency and Natural Resources Wales guidance.

The purpose of this Preliminary Environmental Report chapter is to provide assurance that the BWRX-300 Small Modular Reactor design will meet applicable GDA guidance.

This Preliminary Environmental Report chapter provides assessment for the following GDA guidance Other Environmental Regulations topics:

1. Water use and abstraction
2. Discharges to surface water
3. Discharges to groundwater
4. Operation of installations
5. Control of Major Accident Hazards Regulations
6. Fluorinated greenhouse gases and ozone-depleting substances

For each of the aforementioned topics, this chapter provides the regulatory context, describes the applicable aspects of the small modular reactor design and identifies future assessments where current design maturity does not allow a complete assessment in accordance with GDA guidance. This Preliminary Environmental Report chapter also identifies the stages in which further assessments required in the aforementioned topics are to be completed in Appendix A.

GEH believes that the findings set out in this chapter and the collation of further design evidence combined with the resolution of further assessments at later stages shall demonstrate that the BWRX-300 has been optimised to meet applicable GDA guidance Other Environmental Regulations topics.

ACRONYMS AND ABBREVIATIONS

Acronym	Explanation
AHU	Air Handling Unit
BAT	Best Available Techniques
BIS	Boron Injection System
CA	Competent Authority
CDOIF	Chemical and Downstream Oil Industries Forum
CFS	Condensate and Feedwater Heating System
CIGWS	Consent to Investigate Groundwater Sources
CLP15	Classification, Labelling and Packaging of Chemicals (Amendments to Secondary Legislation) Regulations 2015
COMAH15	Control of Major Accident Hazards Regulations 2015
CST	Condensate Storage Tank
CUW	Reactor Water Cleanup System
CWE	Chilled Water Equipment
CWS	Circulating Water System
DAA	Directly Associated Activity
DEFRA	Department for Environment, Farming and Rural Affairs
EA	Environment Agency
EC	European Commission
EFS	Equipment and Floor Drain System
ELV	Emission Limit Value
EME	Emergency Mitigation Equipment
EPR16	Environmental Permitting (England and Wales) Regulations 2016 (as amended)
EPR18	The Environmental Permitting (England & Wales) (Amendment) Regulations 2018
EQS	Environmental Quality Standard
ER09	The Eels (England and Wales) Regulations 2009 (as amended)
EU	European Union
ETS	Emissions Trading Scheme
FPC	Fuel Pool Cooling and Cleanup System
FPS	Fire Protection System
GDA	Generic Design Assessment
GEH	GE Hitachi Nuclear Energy
GHGE	Greenhouse Gas Emission
GIS	Gas Insulated Switchgear
GWP	Global Warming Potential

Acronym	Explanation
HFC	Hydrofluorocarbons
HSC15	Planning (Hazardous Substances) Regulations 2015
IED	Industrial Emissions Directive 2010/75/EU
IWS	Integrated Waste Strategy
LWM	Liquid Waste Management System
MATTE	Major Accident to the Environment
MCA	Main Condenser and Auxiliaries
MCP	Medium Combustion Plant
MCPD	Medium Combustion Plant Directive
MCR	Main Control Room
NFPA	National Fire Protection Association
NHS	Normal Heat Sink
NRMM18	Non-Road Mobile Machinery (Type-Approval and Emission of Gaseous and Particulate Pollutants) Regulations 2018 (as amended)
OER	Other Environmental Regulations
ODS	Ozone-Depleting Substance
ONR	Office for Nuclear Regulation
PCW	Plant Cooling Water System
PCER	Pre-Construction Environmental Report
PCSR	Pre-Construction Safety Report
PER	Preliminary Environmental Report
PREMS	Process Radiation and Environmental Monitoring System
PSR	Preliminary Safety Report
RB	Reactor Building
RP	Requesting Party
RWB	Radwaste Building
RWST	Refuelling Water Storage Tank
SDC	Shutdown Cooling System
SDG	Standby Diesel Generator
SDS	Safety Data Sheet
SG	Specified Generator
SMR	Small Modular Reactor
SS	Suspended Solids
STU	Stationary Technical Unit
SuDS	Surface Water Drainage System
SWM	Solid Waste Management System

Acronym	Explanation
TB	Turbine Building
TBD	To Be Determined
TEC	Trade Effluent Consent
UK	United Kingdom
WGC	Water, Gas, and Chemical Pads

SYMBOLS

Symbol	Definition
°C	Degrees Celsius
°F	Degrees Fahrenheit
gpm	Gallons per minute
L/s	Litres per second
m	Metres
m^3	Cubic metres
m^3/d	Cubic metres per day
mg/Nm^3	milligrams per normal cubic metre
m^3/h	Cubic metres per hour
m^3/s	Cubic metres per second
MW_e	Megawatt Electrical
MW_{th}	Megawatt Thermal
m^3/y	Cubic metres per year
NO_x	Nitric oxide (NO) and Nitrogen dioxide (NO_2)
ppb	Parts Per Billion
SF_6	Sulphur Hexafluoride
SO_2	Sulphur Dioxide
t	Tonne

DEFINITIONS

Term	Definition
BREF	Best Available Techniques Reference Document
E1	Ecotoxicity of substances and mixtures under the European Union's CLP
F gas	Fluorinated Gases
FLEX	Diverse and Flexible Coping Strategies

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Revision #	Section Modified	Revision Summary
A	All	Initial Issuance

10. OTHER ENVIRONMENTAL REGULATIONS

Introduction

GEH is progressing the design and development of the BWRX-300 Small Modular Reactor (SMR). The tenth generation BWRX-300 design incorporates the lessons learned from worldwide programmes, building on 60 years of design innovation and operating experience. GEH is the Requesting Party (RP), presenting a Preliminary Environmental Report (PER) submission to the United Kingdom (UK) regulators for a two-step GDA for the BWRX-300.

Purpose and Objectives

The purpose of this chapter is to provide assurance that the BWRX-300 SMR design will meet the relevant Other Environmental Regulations (OERs) as defined in the GDA. This chapter assesses OER associated with non-radioactive substances and emissions.

This PER provides high-level overview descriptions of the BWRX-300 plant, systems, and processes, applicable for explaining how the SMR generic design will meet OER at an appropriate level of detail for Step 2.

The Environment Agency (EA), working together with Natural Resources Wales, herein referred to as the 'environmental regulators', have defined the information they require to assess the generic design of the GEH BWRX-300 SMR as part of the PER submission of the GDA process. This PER chapter presents a level of detail proportionate with a two-step GDA and is structured in line with the environmental regulators' guidance, "New nuclear power plants: Generic Design Assessment guidance for Requesting Parties," (Reference 10-1).

The objectives of this chapter are:

- To determine applicability of GDA OERs with BWRX-300 SMR plant processes, systems, and activities.
- To demonstrate compliance with relevant regulations (where GDA OERs are applicable). Where the level of current design maturity does not allow a complete compliance assessment, further assessments needed to demonstrate compliance will be documented.
- To demonstrate how conventional environmental impacts associated with GDA OERs are prevented, or, where this is not possible, managed to minimise conventional environmental impact within the BWRX-300 SMR design.
- To document consideration of other relevant or connected legal requirements, appropriate measures, and Best Available Techniques (BAT) associated with GDA guidance OER topics.

Scope

The scope of this chapter is to concisely describe the applicable aspects of design of the BWRX-300 to the GDA OER topics, highlighting aspects of the design that are still evolving and may be subject to change. It follows the topics structure of the "Information relating to other environmental regulations" section within the "Information required for environment case submission" from the GDA guidance for RPs (Reference 10-1). It addresses the following topics:

1. Water use and abstraction
2. Discharges to surface water
3. Discharges to groundwater
4. Operation of installations

5. Control of Major Accident Hazards Regulations 2015 (COMAH15)
6. Fluorinated greenhouse gases and ozone-depleting substances

For each of the aforementioned topics, this chapter provides the regulatory context, describes the applicable aspects of the SMR design, and identifies future assessments where current design maturity does not allow a complete assessment to be made in accordance with the environmental regulators' GDA guidance.

Appropriate information will be provided to support the SMR plant, systems and processes that have a particular connection with GDA OER, as stated in the GDA guidance for RPs (Reference 10-1). Where further work may be required, further assessments are identified throughout the topics and summarised in Appendix A.

Exclusions

Excluded from the scope of this document is:

- Detailed assessment of applicability for other environmental regulations associated with operation phases outside the scope of GDA.
- Detailed assessment of multi-SMR impacts on GDA OER applicability.
- Detailed assessment of all the philosophies, processes, means, methodologies, and standards that have been used in the development, substantiation, and specification of the design.

There are additional environmental aspects and applicable regulations that will be appropriately considered during later design stages of the SMR but are outside the scope of the GDA process and this chapter. This includes, for example:

- Amenity impacts – fugitive emissions – noise, odour, dust, pests, litter etc.
- Visual impacts – lighting, unsightly structures etc.
- Terrestrial ecology – habitats directive
- Conventional solid waste management regulations such as Duty of Care Regulations, Hazardous Waste Regulations and Waste Carrier Regulations

Document Structure

Following this introductory section, the chapter is structured in the following manner:

Section 10.1 Water Use and Abstraction

Section 10.2 Discharges to Surface Water

Section 10.3 Discharges to Groundwater

Section 10.4 Operation of Installations

Section 10.5 Medium Combustion Plant and Specified Generators

Section 10.6 The Control of Major Accident Hazards Regulations 2015

Section 10.7 Fluorinated Greenhouse Gases and Ozone Depleting Substances

Section 10.8 References

Appendix A Forward Action Plan

Chapter Interfaces

This document interfaces with chapters within both the PER and Preliminary Safety Report (PSR) that provide additional design detail, context, or loss prevention controls. These interfaces are detailed in Table 10-1. Clear reference to the relevant chapters is made throughout.

10.1 Water Use and Abstraction

The BWRX-300 SMR generic site has no current planned design for use of conventional cooling towers or hybrid cooling towers. Additional description of the characteristics of the generic site is documented in NEDC-34219P, "BWRX-300 UK GDA Preliminary Environmental Report Ch. E2: Generic Site Description," (Reference 10-2).

There are no operational sources of water abstracted from groundwater, rivers, or lakes. This section explores sea water abstraction and other potential groundwater abstractions.

10.1.1 Regulatory Context

In England and Wales, "The Water Resources Act 1991" (Reference 10-10) requires operators of abstractions or impoundments to hold a license. The regulating authority for water abstractions and impoundments are the environmental regulators. For abstractions, a license is required for any abstraction of more than 20 m^3/d. An abstraction license is not required for abstractions in coastal waters. Marine water abstraction is currently outside the scope of Part II, Chapter II of "The Water Resources Act 1991" (Reference 10-10), and "The Water Resources (Abstraction and Impounding) Regulations 2006" (Reference 10-11).

For impoundments, a license is required for any new structure within inland waters that can permanently or temporarily change the water level or flow. This includes dams, weirs, fish passes, sluices, and penstocks. An impoundment license is not required for structures in coastal waters and therefore would not be applicable for a BWRX-300 coastal site location.

"The Water Abstraction and Impounding (Exemptions) Regulations 2017" (as amended) (Reference 10-12) exempts small scale dewatering in the course of building or engineering works from requiring an abstraction license where:

- Abstractions are temporary and, in any event, carried out over a period of less than six consecutive months, beginning with commencement of the first abstraction.
- Abstractions do not cause, or are not likely to cause, damage to a conservation site or specific features in such a site.
- Abstractions do not cause, or are not likely to cause, damage to protected species, and either the water abstracted is immediately discharged to a soakaway, or the volume of water abstracted is less than 100 m^3/d and there is no intervening use of that water before discharge.
- An abstraction is undertaken within 500 m of a conservation site or within 250 m of a spring, well, or borehole used to supply water for any lawful use, and water abstraction is less than 50 m^3/d.

Connected to groundwater abstraction is the requirement for Consent to Investigate a Groundwater Source (CIGWS) under the Water Resources Act 1991 (also through the environmental regulators) if an abstraction license is also needed. The consent allows the holder to carry out work (or further work) to detect the presence, quality, and quantity of underground water, for the purpose of abstracting (removing) over 20 m^3/d. If a site with groundwater boreholes will be abstracting 20 m^3 or less per day and does not need an abstraction license, a CIGWS is also not required.

"The Eels (England and Wales) Regulations 2009" (as amended) (ER09) (Reference 10-13) implements 1100/2007, "Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel," (Reference 10-14). The regulating authority for ER are the environmental regulators. ER requires the operator of an abstraction or water diversion of more than 20 m^3/d, or any discharge to a channel, bed, or sea (out to six nautical miles), to provide a screen in order to prevent the entrainment of eels.

In very specific circumstances, the environmental regulators can issue a notice to exempt the requirement for a screen.

The provision of fish passes and screens for the protection of salmon and migratory trout (sea trout/sewin) under the "Salmon and Freshwater Fisheries Act 1975" (as amended) (Reference 10-15) may also be required for sea or river abstraction infrastructure.

10.1.2 Water Requirements for the Design

Water requirements for the BWRX-300 are met using water from three sources:

- Seawater abstraction
- Demineralised water supply
- Potable water supply

Wastewater is also recovered and re-used within the process after treatment to remove contaminants via the Liquid Waste Management System (LWM). Further discussion is provided in Section 10.2.

The Fuel Pool Cooling and Cleanup System (FPC), whilst provided with reused water from the LWM condensate storage tanks, also has water reuse capability with a particulate filtration and demineraliser cleanup system to help maintain a continuous cooling of the water volume in the fuel pool. Further information on this system is provided in NEDC-34221P, "BWRX-300 UK GDA Preliminary Environmental Report Ch. E4: Information about the Design," (Reference 10-3) in Section 4.2.11.6.

Seawater Abstraction

The Circulating Water System (CWS) uses debris-free water from the Normal Heat Sink (NHS), assumed to be the sea at this stage, to provide cooling water for the plant.

