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4.1 ACRONYMS AND ABBREVIATIONS

The standard project glossary of terms, abbreviations, and plant systems is provided in SMR-300 Plant Breakdown Structure, Acronyms, and Glossary of Terms [1]. The following additional definitions and abbreviations are used herein:

Table 1: Definitions and Acronyms Used in this Chapter

Term	Definition
BAT	Best Available Techniques
BNG	Biodiversity Net Gain
BREEAM	Buildings Research Establishment Environmental Assessment Methodology
BREF	BAT Reference documents
C&I	Controls & Instrumentation
CIA	Conventional Impact Assessment
CIRIA	Construction Industry Research and Information Association
COMAH	Control of Major Accident Hazards Regulations
CPO	Condensate Polisher System
CRS	Circulating Water System
CWS	Chilled Water System
DBA	Design Basis Accident
DESNZ	Department for Energy Security and Net Zero
DWS	Demineralised Water System
EA	Environment Agency
ELV	Emission Level Value
EPR16	Environmental Permitting (England and Wales) Regulations 2016
EQS	Environmental Quality Standards
EU	European Union
FA	Forward Action
F-gases	Fluorinated Greenhouse Gases
GDA	Generic Design Assessment
GHG	Greenhouse Gases
GHGE	Greenhouse Gas Emissions
GWP	Global Warming Potential
HFC	Hydrofluorocarbons
HVAC	Heating, Ventilation and Air Conditioning
IAEA	International Atomic Energy Agency
ICS	Industrial Cooling System
IED	Industrial Emissions Directive
LRW	Liquid Radwaste System
LWR	Light Water Reactor
MCH	Main Control Room Habitability System
MCP	Medium Combustion Plant
MCPD	Medium Combustion Plant Directive
MFS	Main Feedwater System

Term	Definition
MOX	Mixed oxide fuel
MPC	Multi-Purpose Canisters
NDA	Nuclear Decommissioning Authority
NES	Nuclear Energy System
NOx	Nitrous Oxides
NRW	Natural Resource Wales
ODS	Ozone-depleting substances
ONR	Office for Nuclear Regulation
OPEX	Operational Experience
PER	Preliminary Environmental Report
PFC	Perfluorocarbons
PSR	Preliminary Safety Report
PWR	Pressurised Water Reactor
RGP	Relevant Good Practice
RP	Requesting Party
RR	Rolls Royce
SDG	Sustainable Development Goals
SF_6	Sulphur Hexafluoride
SFP	Spent Fuel Pool
SG	Steam Generator
SGBS	Steam Generator Blowdown System
SMR	Small Modular Reactor
SO_2	Sulphur Dioxide
SSC	Structures, Systems and Components
UK	United Kingdom
UK ETS	UK Emissions Trading Scheme
UN	United Nations
uPBT	Ubiquitous, Persistent, Bio-accumulative, Toxic
UPS	Uninterrupted Power Supply
US	United States of America
WFD	Water Framework Directive
WWS	Waste Water System

4.2 INTRODUCTION

This chapter provides information relating to key areas of conventional environmental impact and sustainability.

This section summarises this chapter's objectives, scope, interfaces and links with other Preliminary Environmental Report (PER) and Preliminary Safety Report (PSR) chapters are described in this section.

4.2.1 Purpose

The main objective of this chapter is to provide the Environment Agency (EA) and Natural Resources Wales (NRW) with the information required so that an appraisal of the conventional environmental impact of the generic Holtec Small Modular Reactor (SMR)-300 design can be made.

This is achieved by describing aspects of the generic SMR-300 which have the potential to result in conventional environmental impacts. We will identify knowledge gaps in the design, including where systems, structures or components (SSC) are out of the Generic Design Assessment (GDA) scope, as well as considering embedded mitigation and the potential site-specific measures that could be adopted at a later stage of design development. In doing so, this chapter aims to give confidence to relevant stakeholders that the generic SMR-300 demonstrates environmental impacts can be mitigated. Future iterations of this document will include available information to provide a more detailed picture of the conventional environmental impacts, as the GDA progresses.

4.2.2 Scope

The scope of this chapter is based on the requirements outlined in the EA GDA Guidance for Requesting Parties (RPs) [2], and limited by the scope of the GDA as outlined in the GDA Scope document [3]. More specifically, for conventional environmental impacts, it is required to provide information relating to eight key areas of environmental impact and sustainability. The regulatory context for each of the main aspects is also provided.

The eight key areas of environmental impact addressed in this chapter are:

- Water use and abstraction.
- Discharges to surface water.
- Discharges to groundwater.
- Operation of installations (combustion plant and incinerators).
- Operation of medium combustion plant and specified generators.
- Control of Major Accident Hazards Regulations (COMAH).
- Fluorinated greenhouse gases (F-gases) and Ozone-Depleting Substances (ODS), and
- Sustainability.

The scope of this chapter is bounded by the available data relating to the design, at the time of writing. Gaps in knowledge are identified and a forward action provided for those gaps. These will be addressed in later iterations of this document or at site-specific stage, whichever is the most appropriate.

4.2.3 Chapter Structure

This chapter is structured as follows, to provide the information needed for a meaningful assessment of the generic SMR-300 in a clear and logical manner:

- The chapter structure is linked to the eight key areas listed above. Sub-chapter 4.1 lists the acronyms and abbreviations used in this chapter
- Sub-chapter 4.2 introduces the purpose, scope, interfaces, and assumptions for this chapter
- Sub-chapter 4.3 presents the regulatory context and the GDA requirements for each sub-topic within the Conventional Impact Assessment
- Sub-chapter 4.4 describes the water use and abstraction in the generic SMR-300
- Sub-chapter 4.5 describes the discharges to surface water in the generic SMR-300
- Sub-chapter 4.6 the discharges to groundwater in the generic SMR-300
- Sub-chapter 4.7 describes the operation of installations, medium combustion plant (where applicable) and other specified generators (where applicable) in the generic SMR-300
- Sub-chapter 4.8 describes the design considerations for COMAH regulations in the generic SMR-300
- Sub-chapter 4.9 describes the F-gases and ODS in the generic SMR-300
- Sub-chapter 4.10 describes sustainability in the generic SMR-300
- Sub-chapter 4.11 contains a summary of this chapter as a whole, and
- Sub-chapter 4.12 is the bibliography containing all references.

4.2.4 Interfaces with other Chapters

Table 2 describes the interfaces and relationships between this chapter and other PER chapters for clarity, demonstrating the formation of a strategic environment case.

