Generic design assessment of new nuclear power plants

Other environmental regulations for the UK HPR1000 design - AR08

Detailed assessment – final report

10 January 2022

Version 1

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Executive summary

This report covers our detailed assessment of the Requesting Party's (RP) submission on information relating to other environmental regulations supporting the development of the United Kingdom Hualong One Pressurised Reactor design (UK HPR1000). Our requirements and expectations regarding these arrangements are set out in Table 1, Item 8 of our Process and Information Document (P&ID) (Environment Agency, 2016).

In the GDA process, regulatory effort is focused primarily on matters relating to the minimisation and disposal of radioactive waste and its impact on the environment. Additionally, there are number of other important environmental regulatory requirements that may also apply to the construction, operation and decommissioning of a nuclear power plant. Those where the Environment Agency has a regulatory role include:

- water use and abstraction – nuclear power plants require significant volumes of water for various uses in the operation of the power plant, including for cooling, and an abstraction licence may be required

- discharges to surface waters – nuclear power plants produce non-radioactive liquid waste streams, including waste heat, which require an environmental permit to discharge to surface water

- discharges to groundwater – any discharges to groundwater need an environmental permit

- operation of installations – nuclear power plants require back-up power (for example, diesel generators) in the case of loss of off-site power. Any combustion plant used may need an environmental permit and a greenhouse gas permit. Any incineration of waste on site may also need an environmental permit

- substances subject to the Control of Major Accident Hazards (COMAH) Regulations – nuclear power plants typically use substances classed as dangerous under the regulations, such as diesel oil or hydrazine, and may be subject to COMAH regulations depending on the amount of such substances stored on site

- fluorinated greenhouse gases and ozone-depleting substances - legal requirements are placed on the operator of a site where these types of substances are used

The RP presented information covering these areas in its Conventional Impact Assessment (GNSL, 2021a) following the requirements in Section 8 of Table 1 of our Process and Information Document (P&ID) (Environment Agency, 2016).

There are certain aspects of the UK HPR1000 cooling water design that can only be specified at the site-specific stage. These include the abstraction intakes and fish deterrent and return schemes.

It has been agreed that the assessment of the thermal impact of discharges to surface waters will be out of scope of GDA as this requires information on the behaviour of the site-specific receiving surface water.

Our main conclusions for each of the topic areas covered in our assessment in relation to our future regulation of the UK HPR1000 are:

- an abstraction licence would not be required if cooling water is abstracted from open coastal waters, but it is likely to be required if an estuary location is chosen

- the discharge of non-radioactive liquid waste will require an environmental permit for a water discharge activity. However, a future operator would need to provide more detailed information on the aqueous waste streams and demonstrate that the environmental impact from the discharges is acceptable at the site-specific permitting stage

- there are no proposed direct or indirect discharges to groundwater based on the generic design, therefore, an environmental permit for groundwater discharge activities is not required. The pollution prevention techniques specified in the design should prevent contamination of groundwater. If any of the generic design assumptions change at a site-specific stage, then this conclusion will need to be reconsidered

- the combustion plant proposed to be used (diesel generators) would require an environmental permit for an installation activity. A future operator would need to provide a best available techniques (BAT) case for the specific design of the generators selected for use, demonstrate that the combustion plant would comply with emission limit values for certain substances that we determine to be necessary and that the impact on people and the environment would be acceptable

- the UK HPR1000 has been assessed not to fall under the COMAH Regulations during its commissioning or operational phases. If any of the generic design assumptions change at a site-specific stage, then this conclusion will need to be reconsidered

- no ozone-depleting substances are proposed to be used in the design

- the proposed quantities of specific fluorinated greenhouse gases to be used in the design are currently acceptable under the relevant legislation and in common with current UK practice. The level of detail in the proposed measures to prevent and minimise leakage is considered acceptable for GDA

We have not identified any GDA Issues.

We have identified a number of Assessment Findings that we would expect a future operator to address. These are:

Assessment Finding 37: A future operator shall engage with the local water supply company early in the site-specific stage. This is to ensure that sufficient quantities of fresh water can be supplied to meet the requirements of the UK HPR1000 or to determine whether an alternative source of fresh water will need to be identified.

Assessment Finding 38: A future operator shall ensure that the siting of the cooling water intake and outlets are BAT for the UK HPR1000 design at each specific site.

Assessment Finding 39: A future operator shall review the calculations for emissions of chemicals as part of the site-specific environmental risk assessment. Particular attention should be focused on the application of possible treatment techniques for hydrazine to reduce the amount discharged to the environment and arrangements to minimise any impact.

Assessment Finding 40: A future operator shall ensure that the storage, treatment and monitoring systems for the 3 non-radioactive effluent streams provide the appropriate level of environmental protection for the receiving environment in terms of quality of effluent discharged. This would be regulated by a water discharge activity permit.

Assessment Finding 41: A future operator shall provide in an application for a water discharge activity environmental permit a site-specific environmental impact assessment for discharges to water. The modelling shall use site-specific parameters based on the environmental setting and the specific chemicals selected for use.

Assessment Finding 42: A future operator shall provide in an application for an environmental permit a BAT assessment of the specific combustion plant selected for use against the relevant BAT guidance at the time of application.

Assessment Finding 43: A future operator shall provide in an application for a combustion activity environmental permit a site-specific environmental impact assessment for discharges to air. The modelling shall use site-specific parameters based on the environmental setting and the specific combustion plant selected for use.

Assessment Finding 44: A future operator shall keep the chemical inventories on its site under review so any applicability of COMAH can be identified early and the necessary major accident prevention measures can be installed.

Assessment Finding 45: A future operator shall keep the fluorinated greenhouse gases proposed for use in the UK HPR1000 under review to ensure they continue to be legally acceptable for use.

Contents

1. Introduction

This report provides our detailed assessment of the Requesting Party's (RP) submission in relation to other environmental regulations in the UK HPR1000 design for GDA purposes.

This report is based on the final generic design assessment (GDA) submissions, consideration of all relevant consultation responses and submissions to General Nuclear System Limited's (GNSL) comments process up to 17 September 2021.

We use a 2-stage process to carry out GDA: initial assessment, followed by detailed assessment. The findings from our initial assessment are set out in the Initial assessment: Statement of findings published in November 2018 (Environment Agency, 2018).

This detailed assessment has built on that initial assessment and is based on additional submissions and technical engagement with the Requesting Party (RP) throughout the GDA process. We held a public consultation on our preliminary conclusions on the detailed assessment for 12 weeks between 11 January 2021 and 4 April 2021 (Environment Agency, 2021a & b). Our assessment method, findings, responses to public consultation comments relevant to the scope of this assessment and final conclusions are presented in this final detailed assessment report.

Our GDA process focuses primarily on matters relevant to radioactive waste. In addition to the regulations covering the minimisation and disposal of radioactive waste, there are a number of other environmental regulations that apply to a nuclear power plant. The GDA process ensures that the Requesting Party (RP) has considered the requirements of these regulations in its design.

Our Process & Information Document (P&ID), (Environment Agency, 2016) sets out the information we require on other environmental regulations as follows:

- water use and abstraction
- discharges to surface waters
- discharges to groundwater
- operation of installations (combustion and incineration)
- Control of Major Accident Hazards (COMAH) Regulations
- fluorinated greenhouse gases and ozone depleting substances

Each of the above topic areas are covered within the RP's Conventional Impact Assessment submission (GNSL, 2021a).

Our P&ID was replaced by the 'Guidance for Requesting Parties' (https://www.gov.uk/government/publications/new-nuclear-power-plants-generic-design-assessment-guidance-for-requesting-parties/new-nuclear-power-plants-generic-design-

assessment-guidance-for-requesting-parties) in 2019. This assessment is based on the 2016 P&ID, which was in place when this GDA began (Environment Agency, 2016).

Our assessment of the submissions and the supporting documents throughout the GDA process generated a number of Regulatory Queries (RQs). A summary of these RQs is provided in Appendix 2. Subsequent responses to these RQs and discussions at meetings with the RP have been incorporated into the final version of the document 'Pre-Construction Environmental Report - Chapter 8 Conventional Impact Assessment V2' (GNSL, 2021a).

2. Assessment

2.1. Assessment method and process

This assessment covers the RP's 'Conventional Impact Assessment' submission (GNSL, 2021a). This submission covered a number of different topic areas that are relevant to the operation of the UK HPR1000.

Our approach to the assessment was to:

- consider the RP's submissions for the 'other environmental regulations' topic areas
- hold technical meetings with the Requesting Party (RP) to clarify and better understand the information presented, and to identify and explain any concerns we had with that information
- raise Regulatory Queries (RQs) to clarify our understanding of the information presented
- raise Regulatory Issues (RIs) or Regulatory Observations (ROs) where we believed the RP did not provide enough information
- assess the RP's GDA submission against relevant guidance, legislation and regulatory experience
- decide if there are any GDA Issues to be resolved at the end of detailed assessment and identify any Assessment Findings to carry forward from the GDA process to a site-specific stage.

2.2. Assessment limitations and scope

The 6 topic areas covered in the 'other environmental regulations' assessment are very site-specific by their nature. Each of them will require further work at the site-specific stage when the receiving environment is known and the detailed design has advanced further. The assessment during GDA is intended to ensure that the RP has understood and captured the main legislative requirements that the UK HPR1000 will have to meet, and that these requirements are considered in the design. The scope of the GDA assessment was to develop the submissions as far as is reasonable for a generic site setting and conclude with what will be the likely starting point for site-specific work in the form of final conclusions and Assessment Findings. This approach is followed for each of the 6 topic area assessments in the following sections of this report.

3. Water use and abstraction

The supply of water is limited so we ensure that it is managed and used in a way that meets the needs of people and the natural environment. We do this through an abstraction licensing system. Any person who abstracts more than $20m^3$ a day from inland waters requires an abstraction licence from us. Further information can be found on the GOV.UK website at www.gov.uk/guidance/water-management-abstract-or-impound-water#local-water-availability.

3.1. Assessment objectives

Our assessment for this topic area was aimed at:

- understanding the requirements for water use in the UK HPR1000
- identifying the potential sources of water to be used
- deciding whether any licences or permits might be required for water abstraction
- deciding whether the choice of cooling option(s) proposed for the generic site was appropriate
- identifying any issues connected with water use

3.2. Assessment

3.2.1. Regulatory context

In its submission, the RP demonstrated a good understanding of the legislation relating to water use and abstraction.

3.2.2. Assumptions

The RP made the following assumptions in relation to water use and abstraction:

- Fresh water (for example, process and drinking water) will be provided by a water supply company, therefore an abstraction licence would not be required.
- Water for cooling the turbine condenser and other plant systems will need to be abstracted from the environment. Once-through sea water cooling is considered to be the most appropriate environmental option for a generic coastal or estuary site.
- A biocide dosing strategy necessary for a sea water-based turbine condenser cooling system is a site-specific decision. However, for the purposes of GDA, sodium hypochlorite has been assumed for the water discharge impact assessment.

We consider the assumptions to be reasonable at the GDA stage for a generic site. Any changes to these assumptions are likely to affect our assessment outcomes.

There are certain aspects of the UK HPR1000 cooling water design that can only be specified at the site-specific stage. These include the abstraction intakes and fish deterrent and return schemes, therefore these are not considered in the GDA.

It has been agreed that the assessment of the thermal impact of discharges to surface waters will also be out of scope of GDA as this requires information on the behaviour of the receiving surface water.