The CWS has two subsystems: the main condenser supply and the Plant Cooling Water System (PCW) supply. The main condenser supply uses two 50% pumps to provide cooling water to the Main Condenser and Auxiliaries (MCA) during all modes of condenser heat removal. A hot circulating water return line is provided to recycle water returning from the condenser in cold weather conditions as required to prevent freezing in the NHS structure.

The PCW system consists of two trains, each containing one pump and one heat exchanger, that address the reactor component and turbine component cooling loads. The plant cooling water supply uses two 100% pumps to provide cooling water to the PCW heat exchangers for all normal and abnormal operating modes, according to 005N9751, "BWRX-300 General Description," (Reference 10-16).

The CWS is designed for continuous operation and to provide sufficient circulating water to the condenser to support full power operation throughout the year. The maximum flow rate of the CWS through the condenser is 14.76 m^3/s.

A simplified diagram on CWS is provided in NEDC-34221P, PER Ch. E4 (Reference 10-3).

Normal Heat Sink

The NHS consists of an intake tunnel, a forebay, and an outfall structure to supply and return circulating water back to the environment. The forebay provides a reservoir supply for pump suction, as well as upstream filtering equipment and their associated support equipment.

The outfall structure receives circulating water discharge prior to being routed back to the source. The outfall structure contains a discharge weir, which provides a backpressure to the condenser circulating water pumps to prevent the circulating water from cavitating on the discharge to the condenser, as described in 006N7761, "BWRX-300 Circulating Water System Design Description," (Reference 10-17).

There is a pumphouse structure that provides a building enclosure structure for site-specific designed forebay equipment (i.e., traveling screens, pumps, filters, etc.) All filtering and treatment equipment situated upstream (e.g. intake screens, bar screens, stop logs) and downstream of the supply pumps (e.g. debris filters, strainers, condenser tube cleaning system, inline filters, chemical injection systems) are To Be Determined (TBD) during the site-specific design phase based on location and normal heat sink characterisation (FAP.PER4-219) as described in 006N7761 (Reference 10-17). Design considerations on fish deterrent schemes and fish return systems will include:

- The location of the intake tunnel to avoid sensitive receptors (e.g. eel migratory routes and breeding areas).
- Intake tunnel size design to minimise velocities and reduce risk of wildlife capture from seawater abstraction.
- Barrier/deterrent design

Continuous seawater abstraction from the NHS will exceed 20 m^3/d. However, an abstraction license is not required for abstractions from the sea in open coastal areas.

Section 10.1.4 provides details of further assessments required to address this topic fully.

Demineralised Water Supply

Demineralised water is supplied from an external source to a storage tank situated in the yard, prior to distribution to the following systems, as stated in 006N7797, “BWRX-300 Water, Gas, and Chemical Pads System Design Description,” (Reference 10-18):

- Isolation Condenser Pools Cooling and Cleanup System
- Boron Injection System (BIS)
- FPC
- LWM – specifically the Condensate Storage Tank (CST)
- Chilled Water Equipment (CWE) – specifically the Glycol Autofill Unit
- PCW Surge Tanks

There is also a supply line to the inside of the primary containment for under-vessel work. Makeup requirements are limited to prevent the plant water inventory becoming too high, which would require discharge to the environment. This approach demonstrates the design applying efficient use of raw materials and sustainability principals. This also demonstrates consideration of climate change adaptation and projected change in water resources availability in the future.

A simplified diagram on the Demineralized Water Storage and Distribution subsystem is provided in NEDC-34221P, PER Ch. E4, Figure 4-27 (Reference 10-3).

Potable Water Supply

The potable water distribution system is the main source of potable water to the facility. It receives potable water from the municipal potable water source and provides potable water to the following areas, as in 006N7797 (Reference 10-18):

- Fire suppression system firewater storage tanks;
- Mobile demineralised water trailers, if required to supplement the site’s demineralised water supply;
- Washrooms, break areas, food service equipment, and battery room safety showers; and

- Toilet(s) in the Main Control Room (MCR) habitability envelope.

The stage of design maturity does not allow a meaningful estimate of potable water usage. This will be further influenced by site-specific design such as water chemical treatments. Section 10.1.4 provides details of further assessments required to address this topic fully.

10.1.3 Water Use Efficiency

Water use efficiency has been a significant design consideration for the BWRX-300 design. Processes and systems demonstrating a high degree of water use efficiency are summarised below:

- An aqueous zero discharge philosophy, where under normal conditions (including refuelling outages), appropriate management of the plant water inventory and efficient effluent treatment negates the need for aqueous discharges to the environment. This is also described in NEDC-34223P, "BWRX-300 UK GDA Preliminary Environmental Report Ch. E6: Demonstration of BAT Approach," (Reference 10-4) and NEDC-34224P, "BWRX-300 UK GDA Preliminary Environmental Report Ch. E7: Radioactive Discharges," (Reference 10-5).
- If set limits for water re-use are not met in the LWM effluent batch treatment process, the plant has the capability for pretreatment of effluent in the Solid Waste Management System (SWM) spent resin tank for pretreatment. Following pretreatment, contents are re-routed back to LWM for treatment. This further enables water re-use at the plant and limits frequency of surface water discharge, as described in 006N7733, "BWRX-300 Solid Waste Management System System Design Description," (Reference 10-19).
- Optimised use of closed loop water systems such as the CWE. The CWE is a closed loop chilled water system that supplies chilled water to various non-safety category function Air Handling Unit (AHU) cooling coils and plant equipment coolers in the Turbine Building (TB), Radwaste Building (RWB), Reactor Building (RB), and Control Building. Heat absorbed by the CWE is rejected from the CWE air-cooled condensers mounted in the RWB roof to the atmosphere according to 005N9751 (Reference 10-16).
- The NHS further utilises returning heated seawater with a recirculation line to transfer heat back into the intake forebay to prevent freezing.

Other water re-use/minimisation measures to be considered at later stages in the design or at a site-specific stage include:

- Use of chemical addition systems, such as scale inhibitors, biocides, corrosion inhibitors, and bio-dispersants, to protect the cooling systems and keep them free of deposits/bio-films, described in 006N7769, "BWRX-300 Plant Cooling Water System Design Description," (Reference 10-20). This enables further optimisation of water use and energy use efficiency.
- Layout of equipment to minimise pipe runs and reduce the quantity of water stored within systems.
- Roof water and/or rainwater capture and re-use
- Sustainable surface water drainage systems and re-use

Section 10.1.4 provides details of further assessments required to address this topic fully.

10.1.4 Further Assessment

This sub-section describes further assessments needed for the water use and abstractions topic. When design maturity allows, important future actions to be completed to further assess this topic are:

- Assessing seawater abstraction volumes for different operational phases for cooling water systems.
- Assessing mains and demineralised water demand (average and peak) in different operational phases.
- Assessing fish recovery and return design.
- Assessing intake head design, barrier, and fish deterrent systems, in addition to any other wildlife impact mitigation measures associated with seawater abstraction.

These assessments will only be able to be completed at the site-specific design stage (FAP.PER10-225). Appendix A of this report details the stages in which the further assessments identified in this sub-section are to be completed.

10.2 Discharges to Surface Water

The NHS, part of the CWS, receives returning circulating water which contains waste heat and is discharged into the environment. This makes up the predominant volume of total discharge to surface water. There is only one aqueous discharge point to the environment.

Under normal conditions (including refuelling outages), appropriate management of the plant water inventory and efficient effluent treatment negates the need for treated effluent discharges to the environment, with all aqueous effluent being recycled for use across the plant (aqueous zero discharge philosophy). This approach also demonstrates the application of sustainable development principles and applying the waste hierarchy for waste effluent. However, during off-normal conditions, the effluent treatment systems will reduce radioactivity as far as reasonably practicable prior to discharge to the environment.

10.2.1 Regulatory Context

"The Environmental Permitting (England and Wales) Regulations 2016" (as amended), (EPR16) (Reference 10-21) impose permitting requirements on discharging liquid effluent or wastewater into surface water. The regulatory authority for discharges to surface water in England and Wales are the environmental regulators. Estuaries and coastal water are considered surface waters.

Surface water discharges that are considered under EPR16 as part of other EPR16 permitted processes may be included in environmental permits with other permitted processes. For example, discharges of surface water drainage associated with combustion plant installations would be included in the same permit.

Surface water discharge permit applications require the provision of information on the sources of effluent, flow rate, contaminants present, and thermal load. In addition, an assessment of the impact of surface water discharge releases on the receiving environment is essential for the regulator to determine the environmental risk of the process.

Permitted discharges require operators to control emissions of pollutants including waste heat to surface water. Permits often contain emission limit values of pollutants set to minimise the impact to the receiving environment based in part to receptor sensitivity. For example, waste heat discharges in wastewater will have temperature limits set in permits that consider the receiving water body ambient temperature.

Surface water discharges that are connected to EPR16 processes, such as EPR16 Installations, require demonstration of BAT. Consideration of all applicable EC BAT Reference Documents (BREF) is necessary. This also includes EUR 29362 EN, "European Commission BAT Reference Document for Waste Treatment," (Reference 10-22), which describes appropriate techniques for wastewater treatment, in addition to measures required to prevent or control emissions.

For discharges of trade effluent to foul or combined sewer managed by local sewerage undertakers, Trade Effluent Consent (TEC) may be required from the local site sewage undertaker. This is issued under the regulations within "The Water Industry Act 1991" (as amended), (Reference 10-23). TEC often involves limits set on discharges by sewage undertakers. This can, for example, be limits set on discharge volume, flow, pH, and Suspended Solids (SS) concentration. Sewage undertakers often monitor effluent discharges from consented sites. This requires having ready access and infrastructure in place to enable sewage undertakers to sample discharges.

10.2.2 Sources of Effluent

The BWRX-300 generic design has sources of effluent that are not solely discharged to surface water. The plant also generates other sources of effluent that are not discharged to surface water. For example, non-radioactive trade effluents discharged to foul sewer and liquid conventional wastes disposed off-site treated by a suitable permitted waste management contractor.

The current BWRX-300 design has one discharge point to surface water that is derived from two processes described in Section 10.2.2. Table 10-2 lists effluent sources which are treated and discharged to surface water.

The contributions of different process discharges listed in Table 10-2 released to the environment may change dependant on the operational phase. For example, there may be instances when the CWS is either not running or that the flow is very low (e.g. during an outage). The composition and flow of surface water discharges to the environment can differ significantly. The following sub-sections provide commentary on the process discharges referred to in Table 10-2 in addition to process controls and operating modes.

Circulating Water System

The surface water discharge providing the most significant proportion of discharge volume and frequency of discharge is the NHS returning circulating water. The CWS is designed for continuous operation and to provide sufficient circulating water to the condenser to support full power operation. The predominant pollutant in the CWS discharge is waste heat. Further information is provided in Section 10.1.2.1.

Figure 10-1 shows the connection of the LWM (grey line) with the CWS outfall to surface water (red line). An overview of the CWS is presented in a simplified diagram in NEDC-34221P, PER Ch. E4 (Reference 10-3).

CWS Operational Functions vs Operational Modes are presented in Table 10-3. This lists processes taken within different operating modes, as described in 006N7761 (Reference 10-17).

The NHS has process control alarms and indicators to limit risk of environmental impact from discharges associated with operations. In accordance with 006N7761 (Reference 10-17), these include:

- Forebay water level indicator
- Forebay water temperature indication
- Forebay pump channel level indication
- Pump discharge pressure indication and alarm
- Recirculation water isolation
- Circulating water bulk water discharge temperature indication
- Strap around radiation monitor is placed downstream of each PCW heat exchanger and is interlocked to the downstream valve that isolate the system on detection of high radiation levels.

The CWS process controls can be summarised as:

- The CWS pump starts upon verification that operating water levels on plant are above minimum operating levels.
- The CWS pumps stop if two of the three level switches in the TB detect a high water level caused by a flood inside the facility.
- The CWS discharge valves automatically close upon the trip of the circulating water pump.
- The MCA water box drain pump stops on detection of low level in the inlet water boxes.

- The condenser isolation block valves automatically close upon detection of a high water level in the condenser area of the TB.
- The service water pumps start upon confirmation that the associated PCW heat.
- The exchanger is valved open for service.
- The service water pumps are interlocked with the PCW flow transmitters.

The Process Radiation and Environmental Monitoring System (PREMS) draws water samples from the CWS for chemical analysis. In addition, the PREMS continuously monitors radiation levels on the service water discharge piping from the PCW heat exchangers. In the event of high radiation levels detected downstream of either of the PCW heat exchangers, a signal will be sent to the valves downstream of the heat exchangers. The valves will close to prevent contaminated water reaching the NHS.

Additional description of sampling and monitoring of circulating water via PREMS is documented in NEDC-34225P, "BWRX-300 UK GDA Preliminary Environmental Report Ch. E8: Approach to Sampling & Monitoring," (Reference 10-6).

The potential use of strainers and filters is to be determined at a later design stage. CWS pumps and PCW supply pumps may have a strainer on its discharge side. The strainers would filter the circulating water for the main condenser and PCW heat exchangers. Chemical treatment or other technologies (i.e., ultraviolet, ozone oxidation, extremely low frequency magnetism) may be considered for use to mitigate small aquatic life from entering the circulating cooling water in these systems.

All filtering equipment, upstream (i.e., intake screens, bar screens, stop logs, etc.) and downstream (i.e., debris filter, strainers, Condenser Tube Cleaning System, inline filters, chemical injection systems, etc.), of the CWS pumps and their associated instrumentation and valving are considered part of the CWS, as stated in 006N7761 (Reference 10-17). Material and equipment selection for the CWS is based on the range of environmental conditions that exist at the plant location.

The NHS discharge design limits environmental impact from thermal discharges. For example, the CWS outfall, weir, and discharge tunnel prevents localised thermal shock discharges to marine environments, noting that the average UK sea temperatures are approximately 12 °C. The NHS recirculation line also transfers heat back into the intake forebay to prevent freezing.

Table 10-4 provides information on waste heat discharges to surface water.

