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Title

E3S Case Chapter 31: Conventional Environmental Impact and Other Environmental Regulations

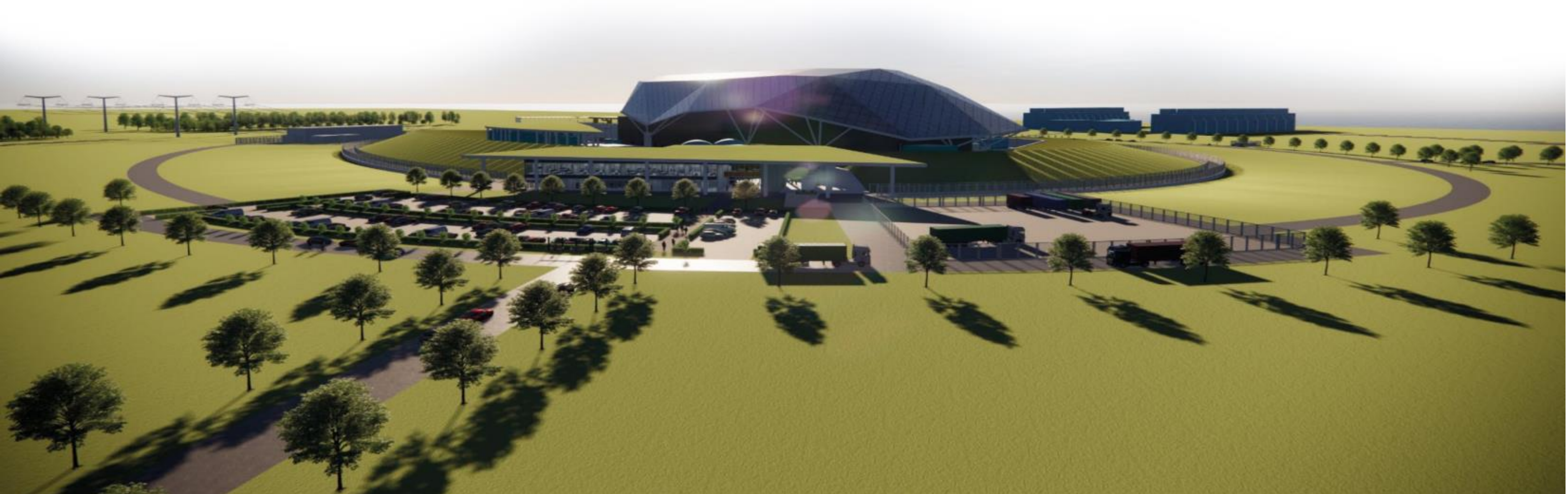
Executive Summary

This report is Chapter 31 of the Environment, Safety, Security and Safeguards (E3S) Case for the Rolls-Royce Small Modular Reactor (RR SMR). The report has been based upon the design information available at Preliminary Concept Definition (PCD).

The report presents information on the conventional (non-radioactive) environmental aspects of the RR SMR within the scope of the Generic Design Assessment (GDA) process and addresses the following topics:

- Water use and abstraction.
- Discharges to surface water.
- Discharges to groundwater.
- Operation of installations (combustion plant and incinerators).
- Control of Major Accident Hazards (COMAH) Regulations.
- Fluorinated greenhouse gases and ozone-depleting substances.

For each of these topics, the report summarises the applicable regulations, describes the relevant aspects of the RR SMR as currently configured, and identifies future assessments and design activities.



Contents

Tables

Figures

31.1 Introduction

31.1.1 Introduction to Chapter

This report presents Chapter 31 of the Rolls-Royce Small Modular Reactor (RR SMR) Environment, Safety, Security & Safeguards (E3S) Case. Chapter 31 forms part of the Generic Environment Report (GER) and is a Tier 1 report in the E3S Case as defined in E3S Case Chapter 1: Introduction.

The chapter presents information on the conventional (non-radioactive) environmental aspects of the design and has been issued based upon the design information available following the completion of Preliminary Concept Definition (PCD).

31.1.2 Objectives

The objectives of the final iteration of this Conventional Environmental Impacts chapter are to:

1. Demonstrate that conventional environmental aspects associated with the RR SMR facility have been identified and are appropriately understood for the current design phase.

2. Demonstrate that relevant environmental regulations associated with conventional environmental impacts are appropriately identified and the impact of those regulations on the design of the RR SMR are understood.

3. Demonstrate how the conventional environmental impacts associated with the RR SMR are being prevented, or where this is not possible, managed to minimise their environmental impact, taking into consideration legal requirements and Relevant Good Practice (RGP).

31.1.3 Scope

The chapter follows the structure of the *"Information relating to other environmental regulations"* section within the *"Information required for environment case as submission"* part of the Requesting Parties (RP) Generic Design Assessment (GDA) Guidance [1]. It addresses the following topics:

1. Water use and abstraction.

2. Discharges to surface water.

3. Discharges to groundwater.

4. Operation of installations (combustion plant and incinerators).

5. Control of Major Accident Hazards (COMAH) Regulations.

6. Fluorinated greenhouse gases and ozone-depleting substances.

For each of these topics, the report provides the regulatory context, describes the relevant aspects of the RR SMR as currently configured, and identifies future assessments and design activities.

This iteration of Chapter 31 does not formally identify Environmental Protection Functions (EPFs) or those Structures, Systems and Components (SSCs) that provide an Environmental Protection Measure (EPM) as the method for this process is still being developed. It is anticipated that EPFs and EPMs associated with conventional environmental protection will be included in the future updates to this report.