3.2.3. Fresh water requirements

The RP states that the GDA is based on the assumption that all fresh water requirements will be supplied by a local water company. This means that there will be no fresh water abstraction and, therefore, an abstraction licence is not required for the generic design. The RP considers fresh water supply to be a site-specific matter and leaves all options open for a future operator to consider. In order to ensure the need to explore all options at site-specific stage is sufficiently highlighted, we consider the following Assessment Finding to be appropriate:

Assessment Finding 37: A future operator shall engage with the local water supply company early in the site-specific stage. This is to ensure that sufficient quantities of fresh water can be supplied to meet the requirements of the UK HPR1000 or to determine whether an alternative source of fresh water will need to be identified.

In terms of the fresh water usage requirements of the design, the RP has outlined 3 main areas:

- demineralised water - estimated normal consumption 490m^3/day
- process water - estimated normal consumption 734m^3/day
- potable (drinking) water - estimated normal consumption 315m^3/day

These estimated consumption figures are based on the operation of one unit. They are underpinned by a full breakdown, with calculations, of fresh water use in the supporting document ‘Fresh Water Requirements Calculation’ (GNSL, 2019a).

We raised RQ-UKHPR1000-0824 to seek clarification on a number of points relating to the detailed calculations presented in the ‘Fresh Water Requirements Calculation’ document (GNSL, 2019a). Our queries were generally related to where particular numbers used in the usage calculations came from. In its response, the RP satisfactorily explained the calculations more fully, and we are now content with the conclusions.

By taking into account several factors, such as the expected plant availability and daily variations in usage, the RP has concluded that the total annual fresh water consumption will be approximately 405,835m^3 a year.

We consider the fresh water requirement estimates to be reasonable for the design and broadly similar to fresh water requirements at other similar nuclear power plants. We

would encourage a future operator to continually monitor and minimise fresh water usage throughout the life cycle of the facility.

3.2.4. Cooling water system requirements

The RP states that the generic site being considered for GDA is a coastal or estuary site (GNSL, 2021a). An abstraction licence would not be required if cooling water is abstracted from open coastal waters, but it is likely to be required if an estuary location is chosen.

Cooling water is essential in 3 aspects of the UK HPR1000 design:

- Circulating water system - this system supplies cooling water to the turbine condenser and the auxiliary cooling water systems. The water is abstracted from the environment, used to cool the heat exchanger equipment, and then discharged back into the environment.
- Essential service water system - this system uses abstracted water to cool the heat exchanger in the component cooling water system and then discharge it back into the environment.
- Auxiliary cooling water system - this system takes some water from the main circulating water system to supply the conventional island closed cooling water system coolers and the condensate vacuum system coolers before it is discharged back into the environment.

Inevitably, the 3 cooling water systems will discharge water at a higher temperature than it was abstracted at. The following table describes the quantity and the approximate temperature rise information the RP provided for each system.

Table 1: Requesting Party information on cooling water usage during normal operation

Cooling water system	Cooling water demand (m^3/h)		Approximate temperature rise (^oC)
	Outage	Operation	
Circulating water system	0	187,200	10
Essential service water system	2,700	3,600	7.3
Auxiliary cooling water system	--	72,000	3.5
Total	2,700	198,000	9.7*

* when the 3 effluents are combined

All 3 systems flow to the seal pit and are mixed before being discharged, therefore, including a total temperature rise is considered appropriate. The seal pit is a structure designed to prevent air getting back into the cooling water and effluent systems and is linked to the main site outfall into the environment.

The quantity and temperature rise figures the RP presented are similar to other reactor designs that have been subject to the GDA process and to existing operational nuclear power plants in the UK. Modelling of the thermal impact of the discharges has been agreed to be out-of-scope of GDA due to the need for complex site-specific modelling, so no further work was carried out during this assessment. It will, however, be required at each site-specific permitting stage when the necessary environmental information is available.

The RP concludes that it considers a once-through cooling system to be the most appropriate environmental option for the UK HPR1000 design. This conclusion is based on information in our 2010 publication ‘Cooling water options for the new generation of nuclear power stations’ (Environment Agency, 2010). The report concludes that direct (once-through) cooling ”can be the most appropriate environmental option for large power stations sited on the coast or estuaries, subject to current best planning, design and operational practice and best available mitigations being put in place, and meeting conservation objectives of the site in question.”

The RP has also made reference to the European Commission’s Best Available Techniques Reference (BREF) Document on ‘Industrial Cooling Systems’ (EU, 2001), and states that a once-through cooling system can be considered BAT for a coastal location. At time of writing, BREF documents continue to be used to inform BAT in the UK. The BREF document also states that rivers and estuaries may be acceptable for processes requiring large cooling capacities if the extension of the heat plume in the surface water leaves passage for fish migration, the intake is designed to reduce fish entrainment, and the heat load doesn't affect other users of the receiving water. A future operator should use the BREF document and all guidance available at the time of each site-specific stage to establish whether the design is BAT for that location. We consider the following Assessment Finding to be appropriate to ensure that site-specific decision-making on cooling water options considers BAT:

Assessment Finding 38: A future operator shall ensure that the siting of the cooling water intake and outlets are BAT for the UK HPR1000 design at each specific site.

Based on the conclusions from the BREF document and our cooling water options report, we accept, for the purposes of GDA, that once-through cooling water could be considered suitable for the UK HPR1000 design at a coastal or estuary location.

Despite presenting a case for a once-through cooling water system at GDA, the RP is also clear that other options are available for consideration at the site-specific stage depending

on site-specific characteristics (including ecology and biodiversity). Other options noted for future consideration are:

- once-through system with cooling towers
- recirculating system using natural draft cooling towers
- recirculation system using mechanical draft cooling towers
- open or closed hybrid cooling system with hybrid cooling towers

All of the above systems are covered in some detail in our 2010 publication ‘Cooling water options for the new generation of nuclear power stations’ (Environment Agency, 2010). Any of the above have the potential to be considered BAT based on site-specific characteristics, so are available for a future operator to consider.

3.2.5. Fish deterrent and recovery and return systems

The RP states that the cooling water intake needs to be located and designed to minimise the impact on surrounding habitats and marine organisms, in particular fish. The RP considers that fish deterrent and recovery and return systems are highly site-specific due to the complex combination of factors that need to be taken into account (for example, intake capacity, nature of the water body, climatic condition, local flora and fauna and the physiology of the fish present). GDA can therefore only consider the options that are available and then highlight the aspects that a future operator needs to consider at the site-specific permitting stage. No site-specific options are ruled out at GDA stage.

The RP proposes that the following aspects will need to be considered:

- location of intake structure - with particular attention on habitats and impact on fish species present
- design of the intake structure - intake velocities should be sufficient for the power plant’s needs while being low enough to allow fish and other aquatic organisms to escape entrainment, impingement and entrapment. An additional consideration for the intake design is to minimise entrainment of sediment in the water drawn into the plant
- use of screens and fish return systems – the RP states that the UK HPR1000 design can accommodate various screening systems that incorporate a coarse and fine rack system to minimise fish and debris entering the cooling water systems as well as a fish return system
- use of physical barriers - physical barriers include barrier nets, microfiltration barriers and bar screens. Any debris clearing methods used at the coarse rack should consider the protection of fish

- use of behavioural barriers - options for the UK HPR1000 include bubble curtains, electrical barriers, acoustic fish deterrents, artificial lighting or a combination of these

The RP concludes that the above aspects are site-specific considerations when the local environmental setting and species present are known. We agree with this conclusion for GDA.

In preparing this part of its submission, the RP has referred to our published guidance 'Screening for intake and outfalls: a best practice guide' (Environment Agency, 2005). A future operator will need to consider this in greater detail at the site-specific stage.

At the time of writing, an additional Environment Agency guidance document had recently been published (April 2020) 'Nuclear power station cooling waters: protecting biota' (Environment Agency, 2020a). This new guidance has not been considered during GDA, and will need to be considered in detail at the site-specific stage by a future operator.

3.2.6. Eels Regulations

Operators abstracting more than 20m^3/day of water or discharging water back to any channel, bed or sea are subject to the requirements of The Eels (England and Wales) Regulations 2009 (UK Parliament, 2009) and must screen the abstraction/discharge to prevent the entrapment of eels, unless an exemption notice has been granted.

The RP states that the Eels Regulations requirements will be considered in the site-specific design of the intake location, intake structures, fish return systems and physical barriers that may be implemented to reduce fish entrainment and impingement. We agree with this conclusion for GDA.

3.3. Conclusions on water use and abstraction

Following the assessment of water use and abstraction, our conclusions are that:

- an abstraction licence would not be required for fresh water supply (for example, process and drinking water) if it is provided by a local water company

- an abstraction licence would not be required if cooling water is abstracted from open coastal waters, but it is likely to be required if an estuary location is chosen

- the choice of once-through sea water cooling could be considered appropriate for the UK HPR1000 based on a coastal or estuary location. However, other options are available to be considered at the site-specific stage depending on site-specific characteristics (including ecology and biodiversity)

- the final design of the abstraction intake and fish deterrent and return systems for the UK HPR1000 to minimise fish ingress and injury and meet the requirements of the Eels (England and Wales) Regulations 2009 (UK Parliament 2009), and other

legislation as relevant, is a site-specific issue and can only be determined once the local environmental conditions are known

We consider the following 2 Assessment Findings to be appropriate:

Assessment Finding 37: A future operator shall engage with the local water supply company early in the site-specific stage. This is to ensure that sufficient quantities of fresh water can be supplied to meet the requirements of the UK HPR1000 or to determine whether an alternative source of fresh water will need to be identified.

Assessment Finding 38: A future operator shall ensure that the siting of the cooling water intake and outlets are BAT for the UK HPR1000 design at each specific site.

4. Discharges to surface water

Discharges to surface waters are controlled by The Environmental Permitting (England and Wales) Regulations 2016 (UK Parliament, 2016). An environmental permit is required for the discharge of any non-radioactive effluent to inland freshwaters or coastal waters. Further information can be found at www.gov.uk/guidance/discharges-to-surface-water-and-groundwater-environmental-permits.

4.1. Assessment objectives

Our assessment for this topic area was aimed at:

- understanding the different effluent streams produced by the UK HPR1000 and the non-radioactive contaminants present
- understanding how each effluent stream produced by the UK HPR1000 is treated and disposed of
- understanding the potential environmental impact of the discharges based on the generic site
- deciding, based on the information provided for GDA, whether an environmental permit for a water discharge activity would need to be applied for at the site-specific stage

4.2. Assessment

4.2.1. Regulatory context

The RP demonstrated a good understanding of the main pieces of legislation relating to surface water discharges.

4.2.2. Assumptions

The RP made the following assumptions in relation to surface water discharges:

- Storage, monitoring and treatment of effluent streams implemented for the design will be in accordance with relevant guidance.
- The biocide dosing strategy will be determined at the site-specific stage.
- The reference plant for the information on the out-of-scope systems is Fangchenggang Nuclear Power Plant Unit 3 (FCG3).

We consider the assumptions to be reasonable at the GDA stage for a generic site. Any changes to these assumptions would require us to re-evaluate our assessment outcomes.

4.2.3. Effluent characterisation and treatment

The liquid effluent management systems in the UK HPR1000 design are complex, but can be simplified by considering 3 main types of liquid effluents associated with:

- radioactive waste streams
- non-radioactive waste streams
- cooling water systems

The environmental impact in terms of the physical and chemical composition of these 3 effluent streams would be controlled by a water discharge activity permit granted under the Environmental Permitting (England and Wales) Regulations 2016 (UK Parliament, 2016), which would be required to operate the reactor.