Table 2: Interfaces with Other Chapters of PER

Chapter Title	Interface
Holtec SMR GDA PER Chapter 1: Radioactive Waste Management Arrangement [4]	Radioactive Aqueous discharges are considered in this chapter with respect to the discharges to surface water. Sustainability considerations of PER Chapter 1 are referenced in this section.
Holtec SMR GDA PER Chapter 2: Quantification of Effluent Discharges and Limits [5]	Radioactive Aqueous discharges are considered in this chapter with respect to the discharges to surface water. Sustainability considerations of PER Chapter 2 are referenced in this section.
Holtec SMR GDA PER Chapter 3: Radiological impact Assessment [6]	Sustainability considerations of PER Chapter 3 are referenced in this section.
Holtec PSR Chapter A1: Introduction [7]	Outlines the purpose of the GDA assessment
PSR Chapter A2: General Design and Site Characteristics [8]	Linked to sub-chapter 4.2.5, which covers assumptions.
PSR Chapter B5: Description of the Reactor Supporting Facilities [9]	Linked to sub-chapter 4.9 (Fluorinated Greenhouse Gases and Ozone Depleting substances)
PSR Chapter B11: Environmental Protection [10]	Summarises the chapters of the PER, including the current chapter.
PSR Chapter B23: Reactor Chemistry [11]	Linked to sub-chapter 4.5 (Discharges to surface water) and sub-chapter 4.10 (sustainability).
PSR Chapter B24: Fuel Transport and Storage [12]	This is linked with sub-chapter 4.6 which discusses possible source of discharges to groundwater and sub-chapter 4.10, which discusses sustainability.

As the work progresses, sustainability will be identified across the various chapters. This chapter also interfaces with HI-2240516 Approach and Application to the Demonstration of Best Available Techniques (BAT) [13].

It is recognised that the interfaces between this chapter and other chapters will be continually identified as other chapters are developed within GDA Step 2.

The BAT demonstration for the generic SMR-300 will be developed with the Approach to BAT report [13], to identify the impacts of conventional and non-radioactive waste and how this will be minimised to reduce the impact on members of the public and the environment. For conventional and non-radioactive waste, the approach to BAT is broadly the same as that taken for radioactive wastes, although there are some differences such as best practice being specified in BAT reference documents (BREFs).

4.2.5 Assumptions

Assumptions have been made to progress this chapter. A key assumption which must be made is that the generic SMR-300 will need to be adapted during the site-specific stage to account for environmental conditions encountered at site. Assumptions about the site have been discussed in more detail in, Holtec SMR GDA PSR Part A Chapter 2 General Design and Site Characteristics [8].

Technical assumptions regarding the design are:

- All discharge will be via a single outfall from the site to the receiving body of water.
- Below-grade leak prevention structures, systems and components developed for radiological protection are suitable for protecting against non-radiological pollutants to the environment.
- The cooling system design is based on use of cooling tower technology for the purposes of this CIA; however, this does not preclude the design from opting for other cooling technologies during site-specific design.

4.3 REGULATORY CONTEXT

4.3.1 GDA Requirements

This sub-chapter describes the GDA requirements for each of the sub-topics considered within the CIA. These requirements are taken from the GDA Guidance for RPs [2], under the heading "information relating to other environmental regulations" in the "Information required for environment case submission" section.

4.3.1.1 GDA Requirements for Water Use and Abstraction

The guidance for "Water Use and Abstraction" [2] states:

> RP must provide details and estimates of:
> - Freshwater requirements for the design.
> - Cooling water requirements for the design relevant to the generic site.
>
> The RP should include its consideration of:
> - Seawater or river water abstraction.
> - Use of conventional cooling towers or hybrid cooling towers.
> - Abstraction inlet fish deterrent schemes.
> - Fish return systems.

Where available, the above information is provided for both a coastal and a freshwater generic site, using the assumptions for these sites discussed in PSR Part A Chapter 2 [8].

4.3.1.2 GDA Requirements for Discharges to Surface Water

The guidance for "Discharges to Surface Water" [2] states (reference added for clarity):

> RP must provide a description of how aqueous waste streams will arise, be managed, and disposed of throughout the facility's lifecycle, including:
> - Sources and quantities of contaminants (including disinfectant and biocides), highlighting any priority substances as specified in the Priority Substances Directive [14].
> - Identifying effluent and surface water runoff streams contributing to the overall discharge and how they are controlled.
> - Potential options and the associated environmental impact for the disposal of each individual effluent stream.
> - The means of control if unplanned radioactive (or other) contamination of the discharge is detected.
> - The options for beneficial use of the waste heat produced.
> - The environmental impact of thermal discharges.

4.3.1.3 GDA Requirements for Discharges to Groundwater

The guidance for "Discharges to Groundwater" [2] states:

> If there are planned discharges to groundwater, the RP must describe the nature and quantity of those discharges and provide an assessment of the impact on groundwater. We do not normally allow discharges to groundwater.

4.3.1.4 GDA Requirements for Operation of Installations and Combustion Plant

In the most up to date version of the Guidance [2], two sections relate to emissions to air from combustion plant. These sections state (references added for clarity):

Operation of Installations (Combustion Plant and Incinerators) [2]

> The RP must identify the combustion plant that is provided in their nuclear power plant design, for example standby generators or auxiliary boilers.
> - If the aggregate rated thermal input of all combustion plant is greater than 50MW, they must provide a comparison of the proposed technology against the relevant guidance (European Commission Guidance on Large Combustion Plants [15]).
> - If the aggregate rated thermal input of all combustion plant is greater than 20MW, they must describe how they will monitor greenhouse gas emissions.
> - If the design includes an on-site incinerator with a capacity of 1 tonne or more per hour, they must provide a comparison of the proposed technology against our sector guidance (Incineration of Waste (EPR5.01): additional guidance [16]).

Combustion Plant [2]

> The RP must identify the medium combustion plant that is provided in their nuclear power plant design, for example standby generators. If the aggregate rated thermal input of all medium combustion plant is more than or equal to 1MW and less than 50MW, they must provide a comparison of the proposed technology against the relevant guidance (European Commission, Medium Combustion Plant Directive [17]) and our sector guidance (Collection: Medium combustion plant and specified generator UK Government Regulations [18]).

4.3.1.5 GDA requirements for Control of Major Accident Hazards

The guidance for COMAH [2] states:

> The RP must identify whether they will store quantities of substances on site that are above the qualifying thresholds in COMAH 15 (Control of Major Accident Hazards Regulations 2015 [19]).
>
> The RP must describe the measures taken in the design to prevent a major accident to the environment if they exceed a COMAH threshold.

4.3.1.6 GDA Requirements for Fluorinated Greenhouse Gases and Ozone-depleting Substances

The Guidance for RP [2] states:

> The RP must identify whether any equipment included in the design will contain Fluorinated Greenhouse Gases (F-gases) or Ozone-Depleting Substances (ODS) – as defined in the Fluorinated Greenhouse Gases Regulations 2015 [20] and Ozone Depleting Substances Regulations 2015 [21]. See our guidance on F-gases (UK Government, Bans on F gas in new products and equipment: current and future [22]).
> If so, they must describe the measures taken in the design to prevent and minimise the leakage of such substances.