It should be noted that there are additional conventional environmental aspects that will be appropriately considered during the design of the RR SMR but are outside the scope of the GDA process and this iteration of Chapter 31. This includes, for example:

1. Conventional solid waste.
2. Amenity impacts.
3. Visual impacts.
4. Terrestrial ecology.

All conventional environmental aspects, including those outside the scope of the GDA process, will be assessed within future iterations of the E3S Case.

31.1.4 Key Interfaces with Other Chapters

This chapter draws upon the information in the Tier 1 E3S Case chapters. Notable topic areas within E3S Case that are involved in the continued development of the documentation/data for Chapter 31 are detailed in Table 31.1-1.

Table 31.1-1: Key Interfaces with Other E3S Case Chapters

Chapter Number	Chapter Title	Overview of Chapter
1	Introduction	Chapter 1 provides an overall introduction to the suite of 33 chapters that make up the E3S Case.
9A	Auxiliary Systems	Chapter 9A presents the overarching summary and entry point to the design and safety information for the Auxiliary Systems of the RR SMR. Auxiliary systems include the fuel handling and storage systems, water supply systems, and ventilation systems. Information on water supply will be of particular relevance to Chapter 31.
9B	Civil Structures	The Civil, Structural and Architecture (CS&A) [CIV] scope includes Essential Service Water System (ESWS [PB]) structures, Back-up Generation structures which are relevant to Chapter 31.
10	Steam & Power Conversion Systems	Presents the overarching summary and entry point to the design information for the Turbine Island [T01] steam and power conversion systems of the RR SMR. Turbine Island information will be relevant to Chapter 31.

Chapter Number	Chapter Title	Overview of Chapter
20	Chemistry	Presents the safety Claims and arguments associated with the chemistry of the RR SMR, including how the chemistry regime minimises risks and chemistry impacts on final discharges from RR SMR. It is therefore relevant to Chapter 31.
26	Detailed description of Radioactive Waste Management Arrangements	Describes Radioactive Waste Management Arrangements (RWMA) for RR SMR. Overview on how Waste Minimisation is applied, focus on disposability, optimised disposal routes.
27	Approach for Optimisation through the Application of BAT	Presents the Optimisation and Best Available Techniques (BAT) methodology used during the design of the RR SMR. Details the Claims, Arguments, and Evidence (CAE) for RR SMR to demonstrate that BAT has been applied. Strong interfaces between conventional BAT CAE and Chapter 31.

31.1.5 Fundamental Claims

Three fundamental Claims for conventional environmental aspects have been identified. The aspects of those Claims relevant to the scope of this chapter are:

1. Minimise the use of resources (water, energy and space/footprint).
2. Prevent, or where this is not possible, minimise the emission of substances which give rise to environmental impact (e.g. chemicals, hydrocarbons, greenhouse gases, ozone depleting substances, etc.).
3. Prevent, or where this is not possible, minimise the detrimental environmental impacts of the design.

This chapter provides elements of evidence that will support the arguments needed to satisfy the fundamental Claims listed above. It is recognised that the chapter reflects a point in time and that further engineering design is to be undertaken that will further underpin the fundamental Claims associated with conventional environmental aspects.

31.1.6 GDA Context

The following requirements in Table 31.1-2 are those directly relevant to this chapter and are taken from RP GDA Guidance [1]. This chapter will, on final issue, meet the requirements of Table 31.1-2.

Table 31.1-2: GDA Information Requirements for Generic Environment Report

GDA Information Requirements for Generic Environment Report [1]
Water use and abstraction: Must provide details and estimates of • Freshwater requirements for the design.

GDA Information Requirements for Generic Environment Report [1]
• Cooling water requirements for the design relevant to the generic site. The RP should include its consideration of: o Seawater or river water abstraction. o Use of conventional cooling towers or hybrid cooling towers. o Abstraction inlet fish deterrent schemes. o Fish return systems. **Discharges to surface water:** 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. • Identifying effluents, including both non-rad liquid effluents and the non-rad properties of radioactive liquid effluents, 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. **Discharges to groundwater:** 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 (the Environment Agency) do not normally allow discharges to groundwater. The RP must describe how accidental discharges of radioactivity to land and groundwater will be prevented in the detailed information they provide about their radioactive waste management arrangements. **Operation of installations (combustion plant and incinerators):** 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 plants is greater than 50MW, they must provide a comparison of the proposed technology against the relevant guidance. If the aggregate rated thermal input of all combustion plants 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. **COMAH:** The RP must identify whether they will store quantities of substances on site that are above the qualifying thresholds in COMAH 15. They must describe the measures taken in the design to prevent a major accident to the environment if they exceed a COMAH threshold.

GDA Information Requirements for Generic Environment Report [1]
Fluorinated greenhouse gases and ozone-depleting substances The RP must identify whether any equipment included in the design will contain fluorinated greenhouse gases or ozone-depleting substances - as defined in the Fluorinated Greenhouse Gases Regulations 2015 and Ozone Depleting Substances Regulations 2015.

31.2 Water Use and Abstraction

31.2.1 Regulatory context

It is considered that demonstration of compliance with relevant United Kingdom (UK) environmental legislation, which is primarily based on European Union (EU) legislation, will provide confidence to stakeholders that the RR SMR can operate in accordance with international environmental regulatory requirements.

The operation of the RR SMR cooling systems will be the major source of RR SMR water use and abstraction requirements. The cooling system will be designed and operated with due consideration to the BAT Reference (BREF) Document for Industrial Cooling Systems [2].

The two main pieces of environmental legislation applicable to water abstraction in England and Wales are:

1. The Water Resources Act 1991 (as amended) [3].

2. The Eels (England and Wales) Regulations 2009 [4].

Water abstraction from controlled waters is currently regulated under the Water Resources Act 1991 Part II, Chapter II, and the Water Resources (Abstraction & Impounding) Regulations 2006 [5]. A licence is required from the Regulators to impound water or to abstract over 20m^3 per day of water from a river or stream, reservoir, lake or pond, canal, spring, underground source or estuary, bay or arm of the sea. Abstraction licensing is a site-specific issue.