Each of the 3 types of liquid effluents will be described, in turn, in relation to the effluent characterisation and treatment. During the course of our assessment we have issued 3 Regulatory Queries related to discharges to surface water (RQ-UKHPR1000-0546, RQ-UKHPR1000-0823 and RQ-UKHPR1000-1559). Each of these contained a number of individual queries, which are discussed in the appropriate section below.

Effluents associated with radioactive waste streams

This sub-section focuses on the chemical characteristics and treatment techniques for the radioactive effluent streams.

In the UK HPR1000 design, liquid radioactive effluents are categorised as:

- process drains - characterised by a low level of chemical impurities
- chemical drains - characterised by a higher level of chemical impurities
- floor drains - characterised as being typically high in suspended solids
- laundry drains - characterised as being typically high in suspended solids and containing detergents

These effluent streams are managed and treated separately up to the point at which they enter the Nuclear Island Liquid Waste Discharge System (NLWDS) - see Figure 1 below. Treatment of these effluent streams takes place in the Liquid Waste Treatment System (LWTS). The process drain effluents are treated by demineralisation, chemical drain effluents are treated by evaporation, and the floor and laundry drains are treated by filtration. The treatment options for these effluents are intended to treat radioactive as well as chemical contaminants. We considered that there was not enough detail in the Pre-Construction Environmental Report (GNSL, 2021a) on the treatment techniques proposed for the LWTS, so we raised a question in RQ-UKHPR1000-0546 to seek more information.

The RP's response provided some more information on the evaporation, filtration and demineralisation units, which we considered to be at an acceptable level of detail for GDA.

We also queried the use of detergents in RQ-UKHPR1000-0823. The RP had indicated that the use of detergents in the plant laundry was for a future operator to decide, including whether a laundry should be located on site at all. The RP explained that the need for and use of a laundry depended on the radiological protection barrier and change room arrangements of a future operator depending on operational requirements. The NLWDS also accepts effluent from the coolant storage and treatment system (CSTS). Following treatment and monitoring, the effluents from the LWTS and the CSTS are discharged from NLWDS into the environment via the seal pit. Monitoring takes place from storage tanks in NLWDS to ensure the effluents are of a suitable quality to be released into the environment. If they are not, then they can be re-directed back into the LWTS for further treatment.

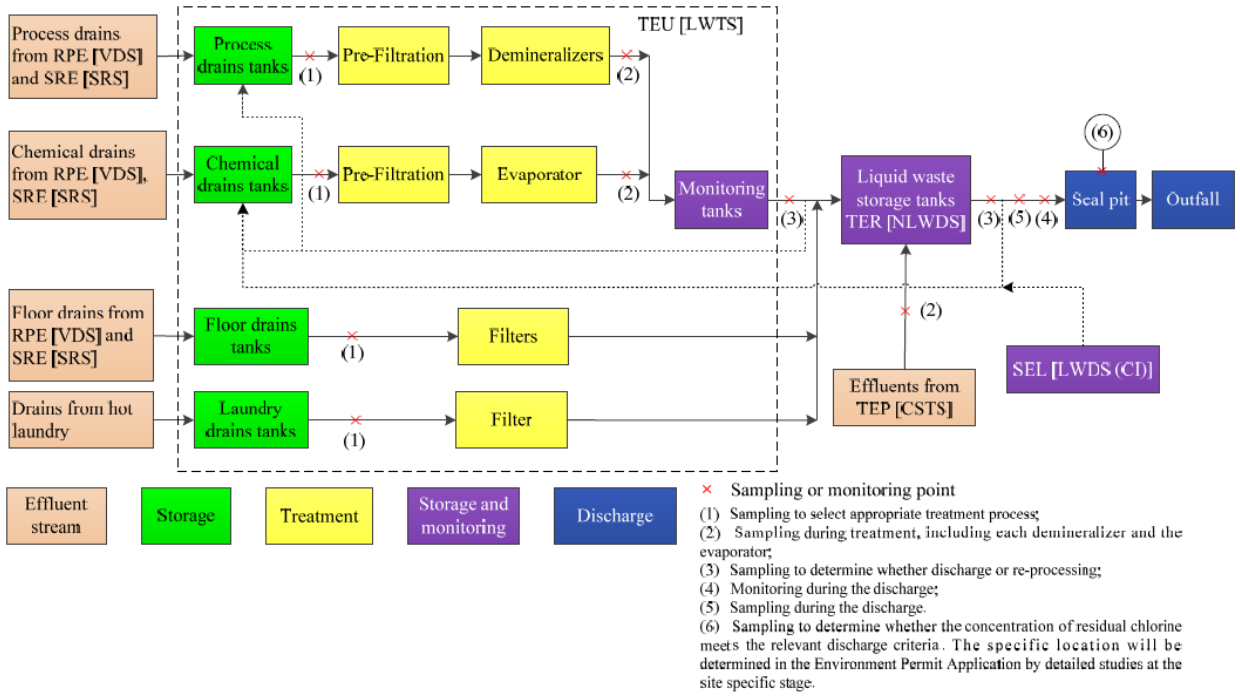

Figure 1: Requesting Party flow diagram for liquid radioactive effluent streams (GNSL, 2021a)

Figure 2 below shows the systems that are used to manage potentially radioactive effluents from the turbine hall (Waste Fluid Collection System for Conventional Island - WFCSCI) and Steam Generator Blowdown System (SGBS) before they go to the Conventional Island Liquid Waste Discharge System (LWDS(CI)). The turbine hall effluents also have the potential to be oily, so the WFCSCI is split into 2 parts: part 1 treats the potentially oily wastes, while part 2 deals with the non-oily effluents. The potentially radioactive, oily effluents are treated by conventional oil/water separation techniques, which remove the oil fraction from the effluent stream which is then dealt with separately by off-site recovery or disposal. The remaining water fraction is sampled in storage tanks in the LWDS(CI) and then either released for discharge via the seal pit or directed to the appropriate treatment facility in the LWTS (see Figure 1 and Figure 2).

We noted that the flow diagrams provided (see Figure 1 above and Figure 2 below) included the option to either discharge the effluent directly into the environment (via the seal pit) or to divert it to be treated in the LWTS. We queried what controls would be in place when deciding to divert an effluent stream that would normally go directly to the seal pit for discharge to the treatment plant at the LWTS instead (RQ-UKHR1000-0546). The RP confirmed that the effluent is expected to be non-radioactive for the majority of the time but may, on occasion, become contaminated by small leakages of radioactivity from the primary to the secondary circuit.

The primary circuit contains the coolant that removes heat from the reactor. Heat from the primary circuit is transferred to water in the secondary circuit via the steam generators where it is allowed to boil at high temperature and pressure. The steam is used to drive the turbines that power the generator to generate electricity. Any radioactivity would be picked up in the monitoring carried out when the effluent is held in the storage tanks that are part of the LWDS(CI). Subsequently, the operator makes the decision to discharge directly to the seal pit and into the environment (if no radioactive contamination or acceptable levels of chemical contamination are present) or to the LWTS for treatment, based on limits defined in its operating instructions. We are satisfied with the operational flexibility this diversion route offers in term of increased protection of the environment. We would follow this through to our site-specific permitting stage to ensure the management systems and procedures provide for robust decision-making at this crucial point in the system.

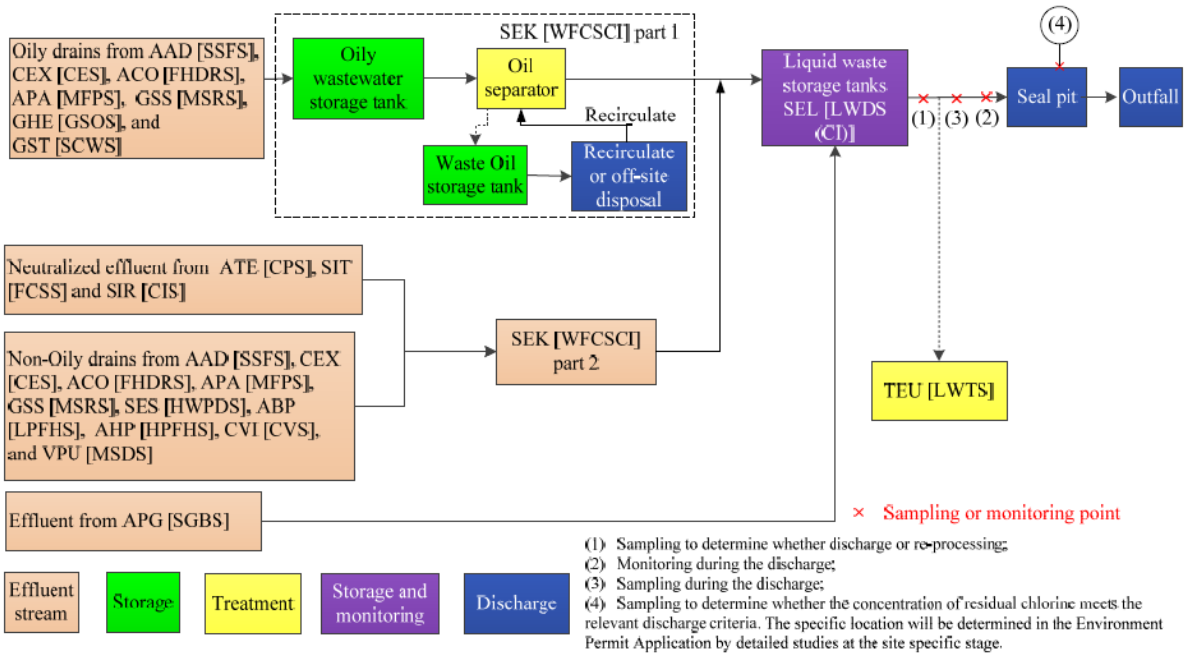

Figure 2: Requesting Party flow diagram for potentially radioactive effluent streams (GNSL, 2021a)

In the Pre-Construction Environmental Report (PCER), there are 7 flow diagrams used to describe the effluent management system. In an earlier version of the PCER, we noted some inconsistencies between the diagrams themselves and between the diagrams and the associated text. We queried these in RQ-UKHPR1000-0546 and RQ-UKHPR1000-

0823. The RP accepted the comments and has made the necessary amendments in its PCER (GNSL, 2021a).

Both the LWDS(CI) and the NLWDS are released to the seal pit before being discharged into the environment via the outfall. The seal pit is a structure designed to prevent air getting back into the cooling water and effluent systems and is linked to the main site outfall into the environment.

The RP has described the chemical characteristics of the radioactive waste streams in terms of the chemicals that are proposed for use in the primary and secondary circuits of the UK HPR1000. The main chemicals used are as follows:

- boric acid for reactivity control
- lithium hydroxide for pH control in the primary circuit
- hydrazine for corrosion control in the primary and secondary circuits
- ammonia for pH control in the secondary circuit
- trisodium phosphate as a corrosion inhibitor in the closed cooling systems
- detergents used in the laundry rooms

The RP provided a supporting document 'Chemical Emission Inventory for Water Discharge' (GNSL, 2019b) to support the work carried out to establish the chemical load to be discharged via the NLWDS and the LWDS(CI) from the radioactive effluent streams. The chemical emission inventory document also includes chemicals used in the cooling water system. The chemical emission inventory was a substantial piece of work the RP carried out during the GDA process, and we were updated regularly throughout the development of this report.