4.3.1.7 GDA Requirements for Sustainability

There are no specific requirements for sustainability, however the most recent version of the GDA Guidance for RPs [2] has been updated to indicate the importance of achieving sustainable development. The Guidance [2] states:

> The Environment Agency and NRW expect to see relevant sustainability considerations taken into account in the design of new nuclear power plants. These considerations may include:
> - Carbon accounting
> - Climate change adaptation and resilience
> - Sustainable management of natural resources
> - Long term lifecycle impacts
> - Contribution to a circular economy.

4.3.2 Regulatory Context for GDA requirements

This section provides an overview of the key statutes and regulations which apply to each area of the CIA.

4.3.2.1 Regulatory Context for Water Use and Abstraction

There are three main pieces of legislation which need to be considered when discussing water use and abstraction for a new nuclear installation:

- The Water Resources Act 1991 (as amended) [23].
- The Eels (England and Wales) Regulations 2009 [24].
- Salmon and Freshwater Fisheries Act 1975 [25].

The Water Resources Act [23] is the primary legislation providing the framework for managing water usage, abstraction, pollution, and flood defence. With reference to the Water Resources Act, Part II, chapter II, any abstraction of water from a water supply, excluding the open sea, requires a licence where the abstraction is more than 20 cubic meters over a 24-hour period. A licence is also required for any impoundment activities, such as a dam or diversion of water supplies. This act gives power to relevant authorities to prosecute, by means of a fine, for any corporate body not complying with these requirements.

A licence is granted for specific abstraction activities and will contain information such as the body of water from which abstraction will be taking place, the applicant has rights to access the water, the dates from which the licence is due to take effect, specific exceptional circumstances which might apply due to the nature of the body of water, and other site-specific information. The granting of the licence will take all information into account and will outline conditions relevant to the site-specific abstraction activities.

The Eels Regulations [24] contains provisions for recording and fishing of eels, the passage of eels in relation to new structures, and gives power to the appropriate agency to request construction of eel passes or suitable diversions/deterrents. The statutory instrument also contains provisions for penalties to be applied in the case of an offence committed with respect to these regulations. For the purposes of this chapter, provisions relating to eel passage obstructions and means for preventing ingress of eels are the most relevant. These regulations will generally apply wherever there is water abstraction in marine or freshwater environments, and typically conditions for any intake structure will be specified within the corresponding abstraction licence. Such conditions will be provided to the operator by a notice from the relevant authority. They generally will stipulate the need for eel screens, with mesh sizing being dependant on the expected life-stage of eels at the site of abstraction. Other stipulations may apply such as inclusion of an eel pass/diversion for any structure which obstructs eels' passages. The applicability of the Eels Regulations 2009 [24] will be considered in more detail during the site-specific stage.

The Salmon and Fisheries Act [25] is the main legislation covering the protection of fishing stocks and protected fish species (and other marine animals). The act also contains provisions related to fish passes and screens, similarly to the Eels Regulations [24].

Where appropriate, the design and operation of the cooling system will give due consideration to all applicable BAT Conclusion recommendations and European Commission BAT Reference (BREF) documents, including the European Union (EU) BREF document for Industrial Cooling Systems (ICS) [26]. The BREF ICS document [26] complies with regulatory requirements and recommends techniques that enhance energy efficiency, reduce water consumption, and mitigate negative ecological effects by optimising the cooling process.

4.3.2.2 Regulatory Context for Discharges to Surface Water

Through the Priority Substances Directive [14], member states of the EU are required to take a preventative and precautionary approach when dealing with any discharges to water that may result in environmental damage. To assist any potential polluter with management of discharges and in understanding which chemicals must be monitored and managed, a list of priority substances was collated for chemicals having ubiquitous, persistent, bio-accumulative and/or toxic (uPBT) properties. Limits, or Environmental Quality Standards (EQS), for each of the priority substances are set in the Environmental Quality Standards Directive [27]. Although the United Kingdom (UK) is no longer in the EU, the Environmental Quality Standards Directive has effect through the UK Water Framework Directive (WFD) [28] (see Article 20).

Where appropriate, the management of the surface water discharge system will give due consideration to all appliable European Commission BREF and BAT conclusion recommendations, including the relevant EU BREF documents below:

- Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector BREF document [29].
- Monitoring of Emissions to Air and Water from Industrial Emissions Directive (IED) Installations BREF document [30].
- Waste Treatment BREF document [31].

These documents address the implementation of environmental management systems within the chemical industry and offer practical guidance for monitoring water pollutions and both hazardous and non-hazardous waste treatment processes.

In addition to pollution prevention and control, water discharges and trade effluent is regulated by the Environmental Permitting (England and Wales) Regulations 2016 (EPR16), as amended [32]. These regulations require operators to hold a permit for discharges of trade effluent to controlled waters (under normal operation). Applicants for permits must supply the relevant data on discharge frequency, volume, and chemistry to the relevant local authority in which the discharge will take place. The Applicant also must undertake an assessment of the impact of these releases on the environment. The regulations outline specific requirements to operators of radioactive substances activities facilities with respect to radioactive discharge limits. The sources and systems that manage liquid radioactive effluent are discussed in

Radioactive Waste Management Arrangements [4] and PER Chapter 2 Quantification of Effluent Discharges and Limits [5].

4.3.2.3 Regulatory Context for Discharges to Groundwater

As with discharges to surface water, discharges to groundwater are covered by the EPR16 [32]. Any discharge to groundwater which results in pollution of groundwater is an offence under these regulations, including intentional discharges and discharges from negligence. Exempt groundwater discharge activities under Schedule 3, part 3 of the EPR16 [32] only apply in certain conditions and will depend on the specific site.

Consideration of relevant BREF guidance such as Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector [29] and Waste Treatment [31], industry standards and Relevant Good Practice (RGP) applicable to prevention of pollution can ensure BAT measures are taken to protect groundwater from pollutants and mitigate any consequences of any accidental release.

BAT measures shall be undertaken when discharging to groundwater as per the Construction Industry Research and Information Association (CIRIA) guidance C736 [33] which supersedes CIRIA R164 to reflect the latest changes in legislation, design and practice. The technical advice focuses on preventing accidental groundwater pollution and spills of non-radioactive pollutants from industrial incidents. Additionally, the advice covers aspects of planning, design, and construction of containment systems.

4.3.2.4 Regulatory Context for Operation of Installations and Combustion Plant

Industrial combustion plant, including backup energy generation, and any incineration activities are subject to EPR16 [32]. These regulations implement the requirements of EU Directive 2010/75/EU on industrial emissions (integrated pollution and control), referred to more commonly as the Industrial Emissions Directive [34].

Under these regulations, industrial combustion plant is required to have a permit if either of the following conditions apply:

- The site comprises a single combustion source with a rated thermal input of greater than or equal to $50MW_{th}$, or
- The site comprises multiple combustion sources, which have an aggregated thermal input of greater than or equal to $50MW_{th}$ and these are operated at the same time by the same operator.