Abstraction from the open sea does not require a licence although the Regulators will be interested in the proposed scheme in terms of the potential impact on fish, particularly with regard to the Eels Regulations.

The UK Government intends to move the regulation of abstraction and impoundment of water from the Water Resources Act 1991 into the Environmental Permitting Regulations 2016 (EPR) [6] regime. After the move has taken place, permits instead of licences will be granted for the abstraction and impoundment of water [7].

The Eels (England and Wales) Regulations 2009 [4] implement EC Council Regulation (1100/2007) (the EC Eel Regulation) (Eels Regulations) [8]. This regulation requires the operator of an abstraction or water diversion of more than 20m^3 per day, or any discharge to a channel, bed or sea (out to six nautical miles) to screen it to prevent the entrainment of eels. It is an offence not to have a screen on any such intake or outfall unless the Environment Agency (EA)/Natural Resources Wales (NRW) has specifically issued notice to exempt the requirement.

In addition, the EA/NRW can require the provision of fish passes and screens for the protection of salmon and migratory trout (sea trout or sewin) under the Salmon and Freshwater Fisheries Act 1975 [9].

31.2.2 RR SMR Water Use

The RR SMR is being developed to operate on a wide range of sites, through adaption and optimisation of a single design, where such sites potentially include the categories of coastal, estuarine, riverine, lakeshore sites, and inland sites without a ready supply of cooling water. For the purposes of engineering design, it is currently assumed the RR SMR will operate at a coastal site.

The Cooling Water Island [C01] provides the primary means of removing waste heat from the power station and is made up of the following systems:

1. Main Cooling Water System (MCWS) [PA], which uses seawater and provides cooling for the main turbine condenser.
2. Auxiliary Cooling & Make-up System (ACMS) [PE], which uses seawater provides cooling to the Turbine Island Closed Cooling Water System (TICCS) [PG] and make-up and blowdown to the MCWS [PA].
3. Essential Service Water System (ESWS) [PB], a separate system that uses potable water and provides cooling to systems within the Reactor Island [R01].

The MCWS [PA] design is based upon indirect cooling via mechanical draught cooling towers (MDCTs) as this arrangement can be deployed on a greater range of sites than would be possible when using direct cooling. The indirect cooling system using MDCTs was selected following an optioneering process [10] which addressed a range of factors for direct and indirect cooling including operability, environmental impact, programme, and cost.

As the RR SMR is also compatible with direct cooling and closed cooling, site-specific requirements may lead to a change in final design, such as at coastal sites for example, as direct cooling may represent BAT. Therefore, RR SMR has not foreclosed decisions on other cooling systems made during the design stage.

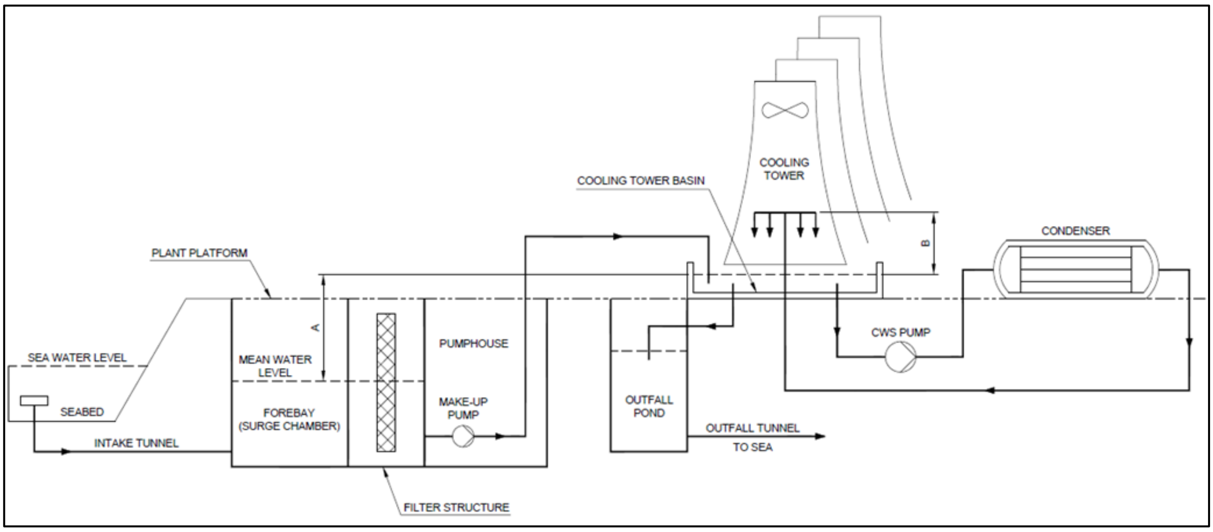


Figure 31.2-1: Indirect Cooling System Schematic

The water abstraction rate for indirect cooling will be approximately 1.47m^3/s [11]. In deployment locations away from the coast, freshwater can be used and abstraction quantities are likely to be lower than those required for the equivalent seawater cooling systems.

Other Water Requirements

Potable water is supplied through the plant potable water system [GA], which feeds the rest of the power station. Other water requirements include:

1. Demineralisation plant [GC].
2. Firewater system [XGA].
3. ESWS [PB] Cooling tower make-up [PBR].
4. General services water supply (cleaning etc.).

Potable water use has not been estimated yet but will be based on volume per operator. The water will be supplied from the mains so there will be no need for freshwater abstraction from surface or groundwater supplies. It is not envisaged that potable water supply will be further considered during generic design but will be an area of consideration during site-specific permitting.