The RP developed a method for establishing an inventory of chemical emissions. The first step was to establish a chemical inventory for the design. This was provided in the supporting document ‘Chemical Inventory for UK HPR1000’ (GNSL, 2019c). This document was a necessary starting point for this and for the COMAH assessment (see section 7 below).

The whole site inventory was then used to select the chemicals that could end up in an effluent stream and therefore required assessing for this aspect of GDA. Once the specific chemicals had been selected, the route each chemical could take through the effluent streams was established, along with normal and maximum discharge scenarios. At this point, the estimated figures were considered in the context of OPEX from operating nuclear power plants in China. These figures were then used to calculate discharge estimates in terms of an average and maximum annual load (in kg).

We would expect the calculations to include decontamination factors for each chemical, and the RP's submission did include them. However, the sources of the values used for

decontamination factors were not clear, so we queried some of these in RQ-UKHPR1000-0823. We specifically queried the decontamination factors used for boric acid (0.17) and lithium hydroxide (0.9). In its response, the RP confirmed how OPEX had been used in calculating the boric acid decontamination factor. The calculations were also provided in the RQ response.

The response regarding lithium hydroxide discussed the variability in factors that can affect treatment and, therefore, the decontamination factors. The RP acknowledged that the variables make it very difficult to determine a reliable decontamination factor, so it based it on ion exchange fundamentals, literature data, laboratory experiments and OPEX.

The discharge estimates obtained for the UK HPR1000 were then compared with French and Chinese PWR fleets as well as the UK European pressurised reactor (UK EPR) design data. The results for all chemicals assessed, apart from hydrazine, show that discharges are comparable to the Chinese and French fleets and the UK EPR. The RP explained that the difference in hydrazine discharges could be due to the assumption at GDA that hydrazine will not be treated before discharge, whereas it is in the French fleet and the UK EPR. The RP considers that the discharge estimates for hydrazine could be reduced by a future operator at the site-specific stage by applying treatment techniques.

In order to ensure this is highlighted as an outcome from GDA, we have raised the following Assessment Finding, which also ensures refinement of the calculations for chemical emissions at the site-specific stage:

Assessment Finding 39: A future operator shall review the calculations for emissions of chemicals as part of the site-specific environmental risk assessment. Particular attention should be focused on the application of possible treatment techniques for hydrazine to reduce the amount discharged to the environment and arrangements to minimise any impact.

Subject to the Assessment Finding above, we are content with the RP's conclusions for this aspect of the design.

Effluents associated with non-radioactive waste streams

There are 3 effluent management systems for non-radioactive waste streams in the UK HPR1000 design:

- station sewer system part 1
- station sewer system part 2
- waste oil and non-radioactive water drainage system

These 3 systems have been classed as out of scope of GDA, but the RP has provided some basic information on each.

The station sewer system part 1 accepts effluents from the non-radioactive parts of the nuclear island (for example, air conditioning systems and ventilation systems) as well as

domestic sewage from a number of buildings. Being out of scope of GDA, no decisions have yet been made on the monitoring or treatment processes that would be appropriate as these will be site-specific design matters. However, the RP has stated in its submission that a conventional activated sludge treatment process (like that used in many domestic sewage treatment works) could be appropriate. Following treatment, this effluent stream will be discharged directly to the environment via the main site outfall (not via the seal pit as the radioactive and cooling water effluent streams are).

The station sewer system part 2 collects site surface rainwater, roof water and uncontaminated water released from the circulating water system among other non-radioactive systems. For the purposes of GDA, this effluent stream is shown as being discharged directly into the environment via the main site outfall.

The waste oil and non-radioactive water drainage system collects all the non-radioactive oily water from various sources. The proposed treatment is conventional oil separators. The oil fraction is taken out of the effluent stream and removed from site for treatment via conventional waste oil management routes. The water fraction is tested and, if it meets the necessary discharge criteria, discharged directly into the environment via the main site outfall.

These 3 systems are out of scope of GDA and can all be independently discharged directly into the environment. It is essential that a future operator focuses on the site-specific design of these systems as this has not been addressed at GDA. We, therefore, consider the following Assessment Finding to be appropriate:

Assessment Finding 40: A future operator shall ensure that the storage, treatment and monitoring systems for the 3 non-radioactive effluent streams provide the appropriate level of environmental protection for the receiving environment in terms of quality of effluent discharged. This would be regulated by a water discharge activity permit.

We are unable to provide any definitive conclusions on this aspect of the design, as it is out of scope of GDA and many important decisions have been left to the site-specific stage.

Effluents associated with cooling water systems

The cooling water system comprises 3 systems:

- circulating water system
- essential service water system
- auxiliary cooling water system

These systems are described in section 3.2.4 above in the context of water abstraction and use. When the water has been used to cool the various components of the design, because a once-through system is proposed, it will need to be discharged back into the environment under the terms of a water discharge activity permit. This assessment is

based on the once-through cooling water system that the RP proposed for GDA. If an alternative cooling water technique is chosen at the site-specific stage, then this will need to be reassessed at that time.

In order to prevent biofouling of the internal systems, the abstracted cooling water is dosed with a biocide. The RP has stated that the final dosing strategy is a site-specific matter for a future operator to decide. For the purposes of GDA, the RP has assumed sodium hypochlorite will be used as the biocide and has carried out the environmental impact assessment based on this (see section 4.2.4 below). The RP has, however, stated that whatever strategy is chosen, the residual chlorine (from the sodium hypochlorite) will be in the range of 0.1mg/l to 0.5mg/l, with a daily average of 0.2mg/l. These estimated values have been carried forward to the environmental impact assessment (section 4.2.4 below). A future operator will need to take into account the appropriate BREF (industrial cooling systems) and Environment Agency guidance applicable at the time when developing its site-specific strategy.

For the purposes of GDA, the RP has proposed a final monitoring point for residual chlorine in the seal pit. This is acceptable for a final (compliance) monitoring point, but a future operator may wish to provide additional monitoring further upstream in the systems to ensure the water discharge activity permit limits will be met.

In common with similar types of power plant, there is no treatment of the cooling water before it is discharged. The 3 cooling water systems are directed to the seal pit where some mixing with the effluents associated with radioactive waste streams will occur as it discharges into the environment via the main site outfall.

Despite much of the above section leaving options open for a future operator to make at the site-specific design stage, we ask the RP to consider the environmental impact of water discharges at the GDA stage. The work the RP has carried out to prepare its ‘Chemical Inventory for Water Discharge’ has enabled suitably underpinned emission values to be developed to use in the environmental impact assessment.

4.2.4. Environmental impact assessment

The PCER (GNSL, 2021a) outlines the RP's modelling work carried out for the environmental impact assessment and this is backed up by a more detailed supporting document ‘Environmental Risk Assessment on Liquid Chemical Discharge’ (GNSL, 2020b).

We asked the RP to provide an environmental impact assessment at GDA stage to determine whether the proposed emissions from the generic design could be considered potentially acceptable at the site-specific stage. The impact assessment is necessarily generic at this stage because there are a number of aspects of the use and treatment of chemicals that are not known at GDA stage and the environmental setting is also not known. Both of these elements will need to be included in more detailed site-specific modelling for the application for a water discharge activity permit. To ensure this aspect is addressed, we raised the following Assessment Finding:

Assessment Finding 41: A future operator shall provide in an application for a water discharge activity environmental permit a site-specific environmental impact assessment for discharges to water. The modelling shall use site-specific parameters based on the environmental setting and the specific chemicals selected for use.

The RP made a number of assumptions in relation to the environmental risk assessment as follows:

- Sodium hypochlorite is used as the biocide.
- Where an environmental quality standard (EQS) doesn't currently exist for a particular substance, then the predicted no-effect concentration (PNEC) was used in the assessment at GDA stage.
- Background water quality data was for an assumed location intended to represent the generic site.

Each of these assumptions will need to be refined when site-specific data are available.

The environmental impact assessment carried out for GDA was an initial screening assessment using our recommended H1 environmental risk assessment tool. Our guidance can be found at https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit. The purpose of the H1 environmental risk assessment at GDA stage is to provide a screening assessment to demonstrate that the impact of discharges to surface waters from the UK HPR1000 could be at levels low enough to potentially allow a water discharge activity permit to be issued. It will also highlight any substances that warrant particular attention at the site-specific permitting stage. The screening carried out at GDA is not intended to replace site-specific risk assessments that will still be required to be carried out as part of the site-specific permitting process. The input parameters required for the impact assessment included information developed in the 'Chemical Emission Inventory for Water Discharge' document (GNSL, 2019b), background concentrations in the environment (assumed location) and average flow rates (estimated to be 55m^3/s).

The RP followed through the series of tests as specified in our H1 guidance. We are satisfied that it followed our approach correctly for this impact assessment. We did query some changes made in the assessment between revision C and revision D of the risk assessment report (GNSL, 2020b) in RQ-UKHPR1000-1559. The responses the RP provided demonstrated that the changes were still aligned with our guidance and were appropriate for the GDA screening assessment.

The initial test specified in our guidance compares the discharge concentration with the corresponding EQS. The discharge concentration is the concentration at the end of the pipe before the effluent enters the environment (in other words, with no further dilution). If the discharge concentration is lower than the corresponding EQS, then the substance is screened out from further assessment. The EQSs the RP used in its assessment were for

'estuaries or coastal waters', so they are appropriate for the generic site proposed in this GDA.

The following substances were assessed:

- boron
- lithium hydroxide
- ammonia
- hydrazine
- chlorine (as TRO)
- copper (dissolved)
- iron
- nickel (dissolved)
- lead (dissolved)
- zinc (total)

All of the above substances were screened out after the initial test except chlorine and hydrazine, which were subjected to further tests.

The next test involved comparing the effective volume flux (EVF) with the allowable effective volume flux (AEVF) for buoyant discharges such as this, as described in our guidance. Chlorine was screened out from needing further assessment at this stage.

Hydrazine did not screen out and would warrant particular attention at a site-specific stage. The RP acknowledged this in its PCER (GNSL, 2021a) and supporting document ‘Environmental Risk Assessment on Liquid Chemical Discharge’ (GNSL, 2020b). If the H1 tool predicts this outcome when being used at a site-specific permitting stage, then we will require the operator to carry out more detailed modelling of the specific discharge in the specific environment. We do not consider it appropriate to ask for this at GDA stage, as there would be so many assumptions that the outcomes would have a high level of uncertainty associated with them.

All substances, apart from hydrazine, were assessed to be at levels low enough to potentially allow a water discharge activity permit to be issued. Hydrazine was highlighted as a substance that warrants particular attention at the site-specific permitting stage. As hydrazine had been highlighted by the screening process, we took this further in GDA and issued 2 questions in RQ-UKHPR1000-0823.

The queries related to possible techniques to either reduce hydrazine usage or treat it in the effluent. In its response, the RP provided more information on the BAT options listed in

the chemical emission inventory for water discharge (GNSL, 2019b) document. The additional detail covered techniques for minimising the need for hydrazine, potential alternatives, management of unplanned loss of containment (which could also fall under COMAH Regulation – see section 7 of this report) and potential for the treatment of hydrazine within the system. We are satisfied that the RP has presented a sufficient range of options at GDA, which should be carried forward to the site-specific permitting stage.