Section 10.2.4 provides details of further assessments required to address this topic fully.

Liquid Waste Management System

The LWM is described in further detail and simplified diagrams are provided in NEDC-34221P, PER Ch. E4 (Reference 10-3). The key subsystems and factors impacting effluent discharge are described below.

Waste Collection and Filtering Subsystem

The LWM filtration skid, part of the Waste Collection and Filtering Subsystem, consists of the following components to remove contaminants from the effluent before re-use or discharge. These are the:

- Sludge Consolidation Filter, designed to remove the majority of the total SS in the waste stream and can also absorb oils and greases that may be present in the influent.
- Pre-Conditioning Filter, which uses granular activated carbon to absorb any heavy organics.

- Ozone System, which destroys any remaining organics to parts per billion (ppb) levels, such as any chemical and detergent waste that may enter the filtration skid.
- First Ion Exchanger, which destroys any remaining ozone and softens the wastewater prior to downstream processing.
- Reverse Osmosis System, which removes approximately 95% of dissolved radioactive and non-radioactive contaminants and all colloidal matter.
- Polishing Ion Exchanger, which polishes the Reverse Osmosis System permeate prior to return to the CST.

The filtration skid operates at a rate of approximately 4.42 L/s and can be configured to optimise contaminant removal, as stated in 006N7729, "BWRX-300 Liquid Waste Management System System Design Description," (Reference 10-24). If the wastewater in the collection tanks exceeds filter skid influent limits, it can be routed to the SWM spent resin tank for pretreatment. Following pretreatment, contents are re-routed back to LWM for treatment.

Waste Sampling Subsystem

The Waste Sampling Subsystem downstream of the filtration skid manages the direction of treated effluent for either re-use in the plant, recirculation for further treatment or discharge to surface water offsite (in the uncommon event that the overall water inventory does not allow for water recycling). Two sample tanks (A and B) are each 100 m^3 capacity (60 m^3 nominal capacity) and are paired with an eductor, centrifugal pump (with capability to cross-over with each other) rated to 9.46 L/s, and return line, in accordance with 006N7729 (Reference 10-24).

This discharge path is routed to the CWS for dilution and release to the environment. The discharge path contains a locked closed manual valve, a radiation monitor, sample line, flow control valve, flow element, and two air operated valves for automatic isolation if radiation greater than a preset limit is detected in the flow stream. The Waste Sampling subsystem operating modes and discharge controls are summarised in Table 10-5.

Discharges to the environment from LWM are monitored by the PREMS. The discharge line is automatically isolated upon receiving a signal from PREMS to ensure that liquid releases to the environment are within prescribed limits, and that the release of radioactive liquid effluents is below the action limits calculated and within source dose limits for effluent release.

Additional description of sampling and monitoring of liquid effluent via PREMS is documented in NEDC-34225P, PER Ch. E8 (Reference 10-6).

Operational Variations

The release of chemical impurities and corrosion products into the reactor systems may challenge the operational limits of the aqueous effluent treatment systems, and subsequently challenge the aqueous zero discharge philosophy (under normal operating conditions). This may result in changed discharge frequencies to surface water.

The inlet flow rate to the LWM will vary significantly during plant operation and will be highly dependent of the diligence of the plant operator in preventing and correcting small system leaks throughout the life of the plant. NEDC-34224P, PER Ch. E7 (Reference 10-5) estimates that, considering 100% LWM discharge to surface water over a year, approximate release would be 5968 m^3/y. This is based on 0.6814 m^3/h average inlet flow rate. The maximum processing capacity of the LWM is 381.6 m^3/d.

The water movement balance assessment detailed in 006N7673, "GEH BWRX-300 Water Balance," (Reference 10-25), concludes that the water demand of the plant is within the available storage capacities of tank volumes present. This eliminates the need for any unnecessary, large discharges of processed water to the environment and avoids, if possible, additions of demineralised water for makeup.

The LWM has defined operating modes including:

- Initial Configuration (pre-startup)
- System startup
- Normal operations
- Off-Normal operation
- System shutdown
- Testing and maintenance
- Temporary configuration
- Required surveillance
- Other inspections and testing

The BWRX-300 is described as a first of a kind plant in the UK, no discharge measurement data is readily available, and existing discharge assessments presented are calculations based on U.S. codes and standards in NEDC-34224P, PER Ch. E7 (Reference 10-5). The current BWRX-300 generic design stage does not allow for an assessment of effluent treatment measures against best practice. For example, appraisal of effluent treatment technologies cannot be referenced against BAT without treatment removal efficiencies, estimated effluent conventional pollutant concentration ranges (across all modes of operation) and analysis of pollutants. Section 10.2.4 provides details of further assessments required to address this topic fully.

10.2.3 Other Potential Discharges to Surface Water

Other discharges from potential sources outside of the nuclear island are beyond the scope of a two-step GDA and so are not assessed in this chapter. It will be necessary to assess discharges from other sources at the site-specific stage, in particular if any environmental permit to discharge to surface water is needed. This requirement has been captured elsewhere in NEDC-34224P, PER Ch. E7 (Reference 10-5).

Examples of potential surface water discharges are listed below:

- The Sanitary Sewage Handling Subsystem is designed to prevent raw sewage overflow in the event of a power outage. The sanitary sewers also receive clean condensate from AHUs and fan coil units in the Control Building. Pumping station design can potentially have overflow capacity that is directed to surface water. Another typical technique applied in locations where foul sewer connection offsite is not possible is to have an on-site package treatment plant that discharges treated wastewater to surface water.
- Stormwater/site yard run-off potentially containing SS and oils may not necessarily be connected to a foul/combined sewer network. Site-specific design may require installation of interceptors with a discharge of uncontaminated surface water drainage to surface water.

Domestic sewage and clean uncontaminated surface water is not considered trade effluent. However, if discharges to off-site foul or the combined sewer network contain waste from chemical toilets, laundry washing, and vehicle washings (e.g. during construction and decommissioning) this can potentially be described as trade effluent. TEC may be required from the local site sewage undertaker. Consideration of suitable effluent treatment and sampling may be necessary.

10.2.4 Further Assessment

This sub-section describes further assessments needed for EPR16 discharges to surface water. When design maturity allows, important future actions to be completed to further assess this topic are:

- Detailed assessment of water emissions waste heat impact on the receiving environment.
- Assessment of potential conventional contaminants and concentrations. This will relate to Environmental Quality Standards (EQS) and any further mitigation required. Additional pollutant information including disinfectant and biocides to be provided as design matures.
- Assessment of beneficial use of heat options and heat recovery methods proposed as design maturity allows.
- A complete assessment of all discharges to surface water considering effluent content and volumes discharged.
- For any Surface Water Drainage System (SuDS) proposed, an assessment of suitability of discharges to surface water.
- For any surface water drainage treatment plants designed for removal of oils/SS, an assessment of suitability of discharges to surface water.
- For any on-site sewage system design/plant, an assessment of suitability of discharges to surface water.

These assessments can only be completed at a site-specific design stage (FAP.PER10-226). Appendix A details the stages in which the further assessments identified in this sub-section are to be completed.

10.3 Discharges to Groundwater

The BWRX-300 SMR generic site has no current planned design for operational sources of water discharge to groundwater. This section explores potential groundwater discharges and control, in addition to consideration of regulatory requirements.

10.3.1 Regulatory Context

EPR16 (Reference 10-21) sets permitting requirements on discharging liquid effluent or wastewater into, or on, the ground, or through an infiltration system to ground. The regulatory authority for discharges to ground are the environmental regulators.

Groundwater discharge permits are designed to control and reduce the impact of potentially polluting ground emissions on the environment through permit conditions. Permits also require holders to implement appropriate measures associated with discharges, monitor emissions, and place limits on emissions.

Some lower environmental risk ground discharge activities do not require an environmental permit. For example, the discharging of uncontaminated water, such as clean rainwater from roofs, in accordance with "The Environment Agency's Approach to Groundwater Protection," (Reference 10-26). However, lower risk activities still require compliance with regulatory requirements. It should be noted that the EA are reviewing their approach to groundwater protection guidance and updating the document where applicable. Regulatory position changes will require review as the generic design develops.

Some extremely low-risk discharges to ground are not considered groundwater activities by the regulator. These are called exclusions and an environmental permit or exemption is not required for them. Discharges to boreholes can be considered 'de minimis' if a discharge is so small in quantity and concentration that it only poses an extremely low risk of polluting groundwater. There must also be no danger of any future deterioration in groundwater quality. As described in "Groundwater activity exclusions from environmental permits," (Reference 10-27), examples of 'de minimis' borehole discharges include:

- Recirculation back into the same strata of water abstracted at natural background quality and unaltered.
- Selective groundwater tracer tests and remediation schemes – direct input into groundwater of the equivalent of 10 L of any non-hazardous pollutant for the scientific purpose of groundwater testing or promoting remediation, at a concentration not greater than 10 times the concentration at which it's suitable for human consumption.
- Very small quantities of substances arising from essential use and maintenance of equipment – for example lubrication of screw threads when drilling boreholes.
- Mains water of drinkable quality not containing any discernible hazardous substances.

Connected to borehole-associated discharge to ground is the requirement for CIGWS under "The Water Resources Act 1991" (Reference 10-10) (also through the environmental regulators) if an abstraction license is also needed. The consent allows the holder to carry out work (or further work) to detect the presence, quality, and quantity of underground water, for the purpose of abstracting (removing) over 20 m^3/d. If a site with groundwater boreholes will be abstracting 20 m^3/d or less and does not need an abstraction license, a CIGWS is also not required.

10.3.2 Potential Discharges to Ground

The yard contains ground monitoring for the site. This includes groundwater monitoring. The design specification and means of groundwater monitoring is not yet established at this stage of the design and is expected to be identified during the site-specific design phase. If implemented through groundwater monitoring boreholes, the installation, well development, well purging, and sampling may involve discharge of abstracted water to ground.

Other discharges to ground not covered in GDA and not described in the current design, but could potentially be considered at the site-specific design stage are:

- Groundwater remediation boreholes during site preparation phase. An example of this is when boreholes are installed to abstract light non-aqueous phase liquid hydrocarbon contaminated groundwater.
- Dewatering during building construction. An example of this is when dewatering pumps are used to abstract perched water and groundwater in excavations in the course of building below ground structures. Water is discharged back into ground through recharge wells or pits.
- Drainage soakaways/French drains installed. An example of this is pedestrian footpath or access road drainage soakaways/French drains.

Consideration of groundwater effects on structures, includes, where applicable, the effects of other building surcharges in the proximity, in addition to lateral soil pressures due to the weight of the soil, water in soil, or bulk materials, as described in 005N9341, “BWRX-300 General Civil Structural Design Criteria,” (Reference 10-28). Surcharge loads adjacent to plant structures shall be considered in the design of embedded structures, including, but not limited to, adjacent building surcharge, traffic, and soil compaction surcharge. The BWRX-300 RB can conservatively be analysed and designed to withstand the effects of groundwater defined at grade. As the site-specific groundwater level becomes available, it shall be compared to the grade level elevation, or the site-specific groundwater level can be used for site-specific analysis.

BAT measures identified for this chapter that can prevent accidental leaks and spills of non-radioactive pollutants with the potential to give rise to accidental pollution of land and groundwater are summarised below:

- Minimised use of combustion plant on site requiring potentially polluting diesel as a fuel.
- Standby Diesel Generator (SDG) storage on self-contained skids within the TB.
- Bulk storage of diesel in tanks with secondary and tertiary containment, as described in Section 10.4.2.
- Leak detection for any unavoidable below-ground diesel transfer pipework, as described in Section 10.4.2.
- Process control instrumentation and measurement, such as high-level sensors and alarms, for hazardous waste treatment process, as described in Section 10.2.2.1.

Currently the BWRX-300 generic design’s level of detail does not allow for a comparison of measures against best practice. For example, specific containment system design standards cannot be referenced against best practice guidance such as C736F “Containment Systems for the prevention of pollution: Secondary, tertiary and other measures for industrial and commercial premises,” (Reference 10-29).

Additional BAT will be developed as the BWRX-300 design matures and also at site-specific design stage. Should BAT demonstration be required in the future, for example as part of an installation permit application, the BWRX-300 design is expected to support meeting relevant BAT, such as firewater containment management.

Internally-generated flooding may occur by pipe or tank failure, fire suppression system operation, misaligned systems with openings in the affected zone, maintenance errors, or failure of a drainage system. Separation is provided by flood hazard containment walls, dikes, curbs, trenches or pits, watertight doors, elevated equipment mounting location (mezzanine or different floor) or pedestals, or placing vulnerable equipment in watertight housings, in accordance with 006N5229, "BWRX-300 Mechanical Equipment Separation Requirements: Plant Specification," (Reference 10-30).

Consideration is given to internal flood protection for on-site equipment failures. This includes the review of building layout, elevations, and rooms to determine the potential list of targets that require flood protection. Protection follows guidelines provided in American National Standards Institute/American Nuclear Society, (ANSI/ANS) 56.11 "Design Criteria for Protection Against the Effects of Compartment Flooding in Light Water Reactor Plants", as described in NEDC-34165P, "PSR Ch. 3: Safety Objectives and Design Rules for SSCs" (Reference 10-31).

10.3.3 Further Assessment

When design maturity allows, important actions to be completed to further assess this topic are:

- Determine if groundwater discharges are designed for the BWRX-300 generic site.
- If groundwater discharges are identified, assess proposed processes relating to discharge controls, emissions, and sampling and monitoring.
- Provide additional description of measures designed to prevent accidental leaks and spills of non-radioactive pollutants that could give rise to accidental pollution of land and groundwater.
- Provide descriptions of how the civil design considers groundwater impact on below ground structures and how the plant stands up to climate change effects on groundwater over long periods.

These assessments will only be able to be completed when at a site-specific design stage (FAP.PER10-227). Appendix A details the stages in which the further assessments identified in this sub-section are to be completed.

10.4 Operation of Installations

This section describes installation activities as part of the BWRX-300 generic design that require an environmental permit.