31.2.3 Water Use Efficiency

Water recovery and re-use has been considered in the design of the RR SMR's effluent collection and treatment system. Effluents will be segregated in order to optimise their treatment and maximise the potential for water re-use. The Wastewater Drainage and Treatment System [GM] will comprise three systems (each with 2 x 100% trains) each performing a function as follows:

1. Treat ESWS [PB] cooling tower blowdown water for recycle back into the process.
2. Treat conventional non-active process drains for recycle back into the process [12].

Further work will be carried out, as the design progresses, to quantify water re-use and identify further opportunities for water minimisation, re-use and recycling.

Opportunities for rainwater capture and re-use are also being considered in addition to the recovery and re-use of water used for the operation of the RR SMR.

Sustainable water use solutions and options are currently being considered by the Sustainability Network for potential implementation. Thus, sustainable water use strategies will be developed at a later stage.

31.2.4 Water Abstraction

As the baseline design is for a coastal site it is assumed that seawater will be abstracted and discharged using the ACMS [PE] for the MCWS {PA]. This is assumed to be via a tunnel that will be designed specifically for the site. The baseline design assumes the cooling water will be abstracted through a **{REDACTED FOR PUBLICATION}** intake tunnel, that extends **{REDACTED FOR PUBLICATION}** offshore, to feed the make-up water system (required to compensate for the evaporated water from the cooling tower and limit the concentration of solid materials in the system). The intake of the tunnel will be developed using BAT design principles but is currently assumed to be a low velocity intake in a low marine life area and will have guard screens to exclude large debris with finer fish and debris screens utilised in the onshore forebay.

The design features of the abstraction system will be developed on a site-specific basis to, as far as possible, minimise its environmental impact. This will include consideration of:

1. Physical barriers and behavioural barriers such as porous dams, light and acoustic fish deterrents.

2. The design of the inlet structure to minimise intake velocities (to allow fish to escape entrainment).

3. The location of the inlet structure (to avoid particularly sensitive areas such as fish nurseries).

4. The design of the inlet structure to minimise impact to any marine life.

It should be noted that the above list is not exhaustive, and the details of relevant issues can only be determined during the site permitting phase.

31.3 Discharges to Surface Water

31.3.1 Regulatory Context

As previously noted, it is considered that demonstration of compliance with relevant UK environmental legislation, which is primarily based on EU legislation, will provide confidence to stakeholders that the RR SMR can operate in accordance with international environmental regulatory requirements.

Where required, liquid effluents will undergo treatment prior to discharge to surface waters. Where appropriate. the design of these treatment systems will give due consideration to all appliable European Commission BREF and BAT Conclusion recommendations, including the EU BREF document on Waste Treatment [13], which covers techniques for the prevention and control of emissions to water and physico-chemical and/or biological treatment of water-based liquid waste.

Discharges of trade effluent (which encompasses both radioactive and non-radioactive effluents generated at the generic site) to controlled waters (which include coastal waters out to the territorial limit) require a permit under the Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No.1154), as amended [6]. Application for the permit will necessitate the provision of information on the source of the effluent, its flow rate, contaminants present, and thermal load, and assessment of the impact of the releases on the receiving environment.

31.3.2 Effluent source and characteristics

Final discharges of liquid effluent to surface water will be via the Cooling Water Island Outfall.

Conventional, non-radioactive liquid effluents will be collected from:

1. R01 (Liquid Effluent Monitoring and Discharge System (LMDS discharge and Steam Generator Blowdown treatment plant effluents only).
2. Balance of Plant [B01].
3. Cooling Water Island [C01].
4. Turbine Island [T01].

Conventional liquid effluent drains will arise from the following sources:

1. Process drains:
    a. Steam generator blowdown treatment plant effluent.
    b. Wastewater Treatment Plant (WWTP) concentrate.
    c. R01 non-active drains.
    d. ESWS [PB] cooling tower blowdown.
    e. Demineralisation plant effluent.

f. Auxiliary boiler blowdown.

g. Equipment maintenance drains.

h. Floor drains - equipment leakages and floor washings in indoor non-active areas.

2. Spills - hydrocarbon / chemical.
3. Firewater system [XGA].
4. Stormwater.
5. Sanitary Drains.

Steam generator blowdown treatment plant effluent and WWTP concentrate will be sampled and discharged into the cooling water outfall.

ESWS [PB] cooling tower blowdown and demineralisation plant effluent will be treated in the WWTP which recycles effluent for re-use internally. The WWTP will **{REDACTED FOR PUBLICATION}** ensure appropriate segregation of effluents.

The remaining process drains will be fed into the sump drains system, whereby effluent will be filtered, settled and quality monitored. If the effluent quality is deemed adequate, it will be discharged into the cooling water outfall.

Chemical and bulk hydrocarbons spills will be avoided through appropriate design and operating techniques, but should they occur, chemicals and hydrocarbons will be collected and transported off-site for further treatment and/or recycle or disposal. These effluents will not be discharged to surface waters from the RR SMR.

Radioactive effluent, which will have the potential to contain conventional contaminants will arise from R01. This effluent is collected in one of three of tanks **{REDACTED FOR PUBLICATION}** in the Liquid Effluent Monitoring and Discharge System [KNF30] and in instances where the effluent cannot be recycled as demineralised water within R01, it will be sampled to determine suitability for discharge to the environment via the C01 outfall. If the samples indicate the effluent is unsuitable for discharge, the effluent will undergo re-treatment in the Processing and Treatment System for Spent Liquid Effluent [KNF20].

All effluents discharged to surface water will have the potential to contain conventional contaminants, and the RR SMR has thus been developed to ensure that effluents will be collected and transferred for treatment in a manner which will optimise their treatment and allow for re-use where practicable. All effluents discharged to surface water will have been subject to treatment, where required, to prevent significant adverse effects on the environment and comply with future environmental permit conditions. As the design matures, details on SSCs to prevent the release of polluting substances will be identified.