Generally, for combustion plant that is less than $50MW_{th}$ but greater than $1MW_{th}$, the Medium Combustion Plant Directive (MCPD) [35] would apply and a permit obtained for Medium Combustion Plant (MCP). Any new combustion plant (i.e., put into operation on or after the 20th of December 2018) will need to comply with Emission Limit Values (ELVs) for specified pollutants, primarily sulphur dioxide (SO_2), nitrogen oxides (NO_x) and dust, see Annex II of the MCPD regulations [35]. The ELV for consideration will depend on the type, fuel material and technology of the combustion plant. Consideration of aggregation must be made for multiple combustion plants having a common windshield (i.e. dispersing through a common structure or stack).

Specified generators may need a permit depending on their technology. Generators specified for a defined nuclear safety role on a nuclear licenced site issued by the Office for Nuclear Regulation (ONR) are excluded from these permit regulations [36].

European Commission BREF and BAT conclusion recommendations can be applicable, including Monitoring of Emissions to Air and Water from IED Installations [30], and the Large Combustion Plants BREF document [15]. The Large Combustion Plants BREF document specifically addresses combustion plants over $50MW_{th}$ input and emphasises the importance of monitoring associated pollutants, but the principles outlined are applicable to smaller combustion plant as well.

4.3.2.4.1 Other Codes and Standards Relevant to Combustion Activities

From a sustainability perspective, the UK Emissions Trading Scheme (UK ETS), launched in 2021, is the UK "cap-and-trade" system for regulating and limiting greenhouse gas emissions in the UK. It is put into effect by the Greenhouse Gas Emissions Trading Scheme Order 2020 [37]. The scheme encourages decarbonisation by capping how much carbon participants can emit, referred to as the emissions allowance. Any emissions over the cap may be traded with other participants, encouraging overall reduction of carbon emissions between participants. For combustion plant over $20MW_{th}$ operating in the UK it is necessary to obtain a Greenhouse Gas Emissions (GHGE) Permit under the GHGE Trading Scheme Order [37]. This permit will set requirements for monitoring emissions.

For the generic SMR-300, application for a GHGE permit may be necessary if all combustion activities across the facility are over $20MW_{th}$, but such a permit may only be applied for and held by the operator of the facility.

4.3.2.5 Regulatory Context for COMAH

Any facility storing priority substances on site are subject to COMAH Regulations 2015 [19]. These regulations require facility operators to prepare and retain a written major accident prevention policy. Such policies must be configured to ensure a high degree of protection of human health and the environment, from major accidents resulting from the misuse or accidental release of specific dangerous substances, listed in Schedule 1 of the COMAH Regulations [38].

The COMAH regulations [19] define two tiers of facility, namely lower and upper tier facilities. These relate to lower and upper thresholds of dangerous substances respectively. The exact measures to be taken by operators of COMAH facilities depend on the tier, and type of dangerous substance. Generally, operators of COMAH facilities must undertake all measures necessary to prevent a major accident and identify measures for mitigation in the event of any major accident should it occur.

The dangerous substances referred to in the COMAH regulations are listed in Schedule 1 of the regulations [38]. The substances may fall within a category of substance, for example certain explosives, flammable gases, flammable liquids (see Part 1, Schedule 1, COMAH regulations). Alternatively, the dangerous substance may be a specific substance listed in Part 2, Schedule 1 of the COMAH regulations.

4.3.2.6 Regulatory Context for Fluorinated Greenhouse gases and Ozone-Depleting Substances

The Fluorinated Greenhouse Gases (GHG) Regulations 2015 [20] regulate the use of F-gases in the UK. These regulations implement the requirements of EU Regulation No. 517/2014 on F-gases [39].

These regulations aim to:

- Reduce the use of non-CO_2 GHGs, including F-gases, by 72-73% by 2030.
- Reduce the use of non-CO_2 GHGs, including F-gases, by 70-78% by 2050.

These regulations aim to reduce the use of F-gases compared to 1990 levels, through limiting the use of equipment containing such gases, take action on the use of hydrofluorocarbons (HFCs) in accordance with the Montreal Protocol [40], and encourage training and certifications for expertise in managing with F-gases, equipment using F-gases, and alternative technologies.

The articles of the EU regulations [39] establish rules on storage use and disposal of F-gases, limitations of introducing new products using specific F-gases to the market, limits how F-gases may be used and limits placing HFCs on the market. The UK regulations [20] echo these stipulations with references to the EU regulations and giving power to the relevant authority (e.g. EA and NRW) to prosecute for offences under the regulations.

F-gases, including HFCs, perfluorocarbons (PFCs) and sulphur-hexafluoride (SF_6), have a high Global Warming Potential (GWP) and are major contributors to climate change and ozone-depletion. A list of all F-gases and their global warming potential can be found in the UK government guidance [20]. This guidance also outlines the UK governments commitments to reducing the use of HFCs by 79% by 2030. The tables in this guidance should be used by any facility using HFCs, PFCs or SF_6.

The ODS Regulations 2015 [21] sets provisions for undertaking work related to specific ODS. These regulations set the need for identifying appropriately qualified people to recover, recycle, reclaim, or destroy controlled substances, and preventing and minimising the leakage of controlled substances. Schedule 2 of the ODS regulations identify specific tasks in handling equipment containing controlled substances.

4.3.2.7 Regulatory Context for Sustainability

Sustainability considerations include environmental impacts but may also include social and economic issues. The Sustainable Development Goals (SDGs) [41] developed by the United Nations (UN) outline several considerations for sustainability. These are not regulations; however, each SDG outlines a number of targets contributing to the achievement of that goal. A list of the UN's SDGs that have been highlighted in the generic SMR-300 are briefly described in Table 6 below.

Wales has specific legislative instruments which set provisions for sustainable development. In addition to the legislation already mentioned in this chapter, the Well-being of Future Generations (Wales) Act 2015 [42] specifically sets goals for public bodies undertaking development in Wales. The development is required to be 'sustainable development' and applies to a specific list of public bodies. There is potential for alterations to this Act in the future and therefore it is likely that sustainability will become a requirement at site-specific stage.

The International Atomic Energy Agency (IAEA) has published a document [43] which outlines the key areas for improvement which could enhance sustainability in Nuclear Energy Systems (NESs), one of which is related to the accumulation of spent fuel that is creating a high-level radioactive waste for future generations to manage.

In November 2023, sustainability within nuclear was addressed at the International Conference on the Safety of Radioactive Waste Management, Decommissioning, Environmental Protection and Remediation [44]. This conference highlighted several key topics, including decarbonisation and climate change, resource sustainability and the relationship between safety and sustainable development, indicating that the importance of these topics is still high for the nuclear industry.

Systems-based thinking in sustainability is understood to be an important tool. There is ongoing work by the EA, the Department for Energy Security and Net Zero (DESNZ), and the Nuclear Decommissioning Authority (NDA) to develop an integrated systems map to support decision making for decommissioning system. Such a map could be considered during project development for the generic SMR-300.