10.4.1 Regulatory Context

In England and Wales, the EPR16 (Reference 10-21) requires operators of specific processes described in the regulations as 'installation activities' to hold environmental permits. In the EPR16, installation activities derive from European Commission (EC) directives including:

- 2010/75/EU, "Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control)," (Reference 10-32), known as the Industrial Emissions Directive (IED).
- 1999/13/EC, "Council Directive 1999/13/EC of 11 March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations," (Reference 10-33), known as the Solvents Emissions Directive.
- 2008/1/EC, "Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control," (Reference 10-34), known as the Integrated Pollution Prevention and Control Directive.
- 2000/76/EC, "Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste," (Reference 10-35), known as the Waste Incineration Directive.
- 2001/80/EC, "Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants," (Reference 10-36), known as the Large Combustion Plant Directive.

Installation activities are listed in EPR16 – Schedule 1 Part II and Schedule 14. Environmental permits for sites operating installation activities are referred to as installation permits.

Installations are defined as a Stationary Technical Unit (STU) consisting of installation activities and Directly Associated Activities (DAAs) that are not listed in EPR16. DAAs are processes that serve an installation activity but also have the potential to impact the environment. For example, waste storage and handling, raw materials storage and handling, and plant surface water drainage are typical DAAs that would be listed in a combustion installation permit. DAAs also require demonstration of BAT.

Installation permits are designed to control and reduce the impact of industrial emissions on the environment through permit conditions. Permits also require holders to implement BAT. Emission limit values to air, water, ground, or sewer may also be listed in installation permits but are dependent on an installation's activities and receiving environment sensitivity.

Installation activities described in EPR16 cover a range of process industry sectors and are also further divided into Part A(1), Part A(2) and Part B installation activities. The type of installation activity operated determines the type of installation permit held. Part A(1) and A(2) installation permits control pollution to air, water, ground, and sewer. Part B installation permits typically control air pollution only. Part A(1) and Part A(2) installation permits, dependent on specific sectors, also include permit conditions controlling fugitive emissions and amenity pollution (e.g. noise and vibration, odour, pests, litter and debris). For example, a Part A(1) combustion installation permit can often have permit conditions controlling noise and vibration associated with plant operation, and odour associated with storage and handling combustion fuels or associated wastes. Other typical installation permit conditions include controls on energy efficiency, sampling and monitoring, and efficient use of raw materials.

Permitted installations often consist of multiple installation activities on a site that are technically connected. Multiple installation activities on a site can cover different process industry sector activities as well as Part A(1), Part A(2), or Part B installation activities. Installations with multiple installation activities hold an installation permit type based on the activity with the highest degree of pollution control. For example, a power station with technically connected Part B combustion and cement use activities that are also technically connected to a Part A(1) waste treatment activity would be classed as a Part A(1) Installation, even if there are more Part B activities.

Installations can be made up of technically connected installation activities managed by different operators. This is referred to as a multi-operator installation where multiple permits to different operators are held for the same installation. For example, multiple units of an SMR at a site with shared services or SMR units serving on-site green hydrogen production could potentially form multi-operator installations.

The authorities regulating EPR16 installations are the environmental regulators or Local Authority. The environmental regulators are the regulators for Part A(1) installations and Part B combustion installations that are also described as medium combustion plant or specified generators by the qualifying date. The Local Authority is the regulator for Part A(2) installations and all other Part B installations.

Operators of installations are required to apply to the regulator for an installation permit. A permit must be issued by the regulator before the permit holder operates the installation. Environmental permit applications require different information depending on the type of activity applied for. For example, a new Part A(1) installation permit application requires BAT demonstration, a detailed environmental risk assessment (which may include air dispersion modelling), a site condition report (for the land occupied by the installation), a noise and vibration impact assessment, emissions monitoring plans, management system implementation evidence, site plans (process flow, drainage plan, site location, site layout, emission points), an energy efficiency plan, and a climate change assessment.

Best Available Techniques

Operation of an EPR16 installation requires the permit holder to ensure activities are operated in accordance with BAT. BAT referred to in this chapter is derived from EC BREF and is related to non-radioactive activities. Description of BAT associated with radioactive substances and radioactive waste is documented in NEDC-34223P, PER Ch. E6 (Reference 10-4).

BREF documents cover a host of different process industry sectors as well as ‘horizontal BREFs' dealing with cross-cutting issues, such as energy efficiency, industrial cooling systems, or emissions from storage with relevance for industrial manufacturing in general. For permitted installations, BAT demonstration is necessary during the permit application process but also throughout the life of the installation site when being assessed for compliance by the regulator.

BREF documents are published periodically by the EC. Where new emerging techniques are proposed by an operator of an installation that are not described in BREF, the regulator gives special consideration to the criteria listed in Annex III of 2010/75/EU, IED (Reference 10-32) to determine if a technique is BAT. This includes:

- The use of low-waste technology
- The use of less hazardous substances
- The furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate.

- Comparable processes, facilities or methods of operation which have been tried with success on an industrial scale.
- Technological advances and changes in scientific knowledge and understanding.
- The nature, effects and volume of the emissions concerned.
- The commissioning dates for new or existing installations.
- The length of time needed to introduce the best available technique.
- The consumption and nature of raw materials (including water) used in the process and energy efficiency.
- The need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it.
- The need to prevent accidents and to minimise the consequences for the environment.
- Information published by public international organisations.

A specific BREF document is developed for the monitoring of emissions to air and water from installations under the IED (referred to as the 'ROM'). However, the ROM does not apply to EPR16 Installation activities that are not derived from the IED (for example, the EPR16 Part B combustion installation activity covered in Schedule 1 Part II Section 1.1 Part B(a)). Demonstration that BAT has been met for non-IED installation activities can be achieved using environmental regulators, or Department for Environment, Farming and Rural Affairs (DEFRA), guidance documents specific to a sector or process. For example, for a Part B cement use installation activity, BAT demonstration would be against DEFRA's Process Guidance Note 3/01(12) "Statutory guidance for blending, packing, loading, unloading, and use of cement," (Reference 10-37).

For installations with multiple installation activities covering different sectors, demonstration of meeting BAT often requires consideration of many BREF documents in addition to demonstration of emerging techniques against IED Annex III criteria and also environmental regulators or DEFRA guidance.

Greenhouse Gas Emissions

For combustion installations with an aggregated net rated thermal input over $20MW_{th,}$ a Greenhouse Gas Emissions (GHGE) permit is required under "The Greenhouse Gas Emissions Trading Scheme Regulations 2012," (Reference 10-38). In England and Wales, the GHGE permit is regulated through the UK Emissions Trading Scheme (ETS) which replaced the UK's participation in the European Union (EU) ETS. GHGE permits are regulated by the environmental regulators.

The UK ETS is established through "The Greenhouse Gas Emissions Trading Scheme Order 2020," (Reference 10-39). GHGE permits have conditions that require permit holders to:

- Ensure records of engine running and fuel use are kept.
- Monitor reportable emissions.
- Report verified reportable emissions.
- Surrender allowances equal to reportable emissions.
- Notify the regulator of various changes.

As required in installation permits, establishing a robust management system to achieve compliance with GHGE requirements is necessary to ensure records of engine running and fuel use are kept and reported to the regulators. As with installation permits, a GHGE permit is required before the combustion plant starts operating.

10.4.2 BWRX-300 Combustion Appliances

This sub-section describes the combustion appliances used for different purposes that are part of the BWRX-300 design.

Standby Diesel Generators

Two SDGs are to be operated in order to maintain safe and continuous operation in the event of a loss of offsite power. Each SDG, labelled SDG A and SDG B, supports a different power bus and both are located in different rooms within the TB. SDG A and SDG B each have a 3.25 MW_e electrical power rating. SDG emission concentrations are listed in Table 10-7.

BWRX-300 backup power plant design can demonstrate applying sustainability principles through minimising fossil fuel use. The use of onsite battery power and battery chargers minimises use of the SDGs.

Potential DAAs for BWRX-300 combustion plant include diesel fuel storage and handling, combustion-related waste storage and handling and drainage associated with combustion liquids.

The SDGs are commercially available, self-contained skid mounted power packages. The Diesel Fuel Oil Storage and Transfer Subsystem is a separate equipment and piping system used to supply diesel fuel to the SDGs. The subsystem provides storage and transfer of diesel fuel oil to the SDG day tanks. It is comprised of one Diesel Fuel Oil Storage Tank, two fully redundant Diesel Fuel Oil Transfer Pumps, and associated piping, valves, and instrumentation. The fuel oil transfer pumps are powered from the Standby Power System to ensure diesel availability. To prevent freezing, the Diesel Fuel Oil Storage Tank is equipped with an immersion heater and a recirculation line from the transfer pumps. A piping tie-in is provided to the tank for Diverse and Flexible Coping Strategies/Emergency Mitigation Equipment (FLEX/EME) connections, in accordance with 006N7797 (Reference 10-18).

The Diesel Fuel Oil Storage Tank is double-walled or provided with a containment berm capable of holding the contents of the tank if a leak develops. The offloading area is bermed to contain the contents of the transport truck if leakage occurs. The bermed area(s) contain(s) a sump pit which can be pumped out following sampling. Provisions are made for sampling of the bermed area(s) for residual oil. The pumps transfer fuel oil underground from the Diesel Fuel Oil Storage Tank to the SDG day tanks located in the diesel generator rooms and provide recirculation as appropriate. Underground fuel oil lines are designed to allow for leak detection. The Fuel Oil Storage Tank and Transfer Pumps are located outside of the RCA. This allows fuel deliveries without needing to enter the protected area. Additionally, this increases the distance between a potential external combustible source and the plant. These measures are described in 006N7797 (Reference 10-18).

SDG A and SDG B exhaust systems have separate exhausts for radiator heat removal and combustion air removal, as stated in 006N7781, "BWRX-300 Heating Ventilation and Cooling System Design Description," (Reference 10-40). The exhaust for combustion air is routed to a safe discharge location. The elevation above finished grade of the release point for SDG exhaust releases is 32 m. The exhaust stacks will be above the top of the TB. Standby diesel exhaust releases SDG emission concentrations listed in Table 10-7 are based on engines running four hours per month with a fuel sulphur content of 50 ppm.

Figure 10-2 shows diesel fuel transfer to SDG A, SDG B, and a security diesel day tank. Information on the security diesel generator design and potential DAA specification is not yet at a detailed design stage. The figure also illustrates the fuel transfer, process controls and containment infrastructure to minimise risk of pollution.

FLEX/EME Generators

BWRX-300 combustion appliances also include FLEX/EME generators providing power in extended loss of power events. Portable FLEX/EME generators can be connected to external RB connection points to supply power to one battery charger in each division. A transfer switch allows either battery charger in each division to be aligned to the FLEX/EME source. The external connections not only provide for connection of EME during emergencies but can also be used to support system maintenance and testing if necessary.

Information on these generators and potential DAA specification is not yet at a detailed design stage.

Diesel-Driven Fire Pump

A diesel-driven fire pump provides firewater in the event of failure of an electrically driven fire pump or Loss-of-Preferred Power as required. The fuel oil day tank for a diesel-driven fire pump is designed in accordance with National Fire Protection Association (NFPA) 20, “Standard for the Installation of Stationary Pumps for Fire Protection,” (Reference 10-41). Information on the fire suppression system diesel driven firewater pump and potential DAA specification is not yet at a detailed design stage. Section 10.4.3 provides details of additional information required to complete this assessment.

The estimated effects of emissions discharged from all combustion sources cannot currently be evaluated using the environmental regulators’ “H1 Risk Assessment Tool,” (Reference 10-43) to provide a meaningful assessment of environmental risk associated with the BWRX-300 combustion plant. Additional design information will be required to input into the tool. This includes:

- All combustion appliances net rated thermal input
- Planned hours of operation for all appliances
- All appliances’ exhaust stack design (e.g. whether shared stacks or not)
- Effective stack heights

Table 10-7 provides emission concentrations for SDGs. Section 10.4.3 provides details of further assessment required to address this topic fully.

Table 10-6 lists all the combustion appliances identified in the BWRX-300 SMR generic design.

*Rated thermal input calculated in accordance with Equation 7 in Appendix B of WG5A001 20180807, “Determination of the thermal input power of an engine driven generator,” (Reference 10-44). Electrical power based on 3.25 MW_e.

At this current stage of GDA, whilst the EPR16 Installation Applicability Assessment for the combustion plant cannot be completed, an estimate can be made based on the approximate generic plant size and energy demands of the plant. The estimated net rated thermal input of the plant’s largest combustion appliances (SDG A and SDG B) places the combustion appliances below the >50 MW_{th} EPR16 Installation Part A(1) large combustion plant description threshold described in Schedule 1 Part II Section 1.1 Part A(1)(a) of EPR16 (Reference 10-21).

There is high confidence that the aggregated net rated thermal input of all combustion plants in the BWRX-300 design will not exceed 50 MW_{th}. Subsequently, Chapter III of 2010/75/EU, IED (Reference 10-32) large combustion plant controls would not apply. This chapter does not include a comparison of combustion technology against relevant guidance.

Estimated net rated thermal input of the SDG appliances is just below the EPR16 Part B Installation combustion plant description (described in Schedule 1 Part II Section 1.1

Part B(a)). There is a high likelihood that the aggregated net rated thermal input of all combustion plant in the BWRX-300 design will exceed 20 MW_{th} and require an EPR Part B Installation permit.

When considering if mobile combustion plant are considered part of the STU and require inclusion in an installation permit, regulatory guidance appraisal is necessary. EC guidance describes how emergency and backup electricity generators may be installed in movable containers but can't be removed from the installation for safety reasons. Such units are considered "stationary" too. Mobile units that are movable but remain stationary during production, e.g. free-range poultry units, may be regarded as STUs, as described in "Guidance on Interpretation of Annex I of the EU ETS Directive (excl. aviation activities)," (Reference 10-45).