The effluent streams arising from the RR SMR for discharge to the environment will be characterised more fully as the design progresses with information developed to include details of effluent volumes, sources, the contaminants present and their concentrations, and justification for the selection of chemical additions (e.g. biocides and corrosion inhibitors). The outline information currently available on conventional aqueous effluent arising from normal operations for discharges via the Outfall is shown in Table 31.3-1. It should be noted that ESWS [PB] and demineralised water interfaces (along with firewater) are not considered to be routine discharges but the design of the

RR SMR will give due consideration to their potential arisings to ensure that they will be appropriately managed.

Table 31.3-1: Potential Conventional Contaminants of Routine Aqueous Effluents Discharged Via Outfall

Effluent	Potential Conventional Contaminants	Discharge Rate
Process Drains	May contain: • Treatment plant concentrates. • Process treatment additions including corrosion inhibitors (nitrites & molybdate). • Secondary circuit additions (ammonia, hydrazine) and steam generator blowdown. • Any auxiliary boiler treatment chemicals (amount and type of treatments required TBD). • Possible detergents from floor washings	Will be estimated as the design matures
MCWS [PA] Blowdown Water	• Concentrated salts and contaminants present in incoming in seawater. • Biocide. • Corrosion inhibitor. • Scale inhibitor. • pH control (if required). • Flocculant (if required). • Heat (the Outfall Pond enables effluent from different sources to mix so temperature and chemical composition can be balanced before discharging to the external environment via the Outfall).	**{REDACTED FOR PUBLICATION}**
Stormwater / Site run-off	Suspended solids and oils. The proposal is that site drainage will be segregated from potential contamination sources and discharged to surface water as uncontaminated surface drainage (which will not require an environmental permit). Site run-off is assumed ultimately to be discharged through the cooling water return.	**{REDACTED FOR PUBLICATION}**
Sanitary effluent	Sewage from staff welfare and canteen facilities.	Will be estimated as design matures and be based on staff numbers. Outage fluctuations will need to be considered.
Radioactive effluents from KNF30	Will arise from process, chemical and floor drains and so risk of highly variable contaminants. Effluent will undergo treatment in KNF20 prior to transfer to C01 outfall to ensure discharge conditions are met.	Will be estimated as design matures.

31.3.3 Effluent Discharge

The water recirculating in the MCWS [PA] will be dosed with biocide, scale inhibitor and corrosion inhibitor, and blowing down, a percentage of water will be used to control sediment and salt concentration. The blowdown will flow from the cooling tower basins to the outfall pond.

The current design baseline is to use Sodium Hypochlorite as a biocide which will be dosed in the make-up water, after fish removal measures and in the cooling tower basin. Scale and corrosion inhibitors will be site specific but based on polymers.

The outfall structure will be designed to diffuse the discharges to ensure mixing and minimise the thermal plume as far as is reasonably practicable, with site specific abatement methods used to minimise the environmental impact of discharges.

Table 31.3-2: Outfall Tunnel Flow Rates

{REDACTED FOR PUBLICATION}

The outfall diffusion structure will be site-specific but **{REDACTED FOR PUBLICATION}** the outlet will remain submerged during all tidal conditions. The intake and outfall will be sited such that there is no recirculation effect between the intake and outfall flows. Separation distances are inherently site-specific and will be confirmed via modelling during detailed design.

31.3.4 Options for the Beneficial Use of Waste Heat

Cooling water circulating through the condenser is used to condense the steam passing through the turbines. In the RR SMR the heat transferred to the circulating water in the condenser (termed "waste heat") is then discharged to the atmosphere via evaporation in the cooling towers. If a direct cooling system were to be used the waste heat would be discharged in the cooling water return (the discharged cooling water would be warmer than the intake water).

There is the potential to take heat from the condenser outlet and supply it for beneficial and more sustainable uses such as:

1. Crop growing (e.g. heating greenhouses).
2. Aquaculture (fish farming) facilities.
3. Desalination.

Options for the beneficial re-use of waste heat will be identified further and will be considered as the design matures and more information becomes available on characteristics of waste heat e.g. temperature and volumes. Viable options will depend on the amount and grade of waste heat available, as well as the proximity and demand from local heat users. Whilst the selection of options for beneficial use of waste heat is highly site-specific, options have been considered in the design to date and can be accommodated through minor alteration of the system architecture. Beneficial use of re-heat will thus be addressed more fully at the site-specific stage.

31.3.5 Summary of Proposed Assessments

More detail will be provided on the following topics as the RR SMR progresses in design maturity:

1. Effluent sources for conventional waste.
2. Effluent sources for excess heat.
3. Design of the effluent collection and treatment systems together with supporting BAT assessments.
4. Characterisation of discharges from the effluent treatment systems and direct discharge (e.g. the MCWS [PA] blowdowns), highlighting the likely presence of any priority substances.
5. Controls on non-conforming effluents and transfers between collection systems.
6. Controls in the event of detection of unplanned contamination of discharges.
7. The proposed thermal uplift of ACMS [PE] discharges.
8. An assessment of the environmental impact for the disposal of each individual effluent stream.

It is envisaged the approach to assessing the environmental impacts arising from the discharge of chemical loads will be based on the use of the EA Surface Water Pollution Risk Assessment for Environmental Permits [14] at the generic site.

Assessing the environmental impact of the thermal plume generated by the Cooling Water discharge will require the use of complex computational modelling and detailed information on the characteristics of the receiving water body, backed by local monitoring data from the development site. It is therefore proposed that no thermal dispersion modelling is undertaken during generic design phase, on the basis that the assessment of the impact of thermal dispersion is site-specific. The thermal impact of discharges will thus be assessed in detail at the site-specific permitting stage.