The risk assessment the RP carried out is sufficient for GDA, but a future operator will have to carry out a site-specific assessment for all substances to be discharged as part of its permit application. This will ensure that the assessment is carried out with site-specific environmental information on the receiving environment and with a much lower level of assumption and uncertainty in the input parameters. We consider the following Assessment Finding (that was introduced above) appropriate to ensure this happens:

Assessment Finding 41: A future operator shall provide in an application for a water discharge activity environmental permit a site-specific environmental impact assessment for discharges to water. The modelling shall use site-specific parameters based on the environmental setting and the specific chemicals selected for use.

As part of the site-specific permit application, the operator will also need to consider whether there are any designated habitat sites (including Sites of Special Scientific Interest, Marine Conservation Zones, Special Protection Areas, Special Areas of Conservation or Ramsar Convention sites) in the area and, if necessary, carry out a Habitats Regulations assessment.

4.2.5. Options for beneficial use of the waste heat

Nuclear power plants, like other thermal power generation processes, convert thermal energy into electrical power. It is not possible to convert 100% of the thermal energy into electricity, therefore residual heat in the cooling water is released into the environment. In our Process and Information Document (P&ID), we ask the RP to consider possible uses of the waste heat that would be compatible with the design.

The RP considers that the potential for beneficial use of waste heat is a highly site-specific matter because it depends on what potential users are situated nearby. We agree with this conclusion. In order to satisfy the P&ID requirement, the RP has suggested a number of ways in which the waste heat (in the form of warm water) from the UK HPR1000 could be used.

- Agricultural sector - warm water could be used to heat commercial greenhouses.
- Industrial sector - warm water could be used to prevent ice forming in cold weather on roads or runways. Alternatively, it could be used as a source of heat for a desalination process.
- Civil sector - warm water may be used as part of a district heating scheme in residential dwellings, hospitals and public buildings.

Each of these uses requires the users to be close to the nuclear power plant. Although this is unlikely for some sectors, it is important that a future operator remains aware of any opportunities to reuse the residual heat from the process as an alternative to releasing it into the environment.

4.3. Conclusions on discharges to surface water

Following our assessment of the surface water discharges, our conclusions are that:

- the UK HPR1000 will have non-radioactive discharges to surface water and will require an environmental permit for a water discharge activity
- the information the RP provided for GDA is sufficient for us to conclude that the impact from discharges to surface waters could be at levels low enough to enable a reasonable application for a water discharge activity permit. However, the risk assessment work carried out for GDA must be revised with greater detail at the site-specific permitting stage to reduce the level of uncertainty that exists in the work carried out to date. At the site-specific stage, all necessary permissions must be applied for and obtained by the future operator

To ensure that the main elements are picked up at the site-specific stage, we have included the following 3 Assessment Findings:

Assessment Finding 39: A future operator shall review the calculations for emissions of chemicals as part of the site-specific environmental risk assessment. Particular attention should be focused on the application of possible treatment techniques for hydrazine to reduce the amount discharged to the environment and arrangements to minimise any impact.

Assessment Finding 40: A future operator shall ensure that the storage, treatment and monitoring systems for the 3 non-radioactive effluent streams provide the appropriate level of environmental protection for the receiving environment in terms of quality of effluent discharged. This would be regulated by a water discharge activity permit.

Assessment Finding 41: A future operator shall provide in an application for a water discharge activity environmental permit a site-specific environmental impact assessment for discharges to water. The modelling shall use site-specific parameters based on the environmental setting and the specific chemicals selected for use.

5. Discharges to groundwater

Discharges to groundwater are controlled by The Environmental Permitting (England and Wales) Regulations 2016 (UK Parliament, 2016). An environmental permit is required for any discharge either directly or indirectly into groundwater unless the activity is exempt. Further information can be found on the GOV.UK website at: www.gov.uk/guidance/discharges-to-surface-water-and-groundwater-environmental-permits.

5.1. Assessment objectives

Our assessment for this topic area was aimed at:

- identifying whether there were any planned discharges to groundwater
- deciding whether there are appropriate measures in the UK HPR1000 design to prevent any accidental discharges to groundwater

5.2. Assessment

5.2.1. Regulatory context

The RP demonstrated a good understanding of the main pieces of legislation relating to groundwater discharges.

5.2.2. Assumptions

The RP made the following assumptions in relation to groundwater discharges:

- All aqueous effluents are managed so that they discharge to a marine or estuary environment (see 'Discharges to surface water' above), therefore there is no need to discharge to groundwater.
- The plant has been designed to prevent accidental discharge to groundwater in accordance with relevant guidance.
- Design of containment measures for fire-fighting water is a site-specific matter.
- Management arrangements will be developed at the site-specific stage to prevent accidental releases to groundwater.

We consider the assumptions to be reasonable at the GDA stage for a generic site. The assumptions will need to be followed through to a site-specific stage to remain valid. Any changes to these assumptions are likely to affect our assessment outcomes.

5.2.3. Discharges

The RP states that the UK HPR1000 does not include any requirement for routine discharges to groundwater and there will be no intentional discharges to groundwater. We would not normally receive an application for a groundwater discharge activity permit for a nuclear power plant. If a future operator were to consider making a routine discharge to groundwater, we would ask for alternative discharge routes to be sought before we would accept such an application.

The RP states that the site infrastructure will be designed to prevent the release of contaminated water to soil and groundwater. This will be based on site-specific credible accident scenarios and will be in line with relevant guidance and legislation. The design requirements will include, but not be limited to:

- primary containment design (tanks)
- secondary containment design (bunds)
- tertiary containment systems (hardstanding linked to the drainage systems)
- firewater containment systems

The RP states that the following measures will also be implemented:

- provision of spill kits
- management arrangements, including staff training (deliveries, spill prevention and response)

The detailed site layout design can only be determined at the site-specific stage, therefore the exact arrangements for drainage, secondary containment (for example, bunding) and tertiary containment (for example, hardstanding linked to the drainage systems) are not known at GDA.

We accept, for the purposes of GDA, that these measures are relevant good practice, and expect these to be incorporated into the management system and implemented before operations begin on any specific site.

We regulate these types of environmental protection systems under a number of regimes (Environmental Permitting (England and Wales) Regulations 2016, COMAH Regulations 2015 and pollution prevention advice), so we will be able to ensure they are implemented properly at the site-specific stage.

5.3. Conclusions on discharges to groundwater

Following our assessment of discharges to groundwater, our conclusions are that:

- there should be no intentional discharges to groundwater, and an environmental permit for a groundwater activity will not be required

- the pollution prevention techniques specified in the design should prevent contamination of groundwater. If any of the generic design assumptions change at a site-specific stage, then this conclusion will need to be reconsidered

6. Operation of installations (combustion plant and incinerators)

The Environmental Permitting (England and Wales) Regulations 2016 (UK Parliament, 2016) covers the operation of certain types of installations. Those installation activities that may be relevant to the operation of a UK HPR1000 are combustion and incinerating waste. Further information can be found on the GOV.UK website at: https://www.gov.uk/guidance/a1-installations-environmental-permits.

An environmental permit is required from us for a combustion activity if an operator is burning fuel in an appliance with a thermal rated input of 50MWth or burning fuel in 2 or more appliances on the same site with an aggregated thermal input of 50MWth or greater. There is no lower threshold in the legislation for appliances to be included in the aggregation calculation. It would be the responsibility of the site regulator to agree a practical and workable lower threshold below which very small combustion plant would not be considered part of the installation.

A permit is also required under the Greenhouse Gas Emissions Trading Scheme Order 2020 (UK Parliament, 2020) if the combustion activity has a net rated thermal input of 20MWth or greater.

An environmental permit is required for incinerating hazardous waste in a plant with a capacity of more than 10 tonnes a day or incinerating non-hazardous waste in a plant with a capacity of more than 3 tonnes an hour.

If relevant, the operator of a UK HPR1000 would be required to apply for a combustion or incineration environmental permit from us before beginning operations.

6.1. Assessment objectives

Our assessment for this topic area was aimed at:

- understanding the combustion and incineration activities proposed for the design, and whether they are likely to require permits (under Environmental Permitting Regulations 2016 and/or Greenhouse Gas Emissions Trading Scheme Order 2020) (UK Parliament, 2020) at the site-specific stage
- where an environmental permit for combustion or incineration activities is likely to be required, assessing whether the proposals represent BAT
- where a greenhouse gas emissions permit is likely to be required, assessing how greenhouse gas monitoring will be carried out
- assessing how the legislative requirements for medium combustion plant (MCP) are likely to apply to the design

- understanding the potential environmental impact of the discharges to air based on the generic site location

6.2. Assessment

6.2.1. Regulatory context

The RP demonstrated a good understanding of the main pieces of legislation relating to the permitting of installation activities and greenhouse gas emissions.

6.2.2. Assumptions

The RP made the following assumptions in relation to installation activities:

- The proposals made at GDA are based on the reference plant (FCG3), but it is acknowledged that these aspects of the design may change at the site-specific stage.
- There is no incineration activity included in the design of the UK HPR1000.
- Each emergency diesel generator (EDG) and station blackout diesel generator (SBO DG) will be in its own building with an approximate height of 25m. The generator buildings will be on either side of the reactor building, but separate from it. The number of generators assessed for GDA are for one reactor unit.
- Pollution prevention abatement measures are assumed to be a site-specific matter, as is final stack height. Both of these aspects are highly dependent on the local site topography and meteorological conditions, and will be optimised at the site-specific stage.
- Locally available diesel will be used that complies with the Sulphur Content of Liquid Fuels Regulations 2007 (UK Parliament, 2007).
- Each generator has a main fuel storage tank which is located in the basement of the diesel generator building.
- Emission limit values from the medium combustion plant (MCP) legislation (UK Parliament, 2018) will not apply to the UK HPR1000 design due to the low number of operating hours (<500 hours a year). See section 6.2.7 for more discussion on the requirements for medium combustion plant.

We consider the assumptions to be reasonable at the GDA stage for a generic site. Most of the assumptions will need to be reviewed and revised at the site-specific permitting stage. Any changes to these assumptions would require us to re-evaluate our assessment outcomes.

6.2.3. Incineration activity installation

The RP states that the UK HPR1000 design does not include any requirement for an on-site incinerator. It is assumed, for the purposes of GDA, that there will be no incineration of waste.

6.2.4. Combustion activity installation

The RP states (GNSL, 2021a) that the combustion plant required in the UK HPR1000 design are as follows:

- 3 fixed emergency diesel generators (EDGs), each with a thermal input of 19.45MW to supply 8MWe of electricity
- 2 fixed station blackout diesel generators (SBO DGs), each with a thermal input of 8.27MW to supply 3.1MWe of electricity
- 2 mobile diesel generators (DGs). One with a thermal input of 6MWth to supply 2.1MWe of electricity. The other with a thermal input of 1.14MWth to supply 0.4MWe of electricity
- one smaller emergency security diesel generator (ESDG) with a rated thermal input of 0.82MWth to supply 0.32MWe of electricity
- one smaller diesel generator (DG) with a rated thermal input of 0.82MWth to supply 0.32MWe of electricity

The RP has considered the 2 smaller generators as out of scope of GDA and, due to their relatively small size, we agree with this conclusion. The 2 mobile generators have been added to the design since we published our Consultation Document (Environment Agency, 2021b). In our Consultation Document we noted that further work was being carried out to address some uncertainty over the power requirements for some aspects of the design. The addition of these 2 mobile generators is the outcome of that work. In the PCER (GNSL, 2021a), the RP states that it will not be revising the existing impact assessments for discharges to air. This is because the 2 mobile generators can never operate simultaneously with the EDGs and SBO DGs, and, because they are a smaller capacity, any impact will be less than any scenario already assessed. We agree that this rationale seems reasonable and accept the impact assessments as being appropriate for this GDA. However, all combustion plant will need to be assessed for individual and in-combination environmental impacts at each site-specific permitting stage (see also Assessment Finding 43 below).