Table 10-6 illustrates gaps in design specification at this stage that do not allow an assessment to ascertain whether EPR16 Installation permitting requirements apply for combustion plant forming part of the BWRX-300 design. Section 10.4.5.1 provides details of additional information required to complete this assessment.

Section 10.5 assesses Medium Combustion Plant (MCP) and Specified Generator (SG) applicability for BWRX-300 combustion plant described in this section.

Waste Management

The BWRX-300 design waste strategy is to prevent waste production in all phases in the life of the plant or, where that is not practicable, minimise waste production and apply waste hierarchy principles.

The range of conventional wastes expected to be produced are documented in NEDC-34228P, "BWRX-300 UK GDA Integrated Waste Strategy," (Reference 10-7). It also identifies a variety of waste management techniques that may be undertaken for different conventional waste types produced at different phases in the life of the plant to achieve waste strategy objectives.

For conventional waste management treatment techniques to be applied, compliance with EPR16 and holding the required EPR16 authorisations/consents will be necessary. This may also include the requirement for a hazardous waste installation permit.

EPR16 listed hazardous waste treatments (specified in EPR16 – Schedule 1 Part 2 Section 5.3 Part A(1)(a)), considered for this assessment are for non-radioactive hazardous wastes only. Repackaging of hazardous waste and physico-chemical treatment of hazardous waste activities have been identified in the generic design during the commissioning and operation and decommissioning phases in the life of the plant.

Repackaging of hazardous waste is further described by the environmental regulators in Regulatory Guidance Series No. RGN 2, "Understanding the meaning of regulated facility," (Reference 10-46), as '*bulking up from one container to another e.g. drum to tank, drum to Intermediate Bulk Container*'.

Physico-chemical waste treatment definition is further described by the environmental regulators in Sector Guidance Note S5.06, "Guidance for the Recovery and Disposal of Hazardous and Non Hazardous Waste," (Reference 10-47) as '*which results in final compounds or mixtures which are discarded by means of any of the operations numbered D1 to D12 in that Annex (for example, evaporation, drying, calcination, etc.) (D9)'.*

10.4.3 Further Assessments

This sub-section describes further assessments needed for EPR16 Combustion Installations, all of which are encompassed by FAP.PER10-228. Appendix A details the stages in which the further assessments identified in this sub-section are to be completed.

Combustion Assessments

To determine EPR16 Installation permitting applicability and technology comparison against BAT requirements, additional assessments are required. This can be achieved upon completion of more detailed design of processes, allowing more combustion technology information being made available to assess.

For combustion activities, an important future assessment to be completed is establishing net rated thermal input (in MW_{th}) for all combustion appliances for the BWRX-300 site. This will allow identification of combustion appliances that do not meet EPR16 Installation definitions and therefore not subject to aggregation rules with other appliances or BAT requirements. However, in the unlikely event that combustion appliances are determined to fall below EPR16 Part B permitting threshold, they may still be subject to MCP and/or SG requirements.

An assessment into operational hours and equipment design parameters for combustion appliances is also necessary, in particular the Fire Protection System (FPS) Diesel Driven Firewater Pump, and FLEX/EME generators. This would further support an assessment into EPR16 Part B permitting applicability/out of scope criteria assessment.

Comparison with proposed technology (that is not subject to site-specific design) can also be made against the relevant EPR16 Part B guidance. This can include:

- Comparison of Emission Limit Values (ELVs) against estimated exhaust emissions based on appliance size.
- Completing a generic air quality screening assessment for all combustion plant.
- Providing details of all combustion unit fuel specification, principles for emissions monitoring, and recording hours of operation.

For aspects of combustion technology at the level of detail that will only be available at a site-specific design stage, comparison with guidance will include:

- Detailed air quality assessment based on all stack heights, stack design, stack locations, and individual combustion appliance emission process contributions.
- Providing details of all appliances' operating hours (for different phases in the life of the plant).
- Providing details of proximity to sensitive receptors.

Having a high confidence level that the aggregated net rated thermal input of all combustion plants is found to be greater than 20 MW_{th}, GHGE permitting requirements and descriptions of how greenhouse gas emissions will be monitored can be further assessed.

10.5 Medium Combustion Plant and Specified Generators

Section 10.4.2 of this report describes combustion plant as part of the BWRX-300 generic design, in addition to other combustion plant that are not currently within the scope of this GDA assessment. Combustion plant previously described will also be assessed for applicability of 2015/2193, "Directive (EU) 2015/2193 of the European Parliament and of the Council of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants," (Reference 10-48), known as the Medium Combustion Plant Directive (MCPD), and "The Environmental Permitting (England & Wales) (Amendment) Regulations 2018," (EPR18) (Reference 10-49).

10.5.1 Regulatory Context

Medium Combustion Plant

The MCPD was introduced in December 2015. In England and Wales, MCPD was implemented through Schedule 25A of EPR18 (Reference 10-49).

The MCPD sets regulatory controls on MCP designed to limit environmental impact associated with emissions from MCP. The MCPD Article 2(1) defines 'medium combustion plant' as a combustion plant with a rated thermal input equal to or greater than 1 MW but less than 50 MW. The directive lists in Article 2 3(a)-(p) and 4 that combustion plant that is not within the scope of the directive is considered excluded. This includes for example, MCP for research and development purposes and combustion used for direct heating. Static MCP used on nuclear facilities are not out of scope (excluded) in the MCPD. MCPD controls do not apply to mobile MCP placed on the market after 1 January 2017 in EPR18 (Reference 10-49) as they are covered by "The Non-Road Mobile Machinery (Type-Approval and Emission of Gaseous and Particulate Pollutants) Regulations 2018," (as amended) (NRMM18) (Reference 10-50). MCP regulations apply if forming an installation, such as those described in Section 10.5.2 of this chapter. Some MCP can be described as both MCP and SG; the regulations requiring the stricter controls will apply.

Environmental regulators' guidance – "Medium combustion plant and specified generators: environmental permits," (Reference 10-51) – describes how in-scope, new MCP are required to hold an environmental permit through the regulator to operate the plant. Existing MCP (i.e. operating prior to 20 December 2018, according to EPR18 (Reference 10-49)) have stipulated deadlines, dependent on net rated thermal input capacity ranges between 2024 and 2029, to hold permits. MCP environmental permits cover combustion processes only. Associated MCP infrastructure, such as fuel storage, waste handling, and surface water drainage, are not included in MCP permits. The permits are stand-alone unless the MCP at a site are part of an Installation, and permitting rules only allow new MCPs to be aggregated into one MCP permit.

MCP controls, where applicable, would be consolidated into installation permits. However, a combustion plant that is considered an excluded MCP can still be regulated as an EPR16 Installation (and subject to BAT) if the aggregated net rated thermal input of all combustion plant at a site exceeds 20 MW_{th}.

MCP controls in permits include the requirement to operate plant below listed air ELVs. For new MCP operating more than 500 hours per year (rolling 3-year average) using diesel fuel, ELVs are listed in Table 10-7, alongside SDG design emissions:

Other MCP permit requirements include:

- Operating in accordance with a management system that identifies and minimises risk of pollution.
- Operating plant in the manner and techniques stipulated in the permit.
- Maintaining records demonstrating permit compliance.

- Monitoring emissions from MCP to air.
- Recording hours of operation, type and quantities of fuel used, malfunctions, or breakdowns.
- Maintaining monitoring infrastructure in accordance with regulatory guidance.
- Reporting monitoring data, non-compliances, incidents, and corrective measures to the regulator.
- Notifying (and varying the permit if necessary) of changes to the combustion plant which could affect the applicable permitted ELVs and listed activities.

Specified Generators

EPR16 Schedule 25B sets regulatory controls on SGs designed to limit environmental impact associated with emissions from SG plant. The regulations (EPR16 (Reference 10-21)) define 'specified generators' as a generator, other than an excluded generator, with a rated thermal input of 1 MW but less than 50 MW.

Environmental regulators' guidance – "Specified generator: when you need a permit," (Reference 10-52) – provides the following explanatory description; 'where two or more generators are operated on a site, other than excluded generators, together have a rated thermal input more than or equal to 1 MW and less than 50 MW, even if one or more of the generators has a rated thermal input of less than 1 MW, those generators together are specified generators'.

Schedule 25B Regulation 2(2) of EPR16 (Reference 10-21) defines what an 'excluded generator' means. Excluded generators are not within the scope of SG controls but can potentially still be described as MCP. Excluded generators are described as:

- Generators subject to the provisions of Chapter II or Chapter III of 2010/75/EU, IED (Reference 10-32).
- Generators operating with a defined nuclear safety role under a nuclear site license issued by the Office for Nuclear Regulation (ONR).
- Back-up generators operated for the purpose of testing for no more than 50 hours per year.
- Generators installed on an offshore platform situated on, above, or below those parts of the sea adjacent to England and Wales from the low water mark to the seaward baseline of the UK territorial sea.
- Generators installed on a gas storage or unloading platform as defined in Regulation 2 of "The Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013," (Reference 10-53).

SG regulations also apply to SG forming an installation. As noted above, where SG can potentially be described as both MCP and SG, the regulations with stricter controls apply, according to EPR18 (Reference 10-49).

New SG are classed by the regulator as Tranche B Generators and are required to hold an environmental permit through Competent Authority (CA) to operate the plant. Tranche B Generators (i.e. operating after 1 December 2016) must hold permits before operation. Tranche A Generators (existing plant, operating before 1 December 2016) have stipulated permitting deadlines (between 2025 and 2030) based on net rated thermal input and emissions, in accordance with SG regulatory guidance (Reference 10-52).

SG environmental permits cover combustion processes only. Associated SG infrastructure, such as fuel storage, waste handling, and surface water drainage, are not included in SG permits. The permits are stand-alone unless the SGs at a site are part of an EPR16 Installation (as described in Section 10.4.1).

Environmental regulators' SG permitting rules, as discussed in the SG regulatory guidance (Reference 10-52), allow aggregation of both Tranche A and B generators to form one MCP permit.

SG controls, where applicable, would be consolidated into installation permits. However, combustion plant that is considered as excluded SG can still be regulated as installations (and subject to BAT) if the aggregated net rated thermal input of all combustion plant exceeds 20 MW_{th}.

SG controls in permits include the requirement to operate plant below listed air ELVs. Schedule 25B of EPR16 (Reference 10-21), for Tranche B SGs operating more than 50 hours per year, lists the ELV as 190 mg/Nm^3 for NO_x (within 10 minutes of operation where secondary abatement is required). Where compliance with air quality aspects of an environmental quality standard requires stricter conditions for the operation of a SG, the regulator may include additional or stricter measures in the permit to comply with those standards, including (if necessary) a stricter ELV.

Other SG permit requirements include:

- Operating in accordance with a management system that identifies and minimises risk of pollution.
- Operating plant in the manner and techniques stipulated in the permit.
- Maintaining records demonstrating permit compliance.
- Monitoring emissions from SG to air.
- Recording hours of operation, type and quantities of fuel used, malfunctions, or breakdowns.
- Maintaining monitoring infrastructure in accordance with regulatory guidance.
- Reporting monitoring data, non-compliances, incidents, and corrective measures to the regulator.
- Notifying of (and varying the permit if necessary) changes to the combustion plant which could affect the applicable permitted ELVs and listed activities.

10.5.2 BWRX-300 Medium Combustion Plant

Table 10-8 illustrates the current stage of assessment for MCP applicability or out of scope/exclusion criteria for all BWRX-300 combustion plant.

Non-mobile combustion plant with a net rated thermal input of over 1 MW_{th} meet the MCPD definition of an MCP. Both SDGs currently meet the definition of MCP and would be required to hold an MCP environmental permit. Other BWRX-300 non-mobile combustion plant listed in Table 10-8 could also potentially be considered MCP and be aggregated under the same MCP permit as SDG A and SDG B.

Table 10-7 SDG Emission concentrations show NO_x emissions exceeding the 190 mg/Nm^3 concentration MCPD ELV. Emission concentration calculations for SDG's and all other combustion appliances will require detailed assessment based on actual power ratings.

NFPA 20 (Reference 10-41) compliant emergency diesel driven firewater pump and security diesel generator could both potentially be considered MCP, although this is dependent on the appliances' net rated thermal input needing to be over 1 MW_{th}.

The FLEX/EME generators are described in Section 10.4.2 as portable power sources providing for connection of EME equipment during emergencies, but they can also be used to support system maintenance and testing if necessary.

Whilst the thermal input of these appliances is not yet defined, the FLEX/EME generators may not necessarily be considered MCP requiring a permit because of being non-road mobile machinery under NRMM18 (Reference 10-50). However, the units could still fall under MCPD controls if they are used on site as existing plant, being first placed on the market (for distribution or use) before 1 January 2017 and with an engine above 560 kW drive output, as described in "Medium combustion plant and specified generators: environmental permits" (Reference 10-51).

Currently the level of design maturity does not allow for a detailed assessment to determine EPR16 MCP permit requirement applicability associated with all combustion appliances. Design maturity does not allow for an assessment of the MCP technology against relevant MCPD and guidance.

Should MCPD compliance demonstration be required in future, for example as part of an MCP permit application, potential MCP in the BWRX-300 design is expected to support meeting relevant MCPD controls. Section 10.5.4 provides details of further assessment required to address this topic fully.

10.5.3 BWRX-300 Specified Generators

Currently the level of design maturity does not allow for a detailed assessment to determine EPR16 SG permit requirement applicability associated with all combustion appliances. Design maturity does not allow for an assessment of the SG technology against relevant EPR18 (Reference 10-49) and SG regulatory guidance (Reference 10-52).

Both MCP and SG regulations may potentially apply for the security diesel generator. Should MCPD and SG compliance demonstration be required in future, for example as part of a permit application, the security diesel generator is expected to support meeting the requirements with the stricter emission limits of SG or MCP and obtain a permit by the earliest date set in the regulations. The BWRX-300 likely site locations are in rural coastal sites instead of urban areas with high background of NO_2. Section 10.5.4 provides details of further assessment required to address this topic fully.