Preliminary options for the beneficial use of the RR SMR's waste heat will be identified at a later stage in the generic design phase recognising that this is being managed by the RR SMR Sustainability Network.

31.4 Discharges to groundwater

31.4.1 Current Status

There are no planned discharges to groundwater from the RR SMR. This position is unlikely to change as the design matures.

31.4.2 Regulatory Context

BAT measures will be identified that are used to prevent accidental leaks and spills of non-radioactive pollutants that could give rise to accidental pollution of land and groundwater. Consideration will be given to RGP and industry guidance on secondary and tertiary containment systems, for example CIRIA guidance C736 [15]. Measures to prevent accidental leaks and spills of pollutants to groundwater will include Physical and Management measures and will be formally recognised as EPMs.

31.4.3 Summary of Proposed Assessments

Throughout the design process, the BAT measures which will be used to prevent accidental leaks and spills of non-radioactive pollutants which could give rise to accidental pollution of land and groundwater will be formally identified. These will include:

1. Avoidance and minimisation of chemicals and oils stored on site in the first instance.

2. Physical measures, such as primary, secondary and tertiary containment of potentially polluting materials (e.g. chemicals and oils), and the use of interceptors.

3. Management measures such as staff training and Examination, Maintenance, Inspection and Testing (EMIT) procedures.

31.5 Operation of Installations (Combustion Plant and Incinerators)

31.5.1 Current Status

The RR SMR does not include an on-site incinerator.

The current design intent is that the RR SMR will raise auxiliary steam via a hybrid of electric boiler and fired boiler (fuel source TBD). The current assumption is that the fired boiler will use low-sulphur diesel, operate for approximately 3-5 days every 18 months and be a mobile plant that is removed from site when not in use. The aspect of the RR design will be kept under review for the purposes of future permitting – see Section 31.5.2.

Current estimates are that the RR SMR emergency power demand will be 3MWe. The technology to provide this has yet to be established and a range of options will be considered during GDA. However, diesel generators are currently used as a layout assumption on the basis that the footprint can be estimated with good confidence based on other power plant designs, and the overall footprint of the other typical option (gas turbine generators) is likely to be similar.

Batteries are likely to provide additional support to back-up power. BAT optimisation during design applies across the board and there are key non-rad considerations for the 'type' of batteries alongside potential environmental/waste disposal risks. Any relevant information from this work will be shared with assessor and may be included at high level if agreed relevant.

Additional combustion plant, not providing a nuclear safety function e.g. infrastructure associated with water management, waste treatment or fuel storage may feature in the design and will be assessed as necessary to help ensure optimised design and regulatory compliance.

31.5.2 Regulatory Context

Permitting

Within the UK or EU, the regulatory regime that would apply to any combustion plant deployed at a RR SMR will depend on the thermal input capacity of all combustion plant on the site. If diesel engines were selected for standby generation, engines with the thermal input capacity of approximately 8.5MWth would be required to provide 3MWe power output. This does not, however, take into account any allowance for redundancy or diversity requirements in the generating equipment, so additional generating capacity may well be required. This will be determined as the design progresses if diesel generators are selected.

It is considered likely that the RR SMR combustion plant will be below the 50MWth input threshold for a Schedule 1 Installation under EPR2016 [6]. The plant would, though, probably come under the provisions of EPR2016 Sch.25A (Medium Combustion Plant (MCP) Controls) due to their likely thermal rating of between 1 and 50MWth. Provided the combustion plant are operated for the purposes of testing less than 500 hours a year no Emission Limit Values (ELVs) would apply, although they would need to have an ERP2016 Sch.25A MCP Permit. There is no requirement to demonstrate BAT as part of the permit application for the MCP Directive (MCPD) Regime.

If the thermal input capacity of all the combustion plant exceeds 20MWth, the plant would also require a Part B Environmental Permit under EPR2016 [6]. This regulatory requirement applies solely to controlling emissions to air (rather than to all environmental media as is the case under Part A Environmental Permits). There is specific regulatory guidance for Part B combustion plant, which a RP would be expected to address at GDA if relevant.

Any diesel generators would be expected to be Excluded Generators under EPR2016 Sch.25B (Specified Generator Controls), by virtue of a specific exclusion for emergency plant on nuclear licensed sites. This will be confirmed with the Regulators during the permit application process (by the future permit holder) but would mean that the requirements of the Specified Generator Controls would not apply.

Future iterations of the E3S Case will present an assessment of the effect of any combustion plant air emissions, including any proposed measures to minimise their environmental impact. This is likely to be required even if the plant is only MCPD-sized, as air modelling is often required for MCPD plant, particularly diesel generators. The assessment will require input information on stack location, surrounding building dimensions operating modes (particularly the test running regime), and capacity of the combustion plant. A stack height calculation is likely to be required to support dispersion modelling of combustion products and help inform whether the proposed stack height(s) represent the BAT option. Stack height calculation is likely to follow, or be very similar to, the HMIP D1 Stack Height Calculation method [16], noting that the default values in the D1 method for local background and current air quality guideline value are out of date and will need to be substituted with more representative values as appropriate [17].

The current assumption is that operation of any combustion equipment potentially would be a Part B activity (and MCP). However, there is potential that due to other conventional Part A(1) installation activities undertaken, that a Part A(1) installation permit would be needed incorporating any Part B combustion within the same permit to avoid multiple permits. Whilst an A(1) installation permit would place specific conditions on the operation of combustion equipment that would not be required under a Part B installation permit (e.g. BAT and emissions to water/sewer), the future permitting requirements will not affect the design of any combustion equipment within the RR SMR. All combustion equipment will be optimised through design in accordance with BAT principles.