The following assessment applies to the 3 EDGs and 2 SBO DGs.

As the total thermal input of the proposed combustion plant exceeds 50MWth, it is a Part A(1) installation as described in Schedule 1, Part 2, Chapter 1, Section 1.1 of the Environmental Permitting (England and Wales) Regulations 2016 (UK Parliament, 2016).

This means that it will require an environmental permit, and the RP acknowledges this in its submission.

The 3 EDGs are classed as nuclear safety equipment. They are included in the design to provide back-up power to the equipment related to the safe shutdown of the reactor and its maintenance in a safe condition in the event of a loss of off-site power supply. The EDGs are required to start up quickly and automatically in the event of a loss of off-site power. The back-up generators would also provide power to important plant providing environment protection functions in this circumstance.

The 2 SBO DGs are also classed as nuclear safety equipment. They are included in the design to provide power to nuclear safety related equipment in the event of a station blackout condition (loss of off-site and on-site power).

The RP describes the 3 operating conditions for the EDGs and SBO DGs:

- Commissioning to ensure reliable operation before they are formally brought into use. The commissioning testing periods are expected to be approximately 50 hours for each EDG and 40 hours for each SBO.
- Periodic testing is carried out to ensure the generators can be brought out of standby and into use as soon as they are required. Periodic tests are carried out once a month, with an annual operation time of approximately 22 hours for each EDG and SBO DG.
- Loss of power
    - The EDGs will be operated if a loss of off-site power occurs and will continue operating until off-site power is restored. As this is a fault condition and necessary for nuclear safety, it is out of scope of our GDA process.
    - The SBO DGs will be operated in the event of a station blackout and will continue until power is restored. As this is a fault condition and necessary for nuclear safety, it is out of scope of our GDA process.

The RP states that the final selection of the combustion plant will be carried out at the site-specific stage. This will be based on a review of suitable combustion plant available and the selection will be based on the assessment of BAT.

6.2.5. Comparison with sector guidance note

In accordance with our P&ID requirements, the RP carried out a high-level comparison of the proposed combustion technology against the Environment Agency Combustion Sector Guidance Note (Environment Agency, 2009) and relevant Environment Agency guidance on controlling and monitoring emissions for an environmental permit (Environment Agency, 2020b). The combustion sector note was withdrawn during the course of this GDA (24 August 2018), but due to the high-level nature of the assessment at GDA stage, the comparison still stands. A future operator will need to carry out a more detailed BAT

assessment at the site-specific permitting stage, so we consider the following Assessment Finding to be appropriate:

Assessment Finding 42: A future operator shall provide in an application for an environmental permit a BAT assessment of the specific combustion plant selected for use against the relevant BAT guidance at the time of application.

The BAT assessment the RP provided for this GDA covers all the relevant topic areas we would expect to see for a proposed combustion plant, a summary of which is as follows.

Energy efficiency

The RP states that it expects a future operator to develop an energy policy and energy management system at the site-specific stage as it greatly relies on the specific combustion plant procured at the time.

Avoidance, recovery and disposal of wastes

The main waste streams from the diesel generators are expected to be spent diesel and spent lube oil. The diesel will be considered spent, and therefore classed as a waste, if it is stored in the main storage tank (linked to each generator) for a long period of time without being used. This is likely to be the case because the generators are expected to be in standby mode for most of the time and only brought into use in the event of a loss of power supplies. The RP proposes a control measure for this (periodic blow-down to remove any water). Both waste streams could potentially be treated by a specialist (and suitably permitted) contractor, but the RP considers this to be a site-specific matter.

Operational issues

The sulphur content of the fuels will be subject to the relevant legislation and standards (UK Parliament, 2007).

Point source emissions to water

No liquid effluents are produced as a result of operating the generators. Any waste generated in the event of an accident (for example, firewater) is expected to be accommodated in the oily wastewater route. This system comprises an oil interceptor and storage before release into the environment via the main site outfall. Any loss of containment in the diesel storage tanks (leaks, spills or catastrophic failure of storage tanks) can be controlled by the proposed mitigation measures (secondary and tertiary containment, leak detection, fire alarms and level alarm systems).

Point source emissions to air

The RP considers the selection of diesel generators rather than gas turbines to be BAT due to the operational flexibility and rapid start-up characteristics. The RP provides some manufacturer’s data on release rates for the main pollutants (oxides of sulphur and nitrogen, carbon monoxide and particulate material).

During the course of our assessment we issued RQ-UKHPR1000-0822, which contained several queries, 2 of which relate to this section. We asked the RP to review the

contradiction between this section, which states that there would be no secondary abatement, and one of the assumptions (section 6.2.2 above), which stated that abatement would be a site-specific matter. In its response to the RQ, the RP provided revised paragraphs that would be included in the next version of the Pre-Construction Environmental Report. Our subsequent assessment found this had been completed. This confirmed that abatement of the air emissions is not ruled out at GDA and can be considered, if necessary, at the site-specific stage.

In RQ-UKHPR1000-0822, we also queried whether the manufacturer's data presented here relate to the environmental impact assessment. In its response, the RP confirmed that the manufacturer's emission data were used to calculate the input parameters for the environmental impact assessment modelling. We are satisfied with this response and do not consider it necessary to look at this in any more detail at GDA stage. This is because the modelling would need to be carried out again at site-specific stage using real location information and emission data from the actual generators selected for use. We will carry out a more detailed assessment of the whole impact assessment as part of our determination for an environmental permit.

Fugitive emissions

The RP considers the risk of fugitive emissions from the proposed combustion plant to be low. Should any leaks or spills occur, there would be appropriate secondary and tertiary containment measures in place to prevent release into the environment.

Monitoring

Monitoring is not proposed for releases to water as there are no planned emissions. The RP acknowledges that monitoring emissions to air may be required, and states that a future operator will need to establish a full site-specific monitoring programme to include air emission monitoring from the diesel generators. While we agree with the RP's conclusion on monitoring, we have stipulated that it will need to go a little further to ensure compliance with the legal requirements for medium combustion plant (see section 6.2.7 below).

Other aspects that will need to form part of the site-specific BAT assessment include management systems, site condition report (for land quality purposes) and raw material usage.

Overall, acknowledging the generic nature of any BAT assessment carried out at GDA stage, which is mainly due to the specific plant and environmental setting of the site being unknown, we consider the assessment the RP has included in its submission to be acceptable.

6.2.6. Environmental impact assessment

The Pre-Construction Environmental Report (GNSL, 2021a) outlines the RP's environmental impact assessment and this is backed up by a more detailed supporting document 'Environmental Risk Assessment on Air Emission' (GNSL, 2021b).

We asked the RP to provide an environmental impact assessment in GDA to determine whether the proposed emissions from the generic design could be considered reasonable at the site-specific stage. The impact assessment is generic at this stage because the specific combustion plant and the environmental setting are not known. Both of these elements will need to be included in more detailed site-specific modelling for the application for an installation activity environmental permit. To ensure this aspect is addressed, we raised the following Assessment Finding:

Assessment Finding 43: A future operator shall provide in an application for a combustion activity environmental permit a site-specific environmental impact assessment for discharges to air. The modelling shall use site-specific parameters based on the environmental setting and the specific combustion plant selected for use.

The environmental impact assessment carried out for GDA involved an initial screening assessment using our recommended H1 environmental risk assessment tool. The purpose of the initial screening assessment was to assess the ground level concentrations of the combustion plant emissions against the applicable relevant short-term and long-term air quality standards. The assessment was based on the operation of a single EDG or SBO DG operating separately. This is considered acceptable because the assessment only applies to commissioning and testing which are both planned activities. The assessment is based on the 3 EDGs operating for 66 hours a year and the 2 SBO DGs operating for 44 hours a year.

The initial screening assessment compared modelled emissions against human health benchmarks (for NO_2, SO_2, CO, PM_{10} and $PM_{2.5}$) and ecological benchmarks (for NO_2 and SO_2).

The outputs of the modelling for the EDGs showed NO_2 exceeding the relevant Environmental Assessment Levels (EALs) in the long-term assessment, and NO_2, SO_2, CO and PM_{10} exceeding the relevant EALs in the short-term assessment. For the SBO DGs, only the relevant short-term EALs were exceeded for NO_2, SO_2, CO and PM_{10}. Particularly notable results were the modelled short-term NO_2 emissions for the ecological EALs, which were significantly higher than the benchmark for both the EDGs and the SBO DGs. Although these results could have initially been a cause for concern, it is important to note that the H1 tool used here is extremely conservative in order to apply a high level of protection to the environment.

At a site-specific permitting stage, we would normally go on to require an applicant to carry out more detailed modelling using a more in-depth air dispersion model (for example, AERMOD or ADMS). This is not reasonable to do at the GDA stage because the detailed models require a lot of information about the site and environmental setting that the emission point is situated in. The necessary level of detail is simply not available at the GDA stage. As an alternative, we asked the RP to carry out a sensitivity analysis to better understand the sensitivity of the H1 tool to each of the model variables, and whether more acceptable ground level concentrations could be achievable at site-specific stage.

The sensitivity analysis the RP carried out was based on published Environment Agency guidance, which states that a sensitivity analysis should be based on:

- meteorology data
- emission parameters (for example, stack height)
- receptor grid resolution
- treatment of terrain and buildings

The detailed sensitivity analysis is presented in the supporting document 'Environmental Risk Assessment on Air Emission' (GNSL, 2021b) and summarised in the PCER (GNSL, 2021a). The RP chose to focus on the highest results from the H1 assessment, which were outlined above as particularly notable: the short-term ecological assessment for NO_2. The outcome of the sensitivity analysis found that the parameters that are most sensitive (that is, those that affect the results the most) are stack height, meteorology and buildings. The results show that a stack height of 28m would bring the ground level concentrations of NO_2 at the site boundary below the relevant EALs for both the EDGs and the SBO DGs. For the EDGs, the modelled stack height had to be increased to 40m in order to bring the on-site ground level concentrations below the relevant EAL. These stack heights are not unrealistic on a nuclear site in England. These conclusions are underpinned by the detailed analysis assessment the RP presented in its submission (GNSL, 2021b).

The decision on final stack heights for the combustion plant is a site-specific matter for a future operator. It is also acknowledged that the final plant layout and further detailed dispersion modelling may reduce the final stack height needed. The purpose of the screening assessment and sensitivity analysis was to demonstrate that the impact of emissions from the combustion plant on the UK HPR1000 could be realistically reduced to an acceptable level to potentially enable a permit to be issued.

The operator will have to carry out site-specific air dispersion modelling as part of the permit application to demonstrate compliance with air quality standards, and to demonstrate that the environmental impact from the combustion plant installation is acceptable. We consider the following Assessment Finding (that was introduced above) appropriate to ensure this happens:

Assessment Finding 43: A future operator shall provide in an application for a combustion activity environmental permit a site-specific environmental impact assessment for discharges to air. The modelling shall use site-specific parameters based on the environmental setting and the specific combustion plant selected for use.