Excluded Generators

SDG A and SDG B are categorised with a defined Safety Class 3 function. The SDGs provide backup power for systems including the BIS, CWE, CWS and PCW, among others. Further information is provided in NEDC-34221P, PER Ch. E4 (Reference 10-3).

The SDGs may potentially be considered 'excluded generators' from SG requirements on the basis of meeting nuclear safety role criteria as discussed in SG regulatory guidance (Reference 10-52). This, however, would be subject to regulatory agreement during the nuclear licensing stage.

In Section 10.4.2, FLEX/EME generators are described as portable power sources providing for connection of EME during emergencies, but can also be used to support system maintenance and testing if necessary. The generators may be considered 'excluded generators' from SG requirements on the basis of meeting SG regulatory guidance (Reference 10-52) on mobile generators exclusion criteria and, dependent on testing/maintenance activities, emergency backup generator exclusion criteria.

Table 10-9 illustrates the current stage of assessment in ascertaining if BWRX-300 combustion plant are considered to meet SG exclusion criteria or EPR18 (Reference 10-49) permitting applies.

10.5.4 Further Assessment

MCP and SG permitting applicability, in addition to comparison of proposed technology against the relevant SG and MCP guidance, requires further assessment. This can be achieved upon completion of more detailed design work of combustion appliances, where more technology information is available to assess.

An important future assessment to be completed is establishing net rated thermal input (in MW_{th}) for all combustion appliances at the BWRX-300 site. This will allow identification of combustion appliances that do not meet SG or MCP definitions and therefore are not subject to aggregation rules with other appliances or MCP/SG permitting requirements. However, excluded combustion appliances may still be subject to EPR16 Part B Installation permitting requirements. This is described in Section 10.4.1.

An assessment into operational hours and equipment design parameters for combustion appliances is necessary, in particular the emergency diesel driven firewater pump. This would further support an assessment into MCP and SG applicability/out of scope criteria assessment.

Comparison with proposed technology (that is not subject to site specific design) can be made against the relevant SG and MCP guidance. This can include:

- Comparison of ELVs against estimated exhaust emissions based on appliance size.
- Completing a generic air quality screening assessment for all combustion plant.
- Providing details of all combustion unit fuel specification, principles for emissions monitoring, and recording hours of operation.

For aspects of combustion technology at the level of detail that will only be available at a site-specific design stage, comparison with guidance will include:

- Detailed air quality assessment based on all stack heights, stack design, stack locations, and individual combustion appliance emission process contributions.
- Providing details of all appliances' operating hours (for different phases in the life of the plant).
- Providing details of proximity to sensitive receptors.

Appendix A details the stages in which further assessments identified in this section are to be completed. These forward actions are captured under FAP.PER10-228.

10.6 The Control of Major Accident Hazards Regulations 2015

The BWRX-300 SMR generic design includes the storage of known dangerous substances and hazardous substances. Therefore, consideration of both "The Control of Major Accident Hazards Regulations 2015," (COMAH15) (Reference 10-54) and the Planning (Hazardous Substances) Regulations 2015 (HSC15) applicability is necessary.

10.6.1 Regulatory Context

COMAH15 (Reference 10-54) is applied in the UK to prevent major accidents involving dangerous substances and limit the consequences to people and the environment of any accidents which do occur. This includes prevention of a Major Accident to the Environment (MATTE). COMAH15 (Reference 10-54) implements the majority of 2012/18/EU, "Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC," (Reference 10-55), known as the Seveso III Directive. COMAH15 (Reference 10-54) applies to establishments that store, produce, or use quantities of named, or categories of, dangerous substances above specified qualifying thresholds. COMAH15 dangerous substances predominantly have two separate tonnage threshold quantities for each substance or hazard category. The thresholds are categorised as lower tonnage thresholds for lower tier COMAH15 establishments and a higher tonnage threshold for upper tier COMAH15 establishments. Qualifying COMAH15 establishments, falling in either the upper or lower tier, have legal duties placed on them. This includes a COMAH15 establishment operator complying with the regulations and being required to take all measures necessary to prevent major accidents and limit their consequences for human health and the environment. COMAH15 compliance also requires demonstrating application of 'as low as reasonably practicable.' The COMAH15 CA is responsible for inspecting COMAH15 establishment's regulatory compliance. The CAs for a nuclear site are the environmental regulators and ONR.

All qualifying COMAH15 establishments are required to submit a notification to the CA of the upper or lower tier COMAH15 establishment. Operators of COMAH15 establishments must also provide information about the site to the CA and share it with the public. All COMAH15 establishment operators are required to maintain a major accident prevention policy describing the measures taken at the site or proposed to be taken to limit the consequences of a major accident. This should be implemented through a safety management system. Operators of COMAH15 upper tier establishments have additional duties including producing safety reports and preparing internal emergency plans.

Closely connected to COMAH15 (Reference 10-54) are "The Planning (Hazardous Substances) Regulations 2015," (Reference 10-56) and "The Planning (Hazardous Substances) (Wales) Regulations 2015," (as amended) (Reference 10-57), collectively referred to as HSC15. These regulations require planning consent for the presence of relevant hazardous substances at a site above specified qualifying thresholds. Consent is determined by the hazardous substances authority. Applications for hazardous substances consent require the submission of site information to the regulator including the measures taken or proposed to be taken to limit the consequences of a major accident.

As with COMAH15 (Reference 10-54), in the assessment of HSC15 applicability for the BWRX-300 SMR, consideration is given to hazardous substances, as defined by "The Classification, Labelling and Packaging of Chemicals (Amendments to Secondary Legislation) Regulations 2015," (CLP15) (Reference 10-58), present, likely to be present at any one time, and generated in a major accident at an establishment.

HSC15 and COMAH15 lower tier qualifying thresholds are largely the same. However, for some substances such as hydrogen, the two sets of regulations differ in qualifying thresholds.

The qualifying tonnage of hydrogen in HSC15 is 2 tons, whereas for COMAH15 the lower tier threshold is 5 tons.

Like COMAH15 (Reference 10-54), rules on HSC15 aggregation, storage, mixtures, unclassified substances (e.g. waste), and inventory changes also apply in determining HSC15 applicability. Hazardous substances consent is not required for the presence of hazardous substances which create a hazard from ionising radiation if present on a nuclear establishment.

10.6.2 COMAH15 and HSC15 Applicability Assessment

In the assessment of COMAH15 (Reference 10-54) applicability for the BWRX-300 SMR, consideration is given to dangerous substances present, likely to be present at any one time, and generated in a major accident at an establishment. COMAH15 also has rules on named dangerous substances and/or category quantity aggregation when assessing thresholds.

In consideration of COMAH15 (Reference 10-54) and HSC15 applicability to the BWRX-300 SMR design, dangerous substances assessment at the SMR site includes both mixed and pure substances, as classified in accordance with the CLP15 (Reference 10-58).

Non-classified substances, such as wastes with major accident potential, are also considered for COMAH15 (Reference 10-54). This is described in the Health and Safety Executive guidance document L111, "The Control of Major Accident Hazards Regulations 2015," (Reference 10-59). However, pertinent to the BWRX-300 SMR, COMAH15 and HSC15 do not apply to substances and wastes which create a hazard from ionising radiation present on nuclear establishments.

Table 10-10 lists potential dangerous substances included in COMAH15 (Reference 10-54) and HSC15 applicability assessment.

Table 10-10 illustrates that the maximum quantities of dangerous and hazardous substances that will be stored, consumed, or produced are not completely identified at this current stage of the design.

Whilst known dangerous substance inventory volumes indicate that individual substance/classification thresholds are not exceeded, COMAH15 (Reference 10-54) and HSC15 applicability cannot be ruled out completely. Examples of other potential substances associated with the BWRX-300 SMR requiring further assessment when design maturity allows include diesel/gasoline contaminated firewater, laboratory testing chemicals, batteries, discarded laboratory testing chemicals, and oily wastes.

10.6.3 Further Assessment

Further assessment is needed in order to determine whether the BWRX-300 SMR design is likely to be a COMAH15 and HSC15 establishment, and whether it would be COMAH15 lower or upper tier. This will include:

- Assessment of BWRX-300 SMR chemical inventory Safety Data Sheet (SDS).
- Assessment of maximum design storage capacities.
- Classifying unclassified chemical inventory in accordance with CLP15 (Reference 10-58) – substances will be provisionally assigned to the most analogous category or named dangerous substance falling within scope of COMAH15 (Reference 10-54).
- Classifying wastes capable of causing a major accident – substances will be considered in accordance with classification information in CLP15 (Reference 10-58) and assigned to most appropriate category.

- Plant design changes in maximum design storage capacities and layout of COMAH15 substances.
- Subsequent assessment of COMAH15 rules in determining applicability for substances identified.

COMAH15 applicability at a BWRX-300 SMR site may change depending on the dangerous substance inventory at specific stages in the site's lifecycle, such as during decommissioning or during major upgrade works.

Whilst outside the scope of this GDA, consideration of site-specific factors will need more detailed consideration, such as how many SMR units are at one location or if a site is already an existing COMAH15 establishment.

If subsequent applicability assessments identify that the BWRX-300 SMR design may be subject to COMAH15 regulatory requirements, detailed description will also be provided of the measures incorporated in the design to prevent a MATTE. This includes environmental risk assessment, which is based upon Chemical and Downstream Oil Industries Forum (CDOIF) Guideline "Environmental Risk Tolerability for COMAH Establishments," (Reference 10-60).

Appendix A details the stages in which further assessments identified in this section are to be completed. These actions are captured as FAP.PER10-229.

10.6.4 MATTE Prevention

Operators of COMAH15 establishments are required to take all measures necessary to prevent a MATTE and limit the consequences to the environment of any accidents which do occur. At this stage in the design, it is not possible to provide a detailed assessment of measures taken in the design to prevent a MATTE. Significantly, ascertaining if a MATTE can potentially occur has not yet been established.

The following points provide a summary overview of design outcomes that prevent or, where not practicable, mitigate conventional pollution risk from the BWRX-300 SMR:

1. Source

   Storage of substances with the potential for conventional environmental impact are designed to limit the risk of conventional environmental impact. Design mitigation includes the following process safety loss prevention approaches:

   - Preventing, where possible, polluting substance inventories held or produced at the site in quantities of upper tier COMAH15.
   - Where prevention is not practicable, minimising polluting substance inventories held or produced at the site.
   - Locating polluting inventories on site to limit risk – considering proximity from pollution pathways, sensitive receptors, and accident initiators.
   - Suitability of containment and transfer systems design for the polluting substances stored.
   - Polluting substance use control – through use of best practice control and measurement instrumentation.
   - Polluting substance operational use – through use of best practice.
   - Secondary and tertiary containment – the diesel fuel storage tank is illustrated in Figure 10-2. The tank will be double walled or provided with a containment berm capable of holding the contents of the tank if a leak develops. The

offloading area is bermed to catch the contents of the transport truck if leakage occurs. Underground fuel oil lines are designed to allow for leak detection.

- Consideration of accident risk from external factors such as security, seismic risk, and extreme weather (e.g. flooding events, drought, storms).

2. Pathway

The BWRX-300 SMR is designed to prevent or reduce source-pathway linkages to reduce environmental impact risk. Design mitigation includes the following process safety loss prevention aspects:

- Implementing an aqueous zero discharge philosophy, which processes potentially polluting wastewater in such a way that minimises release frequency of wastewater into local water bodies of water. Treated wastewater does not present a MATTE risk.
- Sealed system design, where practicable, ensures re-use and recovery principles are applied.
- Where infrequent releases are made to the environment, robust discharge controls are designed.
- Drainage philosophy is designed to segregate potential polluting substances from surface water.
- Abatement technologies are applied to limit environmental impact from releases.

3. Receptor

BWRX-300 SMR site design considers proximity, tolerability, and sensitivity to potential conventional environmental impact from the plant. Design mitigation includes (but is not limited to) the following measures:

- Point source releases to air designed to minimise short-term and long-term exposure risk to receptors.
- Drainage philosophy is designed to segregate potential polluting substances from foul sewer discharges.
- Internal emergency plans including FLEX equipment and spill response.
- Impermeable surfacing to prevent releases to groundwater.
- Cooling water abstraction and discharge wildlife protection.

10.7 Fluorinated Greenhouse Gases and Ozone Depleting Substances

The BWRX-300 SMR generic design includes equipment that may contain fluorinated greenhouse gases and ozone-depleting substances. Therefore, consideration of regulatory applicability and requirements is necessary.

10.7.1 Regulatory Context

"The Fluorinated Greenhouse Gases (F gas) Regulations 2015," (as amended) (Reference 10-61) and "The Ozone-Depleting Substances (ODS) Regulations 2015," (Reference 10-62) are applied in the UK implementing 517/2014, "Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006," (Reference 10-63) and No 1005/2009, "Regulation (EC) No 1005/2009 of the European Parliament and of the Council of 16 September 2009 on substances that deplete the ozone layer," (Reference 10-64).

The F gas regulations are implemented to reduce and, as far as possible, prevent fluorinated gas emissions. The ODS regulations are implemented to control use of ozone-depleting substances in new equipment or when servicing existing equipment to protect the ozone layer and limit climate change.

The EC updated both regulations to 2024/573, "Regulation (EU) 2024/573 of the European Parliament and of the Council of 7 February 2024 on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014," (Reference 10-65) and 2024/590, "Regulation (EU) 2024/590 of the European Parliament and of the Council of 7 February 2024 on substances that deplete the ozone layer, and repealing Regulation (EC) No 1005/2009," (Reference 10-66) with the intention to:

- Deliver higher ambition, e.g. through a tighter quota system for Hydrofluorocarbons (HFCs) and HFC phase-down.
- Ensure compliance with the Montreal Protocol, e.g. making phase-down steps also after 2030 and ending certain exemptions to the EU's HFC phase-down that do not exist under the Montreal Protocol.
- Improve enforcement and implementation, e.g. by making it easier for customs and surveillance authorities to control imports and exports. A quota price will be introduced, and penalties will become harsher and more homogenous across the EU.
- Achieve more comprehensive monitoring, e.g. by covering a broader range of substances and activities and improving the procedures for reporting and verifying data.