4.4 WATER USE AND REQUIREMENTS

This sub-chapter describes aspects of the generic SMR-300 relevant to water use and abstraction, where the information is available and within GDA scope. Aspects of the design which are particularly relevant but are not within the GDA scope may be discussed in future iterations of this chapter, when more information is available and/or using assumptions and Operational Experience (OPEX).

The generic SMR-300 is configured to be adapted for multiple sites, and the specific water use will depend on site-specific requirements. For the GDA it is assumed that the generic SMR-300 is located on either a coastal or a lake site.

Demand for water use in the generic SMR-300 plant includes:

- Cooling water demand for mechanical draft cooling towers – The generic SMR-300 plant utilises mechanical draft cooling towers for cooling the condenser of the secondary circuit. A makeup water system is required to replace water lost from evaporation and cooling tower blowdown.
- Demineralised water – The DWS supplies demineralised water for initial fill and makeup water for various systems including reactor coolant, fuel pool coolant and secondary coolant. Process water refers to the demineralised water that is used in these systems after chemical dosing has been added. Additional uses for demineralised water include sluicing of spent resins from demineralisers for back-flushing, decontamination, or wash water for system vessels such as tanks. Potable water is used to produce demineralised water. The treatment process to produce demineralised water includes removal of ionic impurities and a reduction of oxygen concentration. Demineralised water is stored in a storage tank before being distributed to all areas of the plant where it is required.
- Other potable water demand – Potable water is required on site for personnel use in kitchen and bathroom facilities, as well as cleaning, washing and laundry.

It is assumed that the cooling water demand will be met via sea water or lake water abstraction, the latter of which will require an abstraction licence. For the purposes of this CIA, it has been assumed that the generic SMR-300 will incorporate mechanical-draught cooling tower technology. This assumption does not preclude the design from being adapted during the site-specific stage of design development. For example, depending on the sensitivities of the site (Marine Conservation Zone, Special Sites of Scientific Interest, Ramsar sites, etc.) it may be concluded that air-cooled cooling technology is determined to be best considering all factors. A BAT assessment will be conducted at the site-specific stage to influence the design to select the technology, considering all relevant factors including sensitive environmental receptors, planning considerations, construction methods etc. For a coastal site, it is assumed that abstraction is taken from the open sea and therefore an abstraction licence isn't required. For an estuarine site, an abstraction licence may be required.

It is assumed that potable water, including use for demineralised water, will be provided by the local water utility. Volumes for water use are subject to further design development.

4.4.1 Water Use Efficiency

There are several systems included in the generic SMR-300 that allow for efficient use of water, including water recycle and recovery options. The main areas of efficient water use include the Condensate Polisher System (CPO), the Circulating Water System (CRS), and recycling of blowdown and liquid radioactive waste.

The CPO will be used to remove corrosion products and impurities in the condensate to maintain feedwater chemistry and limit downstream treatment stages. The CPO can treat 100% of the condensate flow during operational stages like startup and shutdown. The polished water is reused in the condenser, as part of the secondary circuit for steam generation. The CPO is also used to treat blowdown water from the steam generator for reuse within the process.

The CRS that rejects waste heat to the environment can be configured to optimise the availability of water at the site location. Typically, mechanical draft cooling towers consume less water than a direct cooling system. This does not foreclose the use of direct cooling when developing site-specific requirements.

The Liquid Radwaste System (LRW) enables reuse of water in the nuclear island (see PER Chapter 1 [4]). The LRW collects, treats, and releases or recycles radioactive liquid effluents generated by the plant. The LRW consists of three main subsystems: equipment drains, floor drain, and chemical waste. Effluents that are fed into the LRW are separated according to quality and are then treated in a prefilter, activated carbon filter, ion exchangers and an after filter, before being reused in the plant.

Water use including additional opportunities to optimise water usage (e.g. rainwater harvesting) are subject to further design development and will be considered further at the site-specific stage.

4.4.2 Water Abstraction

The design of the cooling water intake infrastructure will be a site-specific concern and will be developed using BAT design principles. Control measures that will be considered include:

- Physical barriers, such as fish screens.
- Engineering constraints on intake velocity to prevent likelihood of fish becoming caught in the intake stream, such as low-velocity intakes.
- Physical deterrents, such as locating the inlet pipe away from specific habitats of interest and protected areas.
- Behavioural deterrents, such as light and sounds to scare fish and eels away from inlet.

For a site in which the cooling water is primarily derived from a freshwater source, abstraction limits may be determined by the relevant authority at the site-specific stage during the application for an abstraction licence. Use of fish deterrents will be considered for both coastal and freshwater sites.

As the GDA progresses and this chapter is updated, further information will be provided as the GDA progresses.

4.5 DISCHARGE TO SURFACE WATER

This sub-chapter describes the aspects of the generic SMR-300 which relate to discharges to surface water, within the GDA scope. Areas of the generic SMR-300 which fall outside the GDA scope, and which are of particular relevance to this sub-chapter will be discussed using assumptions and OPEX.

4.5.1 Waste Effluent Management

Fluid processes in the generic SMR-300 plant that use water and chemicals have specific requirements for water quality. These systems generate waste effluents through maintenance operations, including drainage and leaks.

The principal sources of process effluent streams are:

- Circulating Water System – including blowdown from cooling towers.
- Secondary circuit systems – including the Steam Generator Blowdown System (SGB).
- Liquid Radwaste System – including the non-radiological contaminants.
- Auxiliary cooling systems – including equipment cooling circuits.

The principal sources of non-process effluent streams are:

- Sewage effluent,
- Firewater,
- Surface water runoff,
- Laundry wastewater, and
- Sanitary wastewater.

Aqueous effluent from these sources will be treated (if applicable), collected, sampled and monitored as appropriate before release to the environment. All process effluents from the plant are treated in a batch process, recycled where appropriate, and (if recycling is not appropriate) discharged to the outfall before release to surface water [4]. All discharges have conventional (non-radiological) and radiological aspects.

The specific chemicals to be used in the generic SMR-300 plant and their concentrations and quantities are subject to further design development.

4.5.2 Circulating Water System

The CRS requires water for cooling purposes and consists of a steam surface condenser and a mechanical draft cooling tower system. Standard industry practice is to remove a blowdown from the water in the cooling tower system and reject this to the environment. This is essential to maintain water quality within the cooling circuit.

In accordance with standard industry practice, the blowdown effluent stream will typically contain biocides, scale inhibitors, polymer dispersants and corrosion inhibitors, as discussed in EA report, “Chemical discharges from nuclear power stations: historical releases and implications for Best Available Techniques” [45]. The specific selection of biocides used in the circulating water system will be considered at site-specific stage [45].

4.5.3 Secondary Circuit

The secondary circuit includes the steam generation system and the Main Feedwater System (MFS). The CPO ensures the water quality of the secondary coolant, for more information on water quality and treatment, see PSR Part B Chapter 23: Reactor Chemistry [11].