As part of the site-specific permit application, the operator will also need to consider whether there are any designated habitat sites (including Sites of Special Scientific Interest, Marine Conservation Zones, Special Protection Areas, Special Areas of Conservation or Ramsar Convention sites) in the area and, if necessary, carry out a Habitats Regulations assessment.

6.2.7. Requirements specific to medium combustion plant (MCP)

Consideration of legal requirements relating to medium combustion plant (UK Parliament, 2018) is not currently included in our P&ID because they are relatively new. We raised this with the RP and asked it to consider how MCP requirements would apply to its proposed generators. The legislation is fairly new and quite complex, so we raised RQ-UKHPR1000-0680 to try and help the RP understand our expectations for GDA. The Medium Combustion Plant Directive is implemented in the UK by a 2018 amendment to the Environmental Permitting Regulations (UK Parliament, 2018) and the inclusion of Schedule 25A and 25B. RQ-UKHPR1000-0680 directed the RP to the relevant legislation and guidance.

The RP had initially stated that because its proposed hours of operation fell below the threshold of 500 hours a year, MCP requirements did not apply. This is not correct and the RQ was intended to help the RP assess the requirements of the regulations properly. The MCP requirements apply to all combustion plant between 1 and 50MW, so all the generators will be classed as medium combustion plant. They will need to be permitted as such, and this is likely to be as part of the installation environmental permit. The legislation does provide a threshold of 500 hours a year under which the emission limits do not apply. However, a permit will be required, and the permit will still include monitoring requirements for certain parameters (for example, carbon monoxide and oxides of nitrogen). This will mean that suitable monitoring infrastructure will need to be designed into each generator to enable safe and accurate monitoring to be carried out. Separate regulatory requirements relating to 'specified generators' do not apply to these combustion plant as they are exempt because they provide a nuclear safety role on a nuclear licensed site. We are now content that the RP has addressed the MCP requirements correctly in the PCER (GNSL, 2021a).

6.2.8. Greenhouse gas emission monitoring

The UK HPR1000 combustion plant will require a permit from us under the Greenhouse Gas Emissions Trading Scheme Order 2020 (the Order) (UK Parliament, 2020), as the total rated thermal input of combustion units operated on the site exceeds the 20MW threshold set out in the Order.

The RP states that the proposed approach to monitoring greenhouse gas emissions will meet the requirements of the Monitoring and Reporting Regulation (Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council) as amended by the Order (the MRR). The RP states that it will follow the standard methodology used for calculating emissions as outlined in the MRR. The standard methodology involves measuring fuel and process inputs and applying appropriate calculation factors (such as emission and oxidation factors and net calorific values) to calculate the total emissions.

We accept, for the purposes of GDA, that the RP has provided sufficient information on greenhouse gas monitoring.

We will continue to assess this aspect as part of our site-specific regulatory activities.

6.3. Conclusions on operation of installations

Following our assessment of the operation of installations, our conclusions are that:

- the UK HPR1000 combustion plant (diesel generators) is likely to be a Part A(1) installation as described in Section 1.1 of Chapter 1 in Part 2 of Schedule 1 of The Environmental Permitting (England and Wales) Regulations 2016 and will, therefore, require an environmental permit from the Environment Agency
- several aspects of the GDA submission will need to be revised and updated when site-specific data are available. The main aspects that will need considering further are:
    - a BAT assessment for the chosen diesel generators
    - the application of the legal requirements for medium combustion plant. This may require the necessary monitoring infrastructure to be included in the design (in line with technical guidance note M1 (Environment Agency, 2017))
    - site-specific modelling to demonstrate compliance with air quality objectives
    - the UK HPR1000 combustion plant will also require a permit under the Greenhouse Gas Emissions Trading Scheme Order 2020 (UK Parliament, 2020)

To ensure that the main elements are picked up at the site-specific stage, we have included the following 2 Assessment Findings:

Assessment Finding 42: A future operator shall provide in an application for an environmental permit a BAT assessment of the specific combustion plant selected for use against the relevant BAT guidance at the time of application.

Assessment Finding 43: A future operator shall provide in an application for a combustion activity environmental permit a site-specific environmental impact assessment for discharges to air. The modelling shall use site-specific parameters based on the environmental setting and the specific combustion plant selected for use.

7. Substances subject to the Control of Major Accident Hazards (COMAH) Regulations

The Control of Major Accident Hazards (COMAH) Regulations 2015 (the Regulations) (UK Parliament, 2015a) apply to establishments that store or use quantities of named or generic categories of dangerous substances above specified qualifying thresholds. COMAH dangerous substances are defined by the Regulations (UK Parliament 2015a) and include chemicals, oils or explosives. The aim of the Regulations is to prevent or mitigate the consequences of major accidents. A major accident is an occurrence such as an uncontrolled release, fire or explosion in the course of the operation of an establishment that leads to serious danger to human health or the environment. A major accident to the environment (MATTE) could cause severe, widespread, long-term or even permanent damage to ecosystems. In England, we share the responsibility for enforcing COMAH on nuclear licensed sites with the Office for Nuclear Regulation (ONR), working as a joint competent authority. Further information can be found at www.hse.gov.uk/COMAH.

7.1. Assessment objectives

Our assessment for this topic area was aimed at:

- deciding whether the UK HPR1000 would be a COMAH establishment based on the proposed chemical inventory
- deciding whether the UK HPR1000 design included measures to prevent and mitigate a MATTE if the COMAH Regulations were applicable

7.2. Assessment

7.2.1. Regulatory context

The RP demonstrated a good understanding of the COMAH Regulations. The RP particularly noted that COMAH does not apply to radioactive substances, which is correct.

7.2.2. Assumptions

The RP made the following assumptions in relation to substances subject to the COMAH Regulations:

- The wider GDA scope considers a single unit, but in order for the COMAH assessment to be more meaningful, the RP agreed at an early stage in the GDA process to consider 2 units for the COMAH assessment, as it is more usual to deploy nuclear power plants in pairs. Under COMAH, threshold quantities of dangerous substances need to be exceeded in order for the regulations to apply.

Considering 2 units at GDA stage ensures that any design modifications required to comply with COMAH are not missed by assessing one unit in isolation.

- Details of chemicals to be used in construction and decommissioning are out of scope of GDA as the detail is not available at the GDA stage. The COMAH assessment, therefore, only applies to commissioning and operational phases of the plant's life cycle.

- Assessment of chemicals used for decommissioning will be carried out towards the end of the operational phase of the plant and will depend on the future operator's choice and decommissioning techniques available at that time.

- Some substances, such as paints, will be chosen by a future operator so the hazard information is not available for the GDA stage. These types of substances have been excluded from this assessment and they are unlikely to impact on the conclusions reached during GDA. The RP has, however, included all the substances that are expected to be held in larger quantities.

We consider the assumptions to be reasonable at the GDA stage for a generic site and that a meaningful assessment can be carried out. Some of the assumptions would need to be followed through to the site-specific stage. Any changes to these assumptions are likely to affect our assessment outcomes.

7.2.3. Requesting Party's approach to carrying out the COMAH assessment

The RP outlined its approach to carrying out the COMAH assessment to establish whether the regulations apply to the design. The main points of the approach were:

- Step 1 - develop an inventory of chemicals (see 7.2.4 below).

- Step 2 - classify the dangerous substances according to the GB Classification, Labelling and Packaging Regulation (https://www.hse.gov.uk/chemical-classification/legal/clp-regulation.htm) and identify the corresponding qualifying thresholds in the COMAH Regulations.

- Step 3 - carry out the comparison against upper and lower tier thresholds provided in the COMAH Regulations. The COMAH Regulations are set out in such a way that a site (or 'establishment' as defined by the Regulations) can be classed as either upper tier or lower tier depending on the quantities of dangerous substances present.

- Step 4 - application of the 'aggregation rule' and '2% rule'. Both of these rules are provided by the COMAH Regulations.

    - The aggregation rule must be applied when no individual dangerous substance is present in a quantity above or equal to a qualifying threshold. The aggregation rule ensures that substances with similar hazards associated with them (health, physical or environmental hazards) are added

together. This determines whether the establishment as a whole contains sufficient quantities of dangerous substances for the COMAH Regulations to apply.

- The 2% rule states that any dangerous substance present in quantities less than 2% of the appropriate threshold (identified in Step 2 above) can be excluded from the COMAH assessment as long as its location prevents it from initiating a major accident.

We assessed the approach the RP originally outlined (in GNSL, 2020a) and found an issue with how the aggregation and 2% rule had been applied. We issued RQ-UKHPR1000-0821 to ask the RP how it could apply the location aspect of the 2% rule at GDA stage. In its response, the RP acknowledged this and has revised its assessment to consider the whole inventory at GDA stage and not remove any substances in quantities less than 2% of the relevant threshold. We accept the response and this revised approach because it ensures that none of the inventory will be missed from the future site-specific assessment. The RP provided a revised set of assessment tables that have now been included in the PCER (GNSL, 2021a) and 'COMAH Assessment for UK HPR1000' (GNSL, 2020c). The revised assessment did not change the outcome of the COMAH assessment.

7.2.4. Chemical inventory

The first step in a COMAH assessment is to establish what dangerous substances will be present at the site. The RP outlined the work it carried out to establish a chemical inventory in the PCER (GNSL, 2021a) and this is underpinned by a more detailed supporting document (GNSL, 2019c). The chemical inventory has been based on operational experience from the wider China General Nuclear (CGN) fleet of nuclear power plants. The RP has presented an inventory of chemicals with corresponding concentrations, how each will be used, and the maximum storage quantities. Two separate inventories have been presented at GDA, one for commissioning and one for the operational phase of the plant's life cycle.

7.2.5. Requesting Party findings from the COMAH assessment

The RP has provided an outline of its COMAH assessment in the PCER (GNSL, 2021a) and this is underpinned by a more detailed supporting document (GNSL, 2020c). This part of the assessment covers steps 2, 3 and 4 outlined in section 7.2.3 above.

In its submission, the RP has presented tables showing the outcome of its COMAH assessment procedure (GNSL, 2021a and outlined in section 7.2.3 above). The assessment has been separated into a number of operating scenarios as follows:

- 2 units under commissioning
- one unit under commissioning and one unit in operation
- 2 units in operation

We consider this scenario-based approach to be acceptable, as it should ensure that the expected changes in the inventory during the early phases of plant life are considered in this assessment.

The first set of tables (in GNSL, 2021a) compare the chemical inventory against the COMAH thresholds. The 2% rule was originally applied at this stage (in GNSL, 2020a), but this has subsequently been removed following RQ-UKHPR1000-0821.

The second set of tables (in GNSL 2021a) apply the aggregation rule.

In RQ-UKHPR1000-0821, we queried some of the table numbering and discrepancies in the quantity of hydrazine between the PCER (GNSL, 2020a) and the 'COMAH Assessment' supporting document (GNSL, 2020c). The RP accepted the comments and has included the necessary revisions in the latest version of the documents. The amendments did not affect the conclusions of the COMAH assessment.

Having followed through the procedure outlined in section 7.2.3 above, the RP concludes that the UK HPR1000 is unlikely to be subject to COMAH Regulations during the commissioning and operational phases of the plant's life cycle. Construction and decommissioning phases have been agreed as being out of scope of GDA (see 7.2.2 Assumptions above).