The effects of emissions discharged from the combustion sources will be evaluated using the EA's air emissions risk assessment tool [18]. If diesel generators of larger capacity than described above are selected as sources of back-up power, then more detailed assessment may be necessary.

Greenhouse Gas Emissions

Combustion plant over 20MWth in the EU and UK require a Greenhouse Gas Emissions (GHGE) Permit. In the EU the GHGE permit is under the Greenhouse Gas Emissions Trading Scheme Regulations 2012 [19], the instrument which regulates combustion plant operators' compliance with the European Union Emissions Trading Scheme (EU ETS). In the UK, the UK Emissions Trading Scheme (UK ETS) replaced the UK's participation in the EU ETS on 1 January 2021. The UK ETS is established through the Greenhouse Gas Emissions Trading Scheme Order 2020 [20]. The UK was instrumental in developing the EU ETS and the requirements of both regulations are very similar.

Both regulations require operators of qualifying plant to register for a 'Greenhouse Gas Permit' and establish management arrangement to ensure records of engine running and fuel use are kept and reported to the Regulators.

The Greenhouse Gas permit is not required until just before the combustion plant starts operating.

31.5.3 Summary of Proposed Assessments

As the design matures, the technology to supply back-up electrical power to the RR SMR will be known. If diesel engines (or other combustion plant) are selected, the design will be developed, ensuring that BAT and regulatory requirements are identified and addressed as necessary. A comparison of the proposed technology against the sector guidance will be provided.

If the aggregate rated thermal input of all combustion plant is greater than 20MWth, a description will be provided of how greenhouse gas emissions will be monitored. Outline information on typical operator management arrangements to meet the monitoring and reporting requirements will be provided.

31.6 COMAH

31.6.1 Current Status

The RR SMR chemical inventory is in development. As the design matures, an assessment will be carried out to identify the quantities of named or generic categories of dangerous substances that will be produced, used, handled and stored on site, and the COMAH aggregation calculations will be undertaken to determine whether a RR SMR is likely to be a COMAH establishment (and whether it is Lower or Upper Tier).

Based on current information available at PCD, the RR SMR is unlikely to be upper tier COMAH establishment and there is a driver to ensure that the RR SMR falls into the lower tier.

31.6.2 Regulatory Context

The COMAH regulations [21] relate to the prevention, control and mitigation of the effects of accidents. They apply to establishments that store or use quantities of named or generic categories of dangerous substances above specified qualifying thresholds. The COMAH Regulations specify two threshold quantities for each listed substance or risk category of substance: the lower quantities are the threshold for Lower Tier COMAH establishments, the higher quantity is the threshold for Upper Tier COMAH establishments. For any establishment falling in either the upper or lower tier, the operator must take all measures necessary to prevent major accidents and limit their consequences for human health and the environment. The COMAH Regulations cover both mixed and pure substances as classified in accordance with the Classification, Labelling and Packaging (CLP) Regulation and wastes with major accident potential. The COMAH Regulations do not cover radioactive materials.

Further consideration will be given to how many units at one location may change COMAH category, and the potential that the COMAH status of the site may change dependent on the chemical inventory during specific stages of the RR SMR lifecycle, such as during decommissioning.

Whilst it is recognised that there may be future changes that result in the RR SMR falling within a different COMAH tier to that currently anticipated, there is a driver during the design of the RR SMR to ensure that the RR SMR does not fall within the upper tier.

Should hazardous substances be stored or used at or above defined limits within the Planning (Hazardous Substances) Regulations 2015 or the Planning (Hazardous Substances) (Wales) Regulations 2015, a hazardous substance consent will need to be granted by the relevant Hazardous Substances Authority. An application for hazardous substances consent will require the submission of information including the measures taken or proposed to be taken to limit the consequences of a major accident.

31.6.3 Summary of Proposed Assessments

Future iterations of this chapter will provide the maximum quantities of any dangerous substances that will be stored on the RR SMR site once proposed dangerous substances are fully known. These quantities will be compared with the corresponding COMAH qualifying levels and classification of site to determine whether a RR SMR is likely to be a COMAH establishment, and whether it is Lower or Upper Tier. If the site is a COMAH site, a description will be provided in future iterations of the E3S Case of the measures incorporated in the design to prevent a Major Accident To The Environment (MATTE), which will be based upon the Chemical and Downstream Oil Industries Forum (CDOIF) Environmental Risk Assessment method.

31.7 Fluorinated Greenhouse Gases and Ozone Depleting Substances

31.7.1 Current Status

The RR SMR chemical inventory is currently in development.

31.7.2 Regulatory Context

In April 2022, the European Commission made a legislative proposal [22] to update the 'Fluorinated Greenhouse Gases Regulations' [23] with the intention to:

1. Deliver higher ambition e.g. through a tighter quota system for hydrofluorocarbons (HFCs) – HFC phase-down: reduce the amount of HFCs placed on the market by 98% by 2050 (compared to 2015). New restrictions on the use of fluorinated gases in equipment are also included.

2. 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.

3. 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.

4. Achieve more comprehensive monitoring, e.g. by covering a broader range of substances and activities and improving the procedures for reporting and verifying data.

To what extent regulations in England and Wales will follow EU changes is presently unknown, however these requirements are likely to be upheld and as RR SMR is to be deployed world-wide, compliance with these regulations will be adhered to. Regulations covering England and Wales will be monitored at the Project proceeds.