The SGBS is used to maintain water chemistry, alongside the CPO, within the process, which includes the control of pH, suspended solids, and conductivity. This is performed by managing accumulation of corrosion products and solutes in the Steam Generator (SG) blowdown water. The blowdown from the steam generator is filtered and purified in the condensate polishing system for blowdown recovery to the MFS.

When necessary, disposal may be required instead of recovery as to not exhaust the CPO resins, the blowdown will be sent to waste processing systems such as the Wastewater System (WWS) or the LRW, more information available in PSR Part B Chapter 23 [11]. If the blowdown water quality is poor and has a number of radionuclides below the threshold level for tolerable risk following sampling and monitoring, it will be directed to the WWS before discharge via the site outfall. Further details on the specifics of the WWS are not currently available and are out-of-scope for this document. Alternatively, if the blowdown contains elevated radioactivity levels, it will be directed to the LRW for further treatment.

The following considerations are made for the effluents generated by the SGB:

- The secondary coolant is dosed with pH raising agents to manage corrosion. Standard industry practice is to use chemicals such as ammonia, morpholine or ethanolamine [45]. These chemicals will typically be present in the blowdown water when discharged.
- Oxygen scavenging chemicals such as hydrazine will be used during normal operation and dosed during wet lay-up in shutdown operations to minimise corrosion through the removal of oxygen. Any contaminated fluid resulting from the wet lay-up activities will require treatment to destroy the hydrazine before it is discharged. Hydrazine can also decompose into ammonia.
- When dosing hydrazine, secondary side chemicals such as ammonia and amines are sometimes produced. These chemicals will also end up in the discharge.
- The SGs can be sparged and blanketed with nitrogen gas to prevent corrosion during lay-up. This results in no chemical contaminants in the discharge.

4.5.4 Liquid Radwaste System

The non-radioactive contaminants in aqueous radioactive waste effluent will primarily consist of contaminants such as boric acid and lithium hydroxide, both of which are dosed in the primary circuit. The following considerations are made for the effluents generated by the primary circuit:

- Boric acid is dosed in the primary coolant for reactivity control and may result in borated water being discharged to the outfall via the LRW. Aqueous effluent held up by the LRW is treated for reuse where practicable, minimising discharges. Deborating resins are used for removing boron to purify the reactor coolant towards the end of the cycle through the mixed beds in the Chemical & Volume Control (CVCS) system, reducing the quantity of boric acid to be discharged to the environment.
- When dosing boric acid, the pH of the system is lowered. To compensate, lithium hydroxide is dosed into the reactor coolant for pH control. Lithium-7 hydroxide is abated by the ion exchange resins in the LRW and upstream demineralisation processes, but residual quantities of this contaminant may be discharged to the outfall, along with boric acid.

The effluent stream from the LRW is sampled and monitored before discharge via the site outfall. A summary of all potential contaminants from process effluents is provided in Table 3 [45] below.

Table 3: Potential Contaminants from Aqueous Effluents Discharged via Outfall

Effluent	Potential contaminants
CRS blowdown water	Biocides (e.g. chlorine) Scale inhibitors Corrosion inhibitors Polymer dispersants Trace solutes and solids (e.g. chlorides, sulphates) [46]
SG blowdown water	Ammonia, morpholine or ethanolamine Hydrazine Amines Trace solutes and solids (e.g. chlorides, sulphates) [46]
Aqueous radioactive waste	Boric acid Lithium hydroxide Trace solutes and solids (e.g., chlorides, sulphates) [46]
Equipment and floor drains	Details of these effluent streams are subject to further design development.

Oil contaminants may arise from leaks (e.g. from machinery) but these are not normally expected in aqueous waste streams. Contaminated oil and organic solvent wastes may be generated during operation and maintenance of the plant however this is dealt with in the Solid Radwaste System.

4.5.5 Effluent discharges

Process effluents will be treated where practicable, sampled, and monitored prior to discharge to the local environment in accordance with BAT. It has been assumed at this stage that all discharge will be via a single outfall from the site to the receiving watercourse. Details surrounding sampling and monitoring arrangements will be established at a later stage and will be included in a future iteration of the PER.

Aqueous radioactive waste will be treated to remove suspended and dissolved solids prior to release to the environment (see PER Chapter 1 [4]).

SG blowdown will be fed to the CPO for treatment and re-use. When the SG blowdown water is of high impurity, the blowdown water will be directed through the WWS and to the outfall.

It is standard industry practice for the blowdown water from the CRS to be discharged directly to the outfall without treatment [45]. The CRS blowdown water volume will provide sufficient dilution of contaminants to meet environmental permits. The overall volume of high temperature water discharged from the plant is reduced due to use of mechanical draft cooling towers when compared to alternative techniques, e.g., direct cooling.

Table 4 below lists the anticipated chemicals expected to be released from Liquid Discharge Systems, OPEX will be used to supplement any missing information.

Table 4: Anticipated Chemical Characteristics of Effluent Released from Liquid Discharge Systems

Chemical	Average annual load (kg/y)	Maximum annual load (kg/y)
Boric acid	TBC	TBC
Lithium Hydroxide	TBC	TBC
Nitrogen excluding hydrazine	TBC	TBC
Hydrazine	TBC	TBC
Phosphates	TBC	TBC

Chemical	Average annual load (kg/y)	Maximum annual load (kg/y)
Total metals	TBC	TBC

4.5.6 Options for the Beneficial Use of Waste Heat

For the purposes of assessing the impact of the generic SMR-300, it has been assumed that mechanical draft cooling tower technology is going to be used in the design. This does not foreclose the final design of the SMR-300 utilising once-through or air-cooled cooling technology, or a hybrid solution. The site-specific design will be dependent upon site conditions and the application of BAT. Thermal energy from the steam in the steam turbine is transferred to the coolant which is then lost either by being carried in suspended water droplets which are carried to the atmosphere or through latent heat of evaporation. The remaining thermal energy is transferred to the fill within the cooling tower as the cooling water flows down to the reservoir. Most of the thermal energy is therefore dissipated to the atmosphere.

With a high secondary superheat, the generic SMR-300 is amenable to co-generation, district heating, or process heat applications, for example:

- Agriculture (heating greenhouses).
- Aquaculture (fish farming).
- Desalination.

Given that opportunities for the beneficial re-use of waste heat will be largely dependent on location, this is a topic that will be explored more fully at the site-specific stage.

4.5.7 Thermal Discharges

The information is not available at present on thermal discharge. This will be developed as the design matures.

4.5.8 Proposed Assessments

As the generic SMR-300 matures, more detail will be available to identify sources and treatments of wastewater and discharges to surface water.

4.6 DISCHARGE TO GROUNDWATER

This sub-chapter describes the aspects of the generic SMR-300 relevant for discharges to groundwater.

4.6.1 Discharges to Groundwater

There are no planned discharges to groundwater. The standard design includes a portion of the generic SMR-300 to be built below grade, i.e., below ground level, as described in Holtec SMR-300 Plant Overview [47]. In particular, the Spent Fuel Pool (SFP) is currently designed to sit at a level below ground. These levels of the facility will be designed to nuclear codes and standards for the prevention of leakages of any spent fuel pool water or other potential non-radiological pollutants.