The UK subsequently amended the F gas regulations (Reference 10-61) through "The Fluorinated Greenhouse Gases (Amendment) Regulations 2023," (Reference 10-67) but only to correct a technical error in Article 16(3) of 517/2014 (Reference 10-63). The correction ensures annual quotas which limit the quantity of hydrofluorocarbons (HFCs) which can be placed on the market in Great Britain each year by producers and importers are calculated as intended. UK regulations in England and Wales have not been changed to follow EC 2024 changes. F gas and ODS regulation changes will require review as the BWRX-300 generic design develops.

Currently users of F Gas and ODS equipment are required to:

- Ensure users have qualifications and company certification to work with F gas.
- Check certain F gas and ODS equipment for leaks.
- Record F gas in certain equipment.
- Recover, reclaim, or recycle F gas and ODS.

- Follow rules for operating and servicing high voltage switchgear containing sulphur hexafluoride (SF_6).

The use of certain F gases, in particular those with high Global Warming Potential (GWP) is banned. For example, HFCs in stationary refrigeration equipment with a GWP above 2500 (e.g. R-404A with a GWP of 3922).

10.7.2 F Gas and ODS Equipment

NEDC-34170P, "BWRX-300 UK GDA Preliminary Safety Report Ch. 8: Electrical," (Reference 10-8) describes the BWRX-300 switchyard design being as an indoor Gas Insulated Switchgear (GIS) type.

GIS consists of metal-enclosed compartments that house circuit breakers, disconnectors, bus bars, transformers, earth switches, surge arresters, and other devices. GIS is mainly used for medium and high voltage applications, where space is limited, and reliability is essential.

GIS is a type of electrical equipment that uses a gas, such as SF_6, to insulate and protect various components of a power system. SF_6 is an F gas but is not an ODS. The use of SF_6 gas allows GIS to operate at higher voltages without breakdown, providing efficient and reliable power system management. Gas type of GIS is not yet established at this stage of the design and is expected to be identified during the site-specific design phase.

In addition, the CWE system uses a propylene glycol/water mixture that transfers heat to a refrigerant which has the potential to be an ozone-depleting substance. The choice of refrigerant is to be determined during the site-specific design phase.

10.7.3 Further Assessment

The BWRX-300 design is expected to support meeting relevant F gas and ODS requirements. If any F gas and ODS are proposed, the option to prevent their use by replacement with less harmful alternatives will be considered. Where F gases and ODS that are not banned and proposed for the BWRX-300 design cannot be replaced, measures will be taken in the design to prevent and minimise leakage.

When design maturity allows, important actions to be completed to further assess this topic are:

- Identify F gas and ODS proposed in the design.
- Assessment of any alternatives to using F gas/ODS in equipment.
- Provide descriptions of the measures taken in the design to prevent and minimise F gas leakage.
- Demonstrate meeting relevant F Gas and ODS requirements, such as ensuring leaks do not occur and equipment can be inspected and maintained by suitably qualified people and in accordance with regulations.

Appendix A details the stages in which further assessments identified in this section are to be completed. The above points are captured under FAP.PER10-230.

Table 10-1: Interfaces with other GDA Chapters/Documents

Chapter Number	Chapter Title	Context of Interface
NEDC-34219P, PER Ch. E2 (Reference 10-2)	Generic Site Description	Additional description of the characteristics of the generic site.
NEDC-34221P, PER Ch. E4 (Reference 10-3)	Information about the Design	Description of relevant systems.
NEDC-34223P, PER Ch. E6 (Reference 10-4)	Demonstration of BAT Approach	Description of BAT associated with radioactive substances.
NEDC-34224P, PER Ch. E7 (Reference 10-5)	Radioactive Discharges	Estimates on maximum treated effluent release.
NEDC-34225P, PER Ch. E8 (Reference 10-6)	Approach to Sampling and Monitoring	Further detail on sampling and monitoring of liquid discharges, waste and D11 – Process Radiation and Environmental Monitoring System (PREMS).
N/A	NEDC-34228P, Integrated Waste Strategy (IWS), (Reference 10-7)	Overview of wastes produced at plant phases and details on the range of conventional wastes expected to be produced.
NEDC-34170P, PSR Ch. 8 (Reference 10-8)	Electrical Power	Describing use of Gas Insulated Switchgear.
NEDC-34171P, PSR Ch. 9A, (Reference 10-9)	Auxiliary Systems	Describing the Sanitary Sewer Collection and Delivery Subsystem, diesel driven fire pump and Standby Diesel Generator (SDG) exhaust arrangement.

Table 10-2: Effluent Sources Which are Treated Before Discharge to Surface Water

Process Discharge No.	System	Process Water/ Effluent Description
1	CWS	Plant circulated seawater will predominantly contain waste heat, but will also contain concentrated salts and contaminants present in incoming in seawater. Other potential contaminants that may be present include: • Biocide • Corrosion inhibitor • Scale inhibitor • pH control (if required) • Flocculant (if required)
2	LWM	The LWM filtered effluent is discharged to the CWS at the outlet of the condenser, inside the TB. The CWS provides dilution flow for monitored releases to the environment. Effluent sources prior to treatment potentially contain total SS; oil and grease; heavy organics; chemical waste; detergent waste; dissolved contaminants (radioactive and non-radioactive); and all colloidal matter.
	LWM Effluent Sources	
	Water, Gas, and Chemical Pads (WGC) System	The WGC provides flush water for the discharge line to the environment.
	Condensate and Feedwater Heating System (CFS)	When MCA hotwell levels are too high, the CFS provides reject flow (condensate reject) to the CST to control reactor inventory. The CFS controls the flow of water.
	Shutdown Cooling System (SDC)	The SDC can overboard to the LWM if overboard flow is contaminated. Overboard flow can be routed to the Refuelling Water Storage Tank (RWST), collection tanks, or sample tanks.
	Reactor Water Cleanup System (CUW)	In the case of over boarding flow from the CUW, the LWM provides connections from the CUW to the RWST, collection tanks, or sample tanks.
	Equipment and Floor Drain System (EFS)	The EFS collects and pumps radioactive liquid effluent to the collection tanks of the LWM. The LWM tanks, filtering skid, pumps, and piping drain to EFS. All LWM tank overflow piping is also routed to EFS. Non-oily aqueous effluents are predominantly transferred to the LWM from the EFS. May contain possible detergents from floor washings.

Table 10-3: CWS Operational Functions vs Operational Modes

Mode	Title	CWS Operation
1	Power Operation (15-100% Rx Power)	Provide means to reject heat from MCA to the environment through the NHS. Provide means to reject heat from the PCW heat exchangers to the environment through the NHS. Remove accumulated air and other gases from the water boxes through water box vents.
2	STARTUP	Provide means to reject heat from MCA to the environment through the NHS. Provide means to reject heat from the PCW heat exchangers to the environment through the NHS. Remove accumulated air and other gases from the water boxes through water box vents.
3	HOT SHUTDOWN	Provide means to reject heat from MCA to the environment through the NHS. Provide means to reject heat from the PCW heat exchangers to the environment through the NHS. Remove accumulated air and other gases from the water boxes through water box vents.
4	STABLE SHUTDOWN	Provide means to reject heat from MCA to the environment through the NHS. Provide means to reject heat from the PCW heat exchangers to the environment through the NHS. Remove accumulated air and other gases from the water boxes through water box vents.
5	COLD SHUTDOWN	Provide means to reject heat from the PCW heat exchangers to the environment through the NHS. Remove accumulated air and other gases from the water boxes through water box vents. Activities to ready the system for operation can be performed on the remaining portions of the CWS not in operation.
6	REFUELING	Provide means to reject heat from the PCW heat exchangers to the environment through the NHS. Remove accumulated air and other gases from the water boxes through water box vents. Activities to ready the system for operation can be performed on the remaining portions of the CWS not in operation.

Table 10-4: Waste Heat Discharge Data

Normal Plant Heat Sink Parameter	Definition	Value	Units	Comments
Maximum Inlet Temperature Condenser/Heat Exchanger	Design assumption for the maximum acceptable circulating water temperature at the inlet to the condenser or cooling water system heat exchangers.	37.8	°C	The maximum Plant Cooling Water (PCW) System inlet temperature is 37.8 °C. This assumes use of cooling towers and can be adjusted for site specific requirements. Maximum temperature for a specific site may be limited by environmental restrictions.
Condenser/Heat Exchanger Duty	Design value for the waste heat rejected to the circulating water system across the condensers.	~570	MW	The BWRX-300 generic design is based on a heat load rejection associated with normal operation and is approximately 570 MW_{th}.
Maximum Cooling Water Flow Rate Across Condenser	Design value for the maximum flow rate of the circulating water system through the condenser tubes.	14.76	m^3/s	Flow provided is based on 9 °C temperature rise and 21 °C inlet temperature with once-thru cooling. Value is dependent on inlet temperature, allowable temperature rise and other factors and will be a site-specific value. Using a 6 °C (10.8 °F) temperature rise between the intake and discharge requires 88,895 m^3/h (391,401 gpm). Flow is similar for cooling tower designs.
Maximum Cooling Water Temperature Rise Across Condenser	Design value for the maximum temperature differential across the condenser.	16	°C	Values range from 6 °C to 16 °C. This value is based upon the use of once-thru cooling and is dependent on site-specific requirements, environmental restrictions, and condenser optimisation.

Table 10-5: LWM Waste Sampling Subsystem Operating Modes and Controls

Operating Mode	Control
Receiving Mode	• This operation mode is entered manually by the operator. • In Receiving mode, one sample tank is selected to receive effluent from the filtering skids while the other sample tank is recirculating (mixing), discharging, or idle. • Only one sample tank may be in Receiving mode at a time. This can be manually overridden if required for both tanks to be in Receiving mode at the same time. • Opening of CUW and SDC overboarding effluent valves in the Receiving mode is a manual operation due to the multiple flow paths available for overboarding. • Overboard flow should not be allowed in the sample tank receiving effluent from the filter skid or a sample tank that is recirculating or discharging. • The overboarding valve will close on a tank alarmed high-high level or on a transition from Receiving mode to another mode. • If the operator doesn't take manual action to prevent tank overflow, the inlet valves to the receiving sample tank will automatically close on a high-high level to prevent overflow of the tank and manual action is required to place the other tank in Receiving mode. A tank can't be placed in the Receiving mode if its level is greater than or equal to the high-high level setpoint.
Recirculation Mode	• This operation mode is entered manually by the competent operator. • Recirculation is performed to ensure adequate mixing for sampling. • The mixing eductor provides an accelerated mixing capacity by effectively doubling the discharge volume of the sample tank transfer pump. This allows a reduction in the recirculation times normally required for tanks without mixing eductors. • For transfers to the CST, an estimated recirculation time required is {0.45 min/% of tank level}. • For releases to the environment, double volume recirculation requires {0.9 min/% of tank level} prior to a sample being taken. • Ensuring the recirculation times are met provides a good representative mixture of the tank contents prior to sampling. • Pressure control prevents pump runout.
Manual Mode	• This operation mode is entered manually by the competent operator. • It allows any remotely operable valve or pump at the discretion of the operator. • The sample tank A pump and sample tank B pump suction crosstie valve is a manual valve with a remote position indicator and logic transfer switch. This device transfers tank level information of one tank to the opposite pump. When crosstie operations are being performed, this logic allows the appropriate pump to trip on a tank low level. • Crosstie operation is administratively controlled, and the crosstie valves are normally locked closed.

Operating Mode	Control
Discharge Mode	• This mode is a manual controlled operation performed by the competent operator and a prerequisite to entering the Discharge mode. • Only one sample tank can be in Discharge mode at any one time. • The discharge flow rate is expected to be a fraction of the normal sample pump flow rate to meet dilution requirements for an environmental discharge. • The setpoint is a predetermined calculated value based on tank sampling results and CWS flow. If the radiation level exceeds the setpoint, the valve will close automatically and modulate to recirculate. • Sample tank pump discharge pressure and Offsite Discharge flow are indicated in the MCR. • Sample tank level high and high-high, level low and level low-low and Environmental Discharge Line High Radiation is alarmed in the MCR.

Table 10-6: BWRX-300 Combustion Plant

Combustion Appliance Reference	Duty	Estimated Rated Thermal Input (MW_{th})
SDG A	Safety Class 3 Standby Generator	*9.29
SDG B	Safety Class 3 Standby Generator	*9.29
Fire Protection System (FPS) Diesel Driven Firewater Pump	NFPA 20 (Reference 10-41) compliant emergency diesel driven firewater pump	TBD
Security Diesel Generator	TBD	TBD
FLEX/EME Generator 1	Portable power for EME during emergencies or maintenance and testing	TBD
FLEX/EME Generator 2	Portable power for EME during emergencies or maintenance and testing	TBD

Table 10-7: Relevant BWRX-300 MCP ELVs

Pollutant	ELV for New Gas Oil Fuelled MCP Engines (mg/Nm^3)	SDG Emission Concentrations (mg/Nm^3)
Sulphur Dioxide (SO_2)	-	20
Nitric oxide (NO_x)	190	6250
Dust	-	60 (Particulates)

Note: From 2015/2193, MCPD (Reference 10-48)

Table 10-8: BWRX-300 Combustion Appliance MCP Applicability

Combustion Appliance	MCP Permitting Applicability	Assessment Comments
SDG A	MCP	Thermal input likely exceeding 1 MW_{th} and not meeting description of out-of-scope MCPD combustion appliances.
SDG B	MCP	Thermal input likely exceeding 1 MW_{th} and not meeting description of out-of-scope MCPD combustion appliances.
Emergency diesel driven firewater pump	TBC	The thermal input for the appliance is not yet known. The plant is located in the firewater service complex and not described as mobile plant.
Security diesel generator	TBC	The thermal input for the appliance is not yet known. The plant located and whether meeting criteria for mobile MCP is not yet known.
FLEX/EME generator 1	NRMM18 MCP	High confidence level that criterion will not be met for requiring an MCP environmental permit. FLEX/EME generators are described as portable power sources providing for connection of EME during emergencies.
FLEX/EME generator 2	NRMM18 MCP	High confidence level that criterion will not be met for requiring an MCP environmental permit. FLEX/EME generators are described as portable power sources providing for connection of EME during emergencies.