31.7.3 Summary of Proposed Assessments

The design will be reviewed to identify whether the use of any fluorinated gases or ozone-depleting gases is proposed. Where any are proposed, the potential to avoid their use or their replacement with less harmful alternatives will be reviewed noting that whichever gases are used, the design should ensure leaks do not occur and the system can be inspected and maintained in accordance with regulations. Where they cannot be replaced, a description will be provided of the measures taken in the design to prevent and minimise leakage. A report will be provided on this matter demonstrating use of BAT and compliance against relevant regulations at a later stage once the proposed fluorinated gases and ozone-depleting gases are known.

31.8 Conclusions

31.8.1 Conclusions

Information relating to other environmental regulations that need to be reflected in the RR SMR and covered in E3S Case have been presented in Chapter 31 based on the current design at PCD of the RR SMR. The sources of conventional environmental aspects and the applicable regulations needed to effectively manage these aspects have been identified. As the design of the RR SMR matures, the design will be optimised to help ensure that BAT is applied to minimise the environmental impact of the RR SMR and the design and future operation complies with all legal requirements.

Future iterations of Chapter 31 will provide more detailed characteristics of the conventional environmental aspects of the RR SMR, the techniques proposed to manage these aspects and minimise their impact on the environment and how the engineering design fulfils legal obligations.

It is recognised that many of the conventional environmental impacts will be site specific e.g. marine life protection and cooling water system, but the RR SMR is being designed with the required flexibility to apply the most suitable techniques and not foreclose options.

31.8.2 Assumptions and Commitments on Future Permit Holders/Dutyholders

The intention is that the E3S Case will capture assumptions and commitments for future permit holders/dutyholders/licensees. Environmental assumptions and commitments for permit holders have not been formally captured at this stage in the process, but will be included in future revisions of the GER.

31.8 References

[1] Environment Agency, Natural Resources Wales, & Office for Nuclear Regulation, "New nuclear power plants: Generic Design Assessment guidance for Requesting Parties," October, 2019.

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[3] *Water Resources Act 1991,* 1991.

[4] *The Eels (England and Wales) Regulations 2009,* December 2009.

[5] *The Water Resources (Abstraction and Impounding) Regulations 2006,* March 2006.

[6] *Environmental Protection, England and Wales: The Environmental Permitting (England and Wales) Regulations 2016,* December 2016.

[7] "Changes to the regulatory framework for abstraction and impounding licensing in England: Moving into the Environmental Permitting Regulations regime," DEFRA, [Online]. Available: https://consult.defra.gov.uk/water/abstraction-impounding-epr-consultation/. [Accessed 24 January 2023].

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[11] Assystem Report, "CWI Water Balance, SMR0001966," October 2022.

[12] RR SMR Report, "RR SMR Design Overview Report, SME0000594," June 2022.

[13] European Commission, "Best Available Techniques (BAT) Reference Document for Waste Treatment," 2018.

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[15] CIRIA, "Containment systems for the prevention of pollution, C736F," June 2014.

[16] Her Majesty's Inspectorate of Pollution, "Technical Guidance Note (Dispersion) D1: Guidelines on Discharge Stack Heights for Polluting Emissions," June 1993.

[17] DEFRA, "FAQ 89: HMIP D1 Stack Height Calculation," [Online]. Available: https://laqm.defra.gov.uk/faqs/faq89/. [Accessed 26 January 2023].

[18] Environment Agency, "Guidance: Air emissions risk assessment for your environmental permit," July 2022.

[19] *The Greenhouse Gas Emissions Trading Scheme Regulations 2012,* December 2012.

[20] *The Greenhouse Gas Emissions Trading Scheme Order 2020,* 2020.

[21] *The Control of Major Accident Hazards Regulations 2015,* March 2015.

[22] European Parliament Briefing, "Review of the Regulation on fluorinated greenhouse gases - Fit for 55 package, PE 733.673," September 2022.

[23] *The Fluorinated Greenhouse Gases Regulations 2015,* February 2015.

31.9 Acronyms and Abbreviations

ACMS [PE]	Auxiliary Cooling & Make-up System
B01	Balance of Plant
BAT	Best Available Techniques
BREF	Best Available Techniques Reference
C01	Cooling Water Island
CAE	Claims, Arguments, Evidence
CDOIF	Chemical and Downstream Oil Industries Forum
CIRIA	Construction Industry Research and Information Association
CLP	Classification, Labelling and Packaging
COMAH	Control of Major Accident Hazards Regulations
CS&A	Civil, Structural and Architecture
E3S	Environment, Safety, Security & Safeguards
EA	Environment Agency
ELV	Emission Limit Values
EMIT	Examination, Maintenance, Inspection and Testing
EPF	Environmental Protection Function
EPM	Environmental Protection Measure
EPR	Environmental Permitting Regulations
ESWS	Essential Service Water System
EU	European Union
EU ETS	European Union Emissions Trading Scheme
FA	Forward Action
GDA	Generic Design Assessment
GER	Generic Environment Report
GHGE	Greenhouse Gas Emissions
HFC	Hydrofluorocarbons
HMIP	Her Majesty's Inspectorate of Pollution

LMDS	Liquid Effluent Monitoring and Discharge System
MATTE	Major Accident To The Environment
MCP	Medium Combustion Plant
MCPD	Medium Combustion Plant Directive
MCWS	Main Cooling Water System
MDCT	Mechanical Draught Cooling Towers
MSL	Mean Sea Level
NRW	Natural Resources Wales
PCD	Preliminary Concept Definition
R01	Reactor Island
RGP	Relevant Good Practice
RP	Requesting Parties
RR SMR	Rolls-Royce Small Modular Reactor
RWMA	Radioactive Waste Management Arrangements
SSC	Structures, Systems and Components
T01	Turbine Island
TBD	To Be Determined
TICCS	Turbine Island Closed Cooling System
UK	United Kingdom
UK ETS	United Kingdom Emissions Trading Scheme
WWTP	Wastewater Treatment Plant