The generic SMR-300 Codes and Standards report [48] sets out the codes & standards applied to ensure structural integrity and leak-tightness of SSCs for the generic SMR-300. The application of these engineering standards and best practice to prevent leakage of radioactive material from the below grade levels, also ensure leakage of non-radioactive pollutants will be prevented. Holtec SMR GDA PSR Part B Chapter 24 Fuel Transport and Storage [12] describes how the SFP is a Seismic Category I structure due to its importance in containment.

One consideration for the design is to ensure any in-leakage of groundwater is prevented. This is discussed in more detail in PSR Part A Chapter 2 [8] which discusses external hazards from flooding, including groundwater flooding.

The use of chemicals will be avoided and only used where necessary, other areas of the facility which could contain sources of non-radioactive pollutants (e.g., diesel fuel storage tank) will be appropriately designed to prevent land and groundwater pollution, for example using CIRIA guidance C736 [33]. It is assumed that monitoring, maintenance and inspection of such areas will be the responsibility of the operator of the facility. The appropriate management arrangements will form part of the standard operational procedures and are to be developed by the operator during site-specific stage to minimise and manage pollution events.

Storage of any fuels, oils, etc., will utilise RGP such as bunding and lining to mitigate consequences of accidental release. Best practice systems include leak detection systems, spill kits and emergency protocols. Furthermore, if the design includes storage and use of any dangerous substances, it will be identified at the detailed design stage of the project. Typically, RGP is to keep chemical constituents of any necessary dangerous substances and make up smaller volumes as and when they are required.

4.6.2 Proposed Assessments

As the generic design matures, appropriate measures to prevent leaks and accidental spills to ground will be implemented. As information becomes available, any aspects of the design which may give rise to accidental pollution will be identified.

4.7 OPERATION OF INSTALLATIONS (COMBUSTION PLANT AND INCINERATORS)

This sub-chapter describes the GDA requirements, regulatory context, and design considerations for any future incinerators within the generic SMR-300 as well as proposed assessments for how this will be managed as GDA progresses.

4.7.1 Design considerations

There are no incinerators in the generic SMR-300.

In the current design, there will be four diesel fuelled stand-by generators and one diesel fuelled security generator. Due to the fact that the generators are either for the purpose of providing nuclear safety and that the facility will be a nuclear licensed site, or that the generators are for providing emergency back-up power, these generators are excluded from needing a specified generator environmental permit, as outlined in the UK Government guidance for specified generators [36].

It may still be necessary to apply for a permit under EPR16 [32], which implement the requirements of the MCPD [35] in the UK, for the diesel generators depending on their overall thermal input. Details regarding the combustion fuel material, and the combustion technology will also affect the necessity for a permit.

Additional back-up power will likely be supplied by battery technology to assist Uninterrupted Power Supply (UPS). BAT considerations during design development will influence the type of batteries chosen for this purpose.

An auxiliary boiler for generating the initial start-up steam for the facility is intended to be used, and further information on the size, technology and fuel type will be provided as the design develops. At the current design stage, it is assumed the auxiliary boiler will be approximately 50 tons (US). It is not intended to generate electricity from the auxiliary boiler.

4.7.2 Proposed Assessments

As the design progresses, further information of the auxiliary boiler and stand-by generators will become available and so it will be possible to identify which activities fall under the legislative instruments mentioned above. Due to the nature of the facility, being a nuclear licensed site, emergency back-up diesel generators will likely be excluded from permit requirements, and this will need to be confirmed as design develops.

During the GDA process it is likely the need for permits can be identified, however the application for permits will be conducted at the site-specific stage. As necessary, OPEX will be used to supplement the available design information.

Emission monitoring equipment will be included in the design for activities which require a GHGE permit under the Greenhouse Gases Emissions Trading scheme [37], i.e., if the total (aggregate) thermal input across the installation is 20MW_{th} or higher.

4.8 CONTROL OF MAJOR ACCIDENT HAZARDS REGULATIONS

This sub-chapter illustrates the GDA requirements, regulatory context, and design considerations for COMAH regulations as well as proposed assessments for how this will be managed.

4.8.1 Design Considerations

The chemical inventory for the design of the generic SMR-300 is in the conceptual design stage and not yet developed.

The reactor primary coolant is a solution of boric acid, maintained at a concentration appropriate to control the reactivity of the core. Chemical additives to coolant will likely include corrosion inhibitors to protect the pipework and function of the reactor, see PSR Part B Chapter 23 for more information [11]. Chemical build-up in blowdown water may be removed and recycled. Exact coolant chemistry may be adjusted for the local water chemistry.

The ventilation system for the facility has three modes of operation: normal, recirculation and emergency. More detail about the safety function of the HVAC systems can be found in PSR Part B Chapter 5 [9]. In emergency mode, air is supplied by pressurised air tanks.

Storage of any fuels, oils, etc., will utilise RGP such as bunding and lining to mitigate consequences of accidental release. Best practice systems include leak detection systems, spill kits and emergency protocols. Furthermore, if the design includes storage and use of any dangerous substances, it will be identified at the detailed design stage of the project. Typically, RGP is to keep chemical constituents of any necessary dangerous substances and make up smaller volumes as and when they are required. Table 5 lists the properties of anticipated dangerous substances relevant to COMAH which are expected to be released from the generic SMR-300. This will be expanded on in later iterations of this chapter.

Table 5: Dangerous Substances in the Generic SMR-300 relevant to the COMAH

Chemical	Concentration (%)	Hazard statements	Quantity (t) / Volume (m^3)	Categories of Dangerous Substances	COMAH threshold (tonnes)	
					LT	UT
TBC	TBC	TBC	TBC	TBC	TBC	TBC
TBC	TBC	TBC	TBC	TBC	TBC	TBC

4.8.2 Proposed Assessments

It is expected that by the end of Step 2 GDA assessment, design maturity will not allow for a full chemical inventory to be shared. Despite this, a broad assessment of the types and approximate amounts can be estimated (using bounding case assumptions or OPEX from existing PWR where necessary) and included in future iterations of this document.

Any COMAH policy for the site will take note of the RGP and legal requirements in force at the time of writing.

4.9 FLUORINATED GREENHOUSE GASES AND OZONE-DEPLETING SUBSTANCES

This sub-chapter provides detail on the GDA requirements, regulatory context, and design considerations for any F-gases and ODS associated with this project as well as proposed assessments for how this will be managed.

4.9.1 Design Considerations

The generic SMR-300 HVAC systems are described in HI-2240777, Holtec SMR GDA PSR Part B Chapter 5 Reactor Supporting Facilities [9].