Table 10-9: BWRX-300 Combustion Plant SG Permitting Applicability Assessment

Combustion Appliance	SG Control Applicability	Assessment Criteria
SDG A	Excluded Generator	Is considered to have a defined nuclear safety role that will be covered under a nuclear site license issued by the ONR.
SDG B	Excluded Generator	Is considered to have a defined nuclear safety role that will be covered under a nuclear site license issued by the ONR.
Emergency diesel driven firewater pump	N/A	N/A – The pump does not meet the EPR16 Schedule 25B definition of a ‘generator’ which means ‘any combustion plant which is used for the purpose of generating electricity’.
Security diesel generator	TBC	Net thermal input of the appliance must be 1 MW_{th} or over to be considered a SG. Operational criteria to be assessed against EPR16 excluded generator criteria.
FLEX/EME generator 1	Excluded Generator	May be considered a backup generator only used to provide power at a site during an emergency. Also considered to be a mobile generator running electricity transmission and distribution during an emergency or planned maintenance.
FLEX/EME generator 2	Excluded Generator	May be considered a backup generator only used to provide power at a site during an emergency. Also considered to be a mobile generator running electricity transmission and distribution during an emergency or planned maintenance.

Table 10-10: BWRX-300 SMR Dangerous Substances COMAH15 and HSC15 Assessment

Dangerous Substance	COMAH15 and HSC15 Schedule Parts 1&2 Substance	Current Design Stage Quantities	Substance Exceeding COMAH15 and/or HSC15 Qualifying Thresholds	Assessment Comments
Diesel	Yes	151-189 m^3 Diesel Tank 90.8 m^3 SDG day tanks	Unlikely	COMAH15 aggregation and 2% rules to be considered. FPS diesel driven firewater pump, security building diesel generator(s) and FLEX mobile generator day tank volumes are to be determined. The approximate volume of 1 ton of diesel is 1.18 m^3. The applicable COMAH15 lower tier threshold (2500 t) equates to 2,268 m^3.
Gasoline	Yes	Approximately 0.02 m^3 containers	Unlikely	COMAH15 aggregation and 2% rules to be considered. The number of gasoline containers stored in the vehicle maintenance garage is to be determined.
Sodium Hypochlorite	Potentially	4 m^3	Unlikely	Safety Data Sheet (SDS) to be assessed. Whilst a named COMAH15 substance, this is dependent on the mixture content classification as E1 Ecotoxic (H400). COMAH15 aggregation and 2% rules also to be considered.
Hydrogen Gas	Yes	Gas canister skid storage volume TBD Hydrogen produced TBD	Unlikely	COMAH15 aggregation and 2% rules to be considered. Hydrogen gas canister storage skid, hydrogen produced within the process and battery charging to be determined. One ton of hydrogen is equivalent to 11,935 m^3 of gaseous hydrogen at Standard Temperature and Pressure conditions.

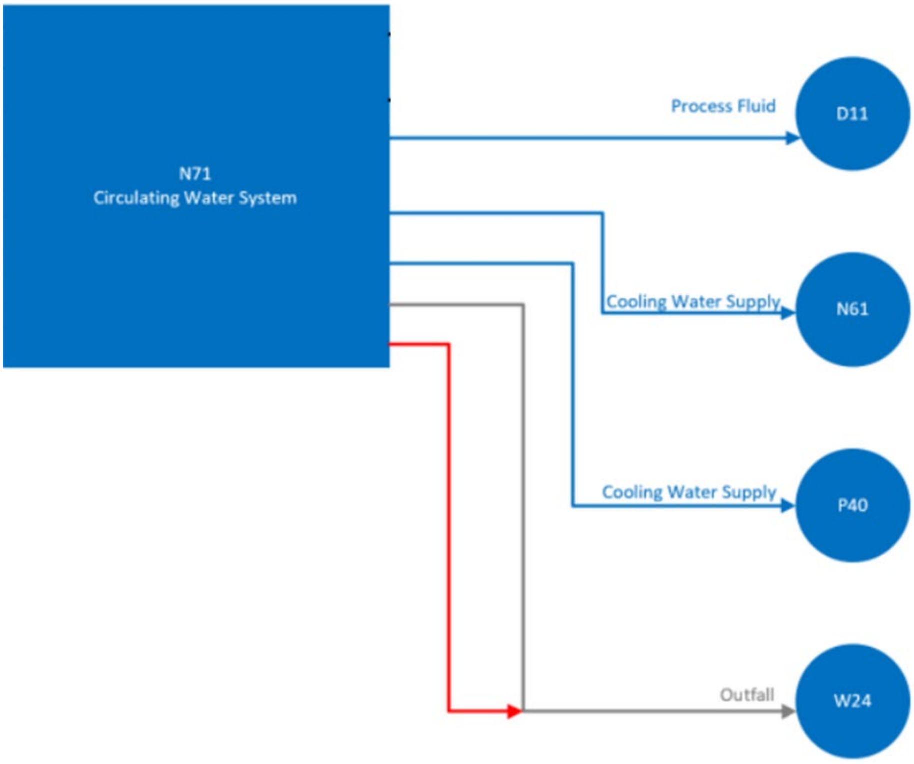

Figure 10-1: Adapted Circulating Water System Input-Output Diagram

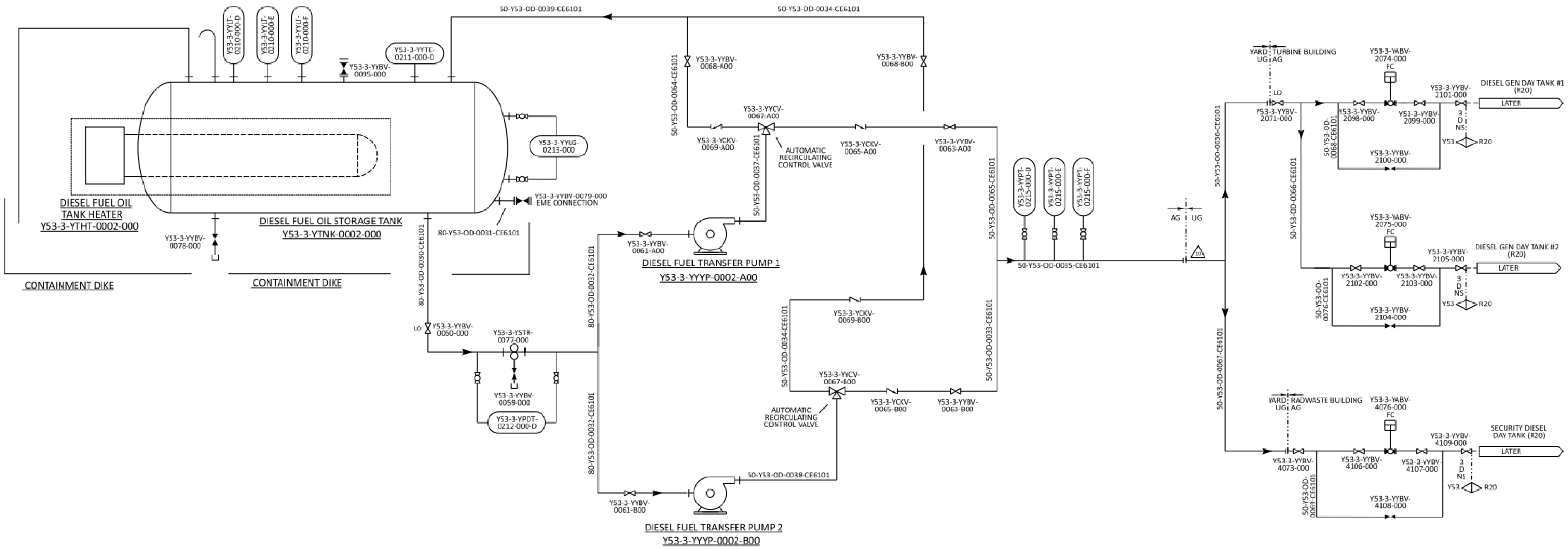

Figure 10-2: Diesel Fuel Storage and Transfer Subsystem

Note: 006N7798, “BWRX-300 Water, Gas and Chemical Pads Piping & Instrumentation Diagram,” (Reference 10-42)

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APPENDIX A FORWARD ACTION PLAN

Future iterations of this chapter will provide more detailed evidence, design characteristics, and details of the techniques proposed to demonstrate meeting the OER topics described in the GDA guidance for RPs (Reference 10-1) as well as the methods to prevent or, where not practicable, minimise risk of conventional environmental impact.

It is recognised that many applicable OER regulatory requirements and conventional environmental impacts will be site-specific, e.g. marine life protection and COMAH15 applicability. The actions presented below have been identified as forward actions for implementation during development of a Pre-Construction Safety Report (PCSR)/Pre-Construction Environmental Report (PCER).

Table A-1: Forward Actions

Action ID	OER Sub-topic	Finding	Forward Actions	Delivery Phase
PER10-225	Water Use and Abstraction	Future assessment of the detailed design documentation, once established, will be required for Water Use and Abstraction.	Assessing seawater abstraction volumes for different operational phases for cooling water system.	For PCSR/PCER
			Assessing mains and demineralised water demand (average and peak) in different operational phases.	
			Assessing fish recovery and return design.	
			Assessing intake head design, barrier and fish deterrent systems in addition to any other wildlife impact mitigation measures associated with seawater abstraction.	
PER10-226	Discharges to Surface Water	Future assessment of the detailed design documentation, once established, will be required for Discharges to Surface Water.	Detailed assessment of water emissions waste heat impact on the receiving environment.	For PCSR/PCER
			Assessment of potential conventional contaminants and concentrations. This will relate to EQS and any further mitigation required. Additional pollutant information including disinfectant and biocides to be provided as design matures.	
			Assessment of beneficial use of heat options and heat recovery methods proposed as design maturity allows.	
			A complete assessment of all discharges to surface water considering effluent content and volumes discharged.	
			For any SuDS proposed, an assessment of suitability of discharges to surface water.	
			For any surface water drainage treatment plants designed for removal of oils/SS, an assessment of suitability of discharges to surface water.	
			For any on-site sewage system design/plant, an assessment of suitability of discharges to surface water.	

Action ID	OER Sub-topic	Finding	Forward Actions	Delivery Phase
PER10-227	Discharges to Groundwater	Future assessment of the detailed documentation, once established, will be required for Discharges to Groundwater.	Determine if groundwater discharges are designed for the BWRX-300 generic site.	For PCSR/PCER
			If groundwater discharges are identified, assess proposed processes relating to discharge controls, emissions, and sampling and monitoring.	
			Provide additional description of measures designed to prevent accidental leaks and spills of non-radioactive pollutants that could give rise to accidental pollution of land and groundwater.	
			Provide descriptions of how the civil design considers groundwater impact on below ground structures and how the plant stands up to climate change effects on groundwater over long periods.	
PER10-228	Operation of Combustion Installations, MCP & SG	Future assessment of the detailed design documentation, once established, will be required for Operation of Installations (Combustion, including MCP and SGs).	Establish the net rated thermal input (in MW_{th}) for all combustion appliances at the BWRX-300 site. This will allow identification of EPR16, MCP and/or SG permitting applicability.	For PCSR/PCER
			Assessment of operational hours and equipment design parameters for all combustion appliances at the BWRX-300 site. This will allow identification of EPR16, MCP and/or SG permitting applicability.	
			Comparison with proposed technology (that is not subject to site-specific design) shall be made against the relevant MCP, SG and/or EPR16 Part B guidance. This will include: • Comparison of ELVs against estimated exhaust emissions based on appliance size. • Completing a generic air quality screening assessment for all combustion plant.	

Action ID	OER Sub-topic	Finding	Forward Actions	Delivery Phase
			• Providing details of all combustion unit fuel specification, principles for emissions monitoring, and recording hours of operation. For aspects of combustion technology at the level of detail that will only be available at a site-specific design stage, comparison with guidance will include: • Detailed air quality assessment based on all stack heights, stack design, stack locations, and individual combustion appliance emission process contributions. • Providing details of all appliances’ operating hours (for different phases in the life of the plant). • Providing details of proximity to sensitive receptors.	
PER10-229	COMAH	Future assessment of the detailed design documentation, once established, will be required for COMAH15.	Assessment of BWRX-300 SMR chemical inventory SDS. Assessment of maximum design storage capacities. Classifying unclassified chemical inventory in accordance with CLP15 – substances will be provisionally assigned to most analogous category or named dangerous substance falling within scope of COMAH15. Classifying wastes capable of causing a major accident – substances will be considered in accordance with classification information in the CLP15 and assigned to most appropriate category. Plant design changes in maximum design storage capacities and layout of COMAH15 substances. Subsequent assessment of COMAH15 rules in determining applicability for substances identified.	For PCSR/PCER

Action ID	OER Sub-topic	Finding	Forward Actions	Delivery Phase
			If a COMAH15 site, detailed description will be provided of the measures incorporated in the design to prevent a MATTE. This includes environmental risk assessment which based upon CDOIF guidance on Environmental Risk Tolerability for COMAH Establishments.	
PER10-230	F Gas and ODS	Future assessment of the detailed design documentation, once established, will be required for F Gas and ODS.	Identify F Gas and ODS proposed in the design.	For PCSR/PCER
			Assessment of any alternatives to using F gas/ODS in equipment.	
			Provide descriptions of the measures taken in the design to prevent and minimise F Gas leakage.	
			Demonstrate meeting relevant F Gas and ODS requirements, such as ensuring F Gas and ODS leaks do not occur and equipment can be inspected and maintained by suitably qualified people and in accordance with regulations.	