Aspects of the cooling systems including chillers will include refrigerants. UK government guidance on use of F-gases in air conditioning and heat pump systems can be used for identifying current and future banned F-gases [22]. The choice of refrigerant will also need to consider safety considerations as many refrigerants with a lower GWP are often more flammable, or more toxic. Where possible, alternatives for F-gases will be used or alternative methods of cooling may be identified. Leaks will be minimised for any refrigerant chosen, in accordance with best practice, through engineering design and monitoring, scheduled inspections and leak detection system.

The RP is committed to protecting the environment and human health therefore a balance must be made when choosing the appropriate refrigerant for the cooling systems of the facility. The Controls and Instrumentation (I&C) of the general design are configured to ensure minimal leaks to the environment (internal and external).

Other key areas for consideration will be the fire safety system as historically some fire protection systems used PFCs and HFC-23. Additionally, any refrigeration units (e.g., in kitchens or storerooms) will be selected based on their environmental performance. It is assumed commercial-off-the-shelf refrigeration units will be chosen. As the design progresses, assessments will be made on selection of equipment using F-gases and ODS. The design decision for specific equipment must consider all commitments to safety, security, health, and the environment to ensure that the impact of the facility is reduced.

Further information on the SSCs expected or known to use F-gases and ODS will be provided as GDA progresses. An assessment considering the systems and equipment protecting the environment from accidental release of F-gases and ODS may be conducted at a later stage of the design development, once site-specific information is known, and exact choices of refrigerants has been made.

4.10 SUSTAINABILITY

This sub-chapter details the GDA expectations, regulatory context, and design sustainability of the generic SMR-300 in relation to relevant UN SGDs, alongside proposed sustainability assessments.

4.10.1 Environmental Objectives of the Requesting Party

Holtec International embed sustainability into their company culture through their mission statement and Environment Justice Mission Statement [49]. The development of nuclear power contributes to carbon net zero energy generation due to its low carbon emissions compared to coal and gas-fired power stations. Therefore, sustainability is inherent in the development of the generic SMR-300.

4.10.2 Sustainability in Design

Generally, this SMR-300 project contributes to sustainable development by providing low carbon energy through development of SMR technology, specific areas of the generic SMR-300 provide clear sustainable benefits. Table 6 outlines specific SDG's that have been identified relevant to the development of the generic SMR-300. It is appreciated that the generic SMR-300 will contribute more directly to some SDGs more than others, but that the SDG should be considered as a whole and contributing to one to the detriment of another would not be acceptable. This table will be developed further as the design matures [41].

Table 6: Sustainable Development Goals relevant to Generic SMR-300

Goal number	Title	Environment, Social or Economic	Description of how generic SMR-300 contributes/will contribute
3	Good Health and Well-being	Environment, Social	TBC
5	Gender Equality	Social	TBC
6	Clean Water and Sanitation	Environment, Social	TBC
7	Affordable and Clean Energy	Social, Economic, Environment	TBC
8	Decent Work and Economic Growth	Social, Economic	TBC
9	Industry innovation and Infrastructure	Social, Economic	TBC
12	Responsible Consumption and Production	Environment, Social	TBC
13	Climate Action	Environment	TBC
14	Life Below Water	Environment	TBC
15	Life On Land	Environment	TBC

The generic SMR-300 uses operational experience and lessons learned, resulting in a simpler design compared to existing generation II and generation III plant designs. This has the sustainability benefit of having less components overall and reduced on-site construction. Modular construction generally is a more sustainable method of construction due to the possibility of producing design elements off-site (therefore minimising concrete-pouring activities on-site and reducing the possibility of environmental damage).

The generic SMR-300 has features which will enable sustainable operation. For example, careful development of the chemistry regimes leads to prolonged SSC life, therefore reducing the need for replacement components to be manufactured, transported and installed. Through this any carbon footprint associated with those activities is eliminated or significantly reduced.

Waste management represents an area where sustainability considerations have been incorporated into the design, for example the consideration of the waste hierarchy principles to mitigate any negative effects of radioactive wate on the public or environment. The radioactive waste management process will be optimised with respect to safety, technical feasibility, environment and socio-economic factors, more information on the sustainability of the radioactive waste management arrangements can be found in PER Chapter 1 [4]. The use of multi-purpose canisters (MPCs) with a large capacity for spent fuel assemblies reduces the quantities of materials needed per unit volume of waste. Further information on the waste canisters, and corresponding Interim Spent Fuel Storage Installation (SFSI) can be found in PSR Part B Chapter 24 [12]. Additionally, the use of a fully integrated dry fuel storage system avoids excluding alternative spent fuel management strategies in the future. Chapter 2 [5] discusses how the liquid and gaseous radwaste systems manage and reduce the proportion of effluent waste discharged to the environment.

The design has possible useful applications for waste heat as it has high secondary superheat, meaning it is amenable to co-generation, district heating or process heat applications.

With a service life of 80 years, an operational life double that of traditional nuclear power plants, enables resources to be appropriately optimised and materials used efficiently without exhausting essential resources. Through eliminating the requirement for further construction and decommissioning periods this lowers associated emissions that come with these processes, in turn reducing waste, conserving energy and the projects overall carbon footprint.

The SMR-300 presents opportunities for long-term social value benefits too. These are beyond the influence of the GDA however, some examples might include:

- The provision of long-term, stable work leading to enhancement of the local economy, over multiple generations throughout construction, operational and decommissioning stages of the project,
- The operator has the opportunity to manage and enhance nearby greenspace as part of its long-term Biodiversity Net Gain strategy (which is necessary for consenting). Enhanced natural spaces can provide ecosystem services, as well as improved habitats for ecology.
- The provision of apprenticeship and school-engagement activities, leading to upskilling of local workforce.

4.10.3 Proposed Assessment

Specific sustainability assessments, for example a Buildings Regulations Establishment Environmental Assessment Methodology (BREEAM) assessment (or equivalent), will be considered at the site-specific stage and as part of the development consenting process. A sustainable procurement plan may be developed during the siting process for life-cycle considerations of the facility. Any further requirements for Environmental Impact Assessments and Sustainability assessments will also be identified where these will support the consenting process.

Assessments such as these may be agreed and committed to at a later stage of the SMR-300 project, when site specifics are known and when the design has been further developed for areas out of scope for this GDA. Certainly, it is not possible to meaningfully conduct these assessments for this GDA.

4.11 SUMMARY

At the current stage of design, it is not possible to undertake a full CIA due to the information not being available. Forward actions have been identified for each of the main topic areas. Some of these forward actions can be progressed as part of the GDA process, while others only become applicable at the site-specific stage of the project.

As information becomes available, this chapter can be updated with greater detail to provide a clear picture of the key areas of concern for environmental impact. A summary of the key areas of the design which may give rise to environmental impacts is provided in this chapter and this forms the basis for further discussion going forward in the GDA process. Aspects of the design and broader project which contribute to sustainability can be identified at this early stage, and future assessments may be conducted at site-specific stage and/or detailed design stage.

There are requirements on the licensee and operator of the eventual facility to demonstrate compliance with environmental regulations and sustainability requirements, which will be considered during the future design stages so that the design can be optimised for environmental protection and sustainable development.

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