We can accept the RP's findings based on the level of detail known at GDA stage. It is, however, important to ensure that as a site-specific design develops, the proposed chemical inventory may change. We, therefore, consider the following Assessment Finding to be appropriate:

Assessment Finding 44: A future operator shall keep the chemical inventories on its site under review so any applicability of COMAH can be identified early and the necessary major accident prevention measures can be installed.

7.2.6. Potential measures to prevent a major accident to the environment (MATTE)

Despite the outcome of the assessment being that the UK HPR1000 is unlikely to be subject to the COMAH Regulations, the RP has fulfilled the P&ID requirement to describe the measures it could use to prevent a MATTE should the inventory (and therefore COMAH assessment) change at the site-specific stage. We welcome this approach as it ensures that any future detailed design and layout of the site considers COMAH.

In the PCER (section 8.7.7) on potential measures to prevent a MATTE there is a focus on hydrazine, whereas the corresponding section in the 'COMAH Assessment' supporting document is more general, and therefore more appropriate for GDA. We queried this disparity in RQ-UKHPR1000-0821. The RP confirmed in its response that this was as a result of hydrazine being identified in an earlier version of the assessment as being subject to COMAH regulation. Subsequent optimisation of proposed hydrazine storage and use and more detailed assessment resulted in hydrazine not being subject to COMAH. The focus on hydrazine in this section of the PCER (GNSL, 2021a) is no longer needed and

has been rewritten to be more in line with the, more acceptable, corresponding section in the ‘COMAH Assessment’ (GNSL, 2020c).

The RP has identified the main aspects of primary, secondary and tertiary containment measures in the ‘COMAH Assessment’ supporting document (GNSL, 2020c). If COMAH was found to apply to the operations at a site at a later date, then these measures would need to be expanded to cover wider aspects such as offloading procedures, COMAH critical equipment, maintenance, management systems and human factors. However, the level of detail the RP presented in its submission is considered sufficient to demonstrate an awareness at the GDA stage.

7.3. Conclusions on substances subject to the Control of Major Accident Hazards Regulations

Following the assessment of substances relevant to COMAH and based on the information submitted, our conclusions are that:

- the UK HPR1000 is unlikely to be subject to the COMAH Regulations. If any of the generic design assumptions change at a site-specific stage, then this conclusion will need to be reconsidered

- changes in inventory at the site-specific stage need to be kept under review to ensure a relevant threshold for the COMAH Regulations isn’t exceeded

We have also concluded that one Assessment Finding would be appropriate:

Assessment Finding 44: A future operator shall keep the chemical inventories on its site under review so any applicability of COMAH can be identified early and the necessary major accident prevention measures can be installed.

It should be noted that the above conclusion relates only to major accidents to the environment. Our partner in the competent authority for COMAH regulation, ONR, is responsible for assessing matters relating to impacts on people.

8. Fluorinated greenhouse gases and ozone-depleting substances

Fluorinated gases (F-gases) are very powerful greenhouse gases that contribute to climate change if released into the atmosphere.

Many industrial sites have air conditioning and refrigeration units which use fluorinated gases. These gases are often known collectively as ‘hydrofluorocarbons’ (HFCs) or ‘F-gases’. The gases, if released into the atmosphere, contribute to climate change as they are greenhouse gases with many times the potency of carbon dioxide. The Fluorinated Greenhouse Gases Regulations 2015 (UK Parliament, 2015b) place certain obligations on producers, suppliers and users of F-gases. The Environment Agency is the enforcing authority for these regulations in England.

Ozone-depleting substances (ODS) are gases that damage the ozone layer in the upper atmosphere. ODS have been largely phased out in Europe, but may still exist in older equipment. There are also a few exceptions for certain uses. Common uses for ODS include refrigeration and air-conditioning equipment.

8.1. Assessment objectives

Our assessment for this topic area was aimed at:

- understanding whether any equipment included in the design will contain fluorinated greenhouse gases (F-gas) and/or ozone-depleting substances (ODS)
- where these gases are included in the design, understanding the measures proposed to prevent and minimise leakage of such substances

8.2. Assessment

8.2.1. Regulatory context

The RP demonstrated a good understanding of the main pieces of legislation relating to F-gas and ODS.

8.2.2. Assumptions

The RP made the following assumptions in relation to F-gas and ODS:

– No ODS will be used in the UK HPR1000.

– F-gases selected for GDA of the UK HPR1000 are based on those used in the reference plant HPR1000 (Fangchenggang Nuclear Power Station Unit 3).

– The gases chosen will not be phased out (due to legislative changes) before the plant is brought into operation.

We consider the assumptions to be reasonable at the GDA stage for a generic site. The assumptions will need to be replaced by real information at a site-specific stage. Any changes to these assumptions would require us to re-evaluate our assessment outcomes.

8.2.3. Equipment using F-gas

A number of F-gases are currently proposed to be used in the UK HPR1000 design in the refrigeration system, fire protection system and as insulating gases. These types of uses are common in other industrial sectors in the UK. The RP specifies the list of F-gases proposed and these are as follows:

- HFC-134a - refrigerant in chiller units
- R407C - refrigerants in air conditioning systems
- HFC-236fa - mobile and portable fire extinguishing equipment
- HFC-227ea - gas fire extinguishing system
- Sulphur hexafluoride - insulate switchgear in the generator circuit breaker

None of the above substances at the proposed quantities are either banned now or are currently planned to be banned in the near future. All of the substances specified above, apart from sulphur hexafluoride are subject to a legislatively controlled phase down, and alternatives will need to be sourced. The legislation controlling these gases may, however, change over time. A future operator should keep the proposed F-gases under review to ensure their continued use at the required quantities remains legally possible in England.

In the PCER submission (GNSL, 2021a), the RP acknowledges this and presents some possible alternatives for future use, namely R513a and R-1233zd as possible alternatives for HFC-134a. The RP concludes that the final choice of F-gases to be used in the UK HPR1000 is a site-specific matter for a future operator. We consider the RP's proposals and conclusion to be acceptable at GDA stage. In order to ensure the extent of the GDA assessment is carried through into the site-specific stage, we consider the following Assessment Finding to be appropriate:

Assessment Finding 45: A future operator shall keep the fluorinated greenhouse gases proposed for use in the UK HPR1000 under review to ensure they continue to be legally acceptable for use.

Where these gases are included in the design, the RP must describe the measures proposed to prevent and minimise leakage of such substances. The RP has outlined the proposed measures for each expected use. Despite being considered at a very high level in the PCER submission, it is deemed to be acceptable for GDA due to the site-specific nature of such decisions.

8.3. Conclusions on fluorinated greenhouse gases and ozone-depleting substances

Following our assessment of the use of fluorinated greenhouse gases and ozone-depleting substance and based on the information submitted, our conclusions are that:

- no ozone-depleting substances are proposed to be used in the design
- the proposed quantities of specific fluorinated greenhouse gases to be used in the design are currently acceptable under the relevant legislation and in common with current UK practice
- the level of detail in the proposed measures to prevent and minimise leakage is considered acceptable for GDA

We have also concluded that one Assessment Finding would be appropriate:

Assessment Finding 45: A future operator shall keep the fluorinated greenhouse gases proposed for use in the UK HPR1000 under review to ensure they continue to be legally acceptable for use.

9. Compliance with Environment Agency requirements for GDA

Compliance with Environment Agency requirements for GDA can be summarised as follows.

P&ID Item 8 - **Water use and abstraction** - If fresh water is provided by the local water company, then an abstraction licence is not required. An abstraction licence would not be required if cooling water is abstracted from open coastal waters, but it is likely to be required if an estuary location is chosen.

P&ID Item 8 - **Discharges to surface waters** - A water discharge activity environmental permit is likely to be required for the design. Hydrazine has been highlighted as a substance that will require particular attention at site-specific permitting stage.

P&ID Item 8 - **Discharges to groundwater** - There are no proposed discharges to groundwater.

P&ID Item 8 - **Operation of installations (combustion plant and incinerators)** - An installation activity permit and Greenhouse Gas Emissions Trading Permit are likely to be required for the design.

P&ID Item 8 - **Substances subject to the Control of Major Accident Hazards Regulations** - The GDA assessment shows that the UK HPR1000 is unlikely to be subject to the COMAH Regulations during its commissioning and operational phases.

P&ID Item 8 - **Fluorinated greenhouse gases and ozone-depleting substances** - No ODS are proposed to be used in the UK HPR1000. Proposed quantities of specific fluorinated greenhouse gases to be used in the design are currently acceptable under the relevant legislation and in common with current UK practice.

Note that all of the above are also subject to associated Assessment Findings and further assessment at the site-specific permitting stage.

10. Public comments

10.1. General Nuclear System Limited's public comments process

The GNSL GDA comments process received 3 public comments up to 17 September 2021 concerned directly with the other environmental regulations assessment area. Two of the comments relate to cooling water abstraction and discharge and the potential impact on the Blackwater Estuary adjacent to the Bradwell site. The third comment related to the impact of heat on the Blackwater Estuary from the cooling water discharge. Impact of heat is a site-specific matter that has been deemed out of scope of GDA.

We've seen the comments and GNSL's responses. These matters will not be addressed during GDA, but would be addressed in detail at the site-specific permitting stage should proposals to construct a power station at that site come forward.

10.2. Environment Agency public consultation

We held a public consultation on our preliminary GDA assessment findings (Environment Agency, 2021a & b), which ran for 12 weeks from 11 January 2021 to 4 April 2021. We received a number of consultation responses, which we have published (https://consult.environment-agency.gov.uk/nuclear/assessing-new-nuclear-power-station-ukhpr1000/). Our replies to each point are presented within our decision document (Environment Agency, 2022a). Any points raised that were in GDA scope and relevant to other environmental regulations are also presented here.

Our overarching approach to this topic area within GDA is explained in section 2.2 of this report 'Assessment limitations and scope'. The section explains the site-specific nature of all the sub-topics covered under 'other environmental regulations' and the limitations we have in a GDA. Each sub-topic will require more detailed work at site-specific permitting stage when sufficient environmental information is available.

10.2.1. Comments on water use and abstraction

We received comment UKHPR1000-011 regarding water use and abstraction.

The comment expressed a view that once-through cooling is not viable at the Bradwell site and went on to say that indirect cooling could not be considered BAT for this site. Concerns such as the site-specific selection of cooling options are outside the scope of GDA. However, the RP has proposed once-through cooling for the UK HPR1000 GDA based on the generic site. While Bradwell has been proposed as a site for the first deployment of the UK HPR1000, GDA is based on a generic site. Section 3.2.4 of this assessment report explains that once-through cooling can be considered BAT for the generic coastal or estuary site, but also that any other cooling water system (listed in section 3.2.4) could be considered BAT for any given site. The RP has left it open for a future operator to determine BAT for cooling based on the characteristics of the specific deployment site. We will use site-specific information and consider guidance current at the

time of a site-specific application to determine whether the operator's proposals are BAT for a particular location.

We received comment UKHPR1000-014 regarding water use and abstraction.

Section 3.2.4 of this report explains that the once-through cooling system proposed for the UK HPR1000 GDA can be considered BAT for the generic site but also that any other cooling water systems (listed in section 3.2.4) could be considered BAT for any given site. The RP has left it open for a future operator to determine BAT for cooling based on the specific deployment site. We will use site-specific information and have regard for guidance current at the time of a site-specific application to determine whether the operator's proposals are BAT for a particular location.

The comment raises concern that there has been no thermal impact modelling carried out in GDA. This issue is not covered in any depth at GDA because meaningful modelling cannot be carried out without detailed information on the behaviour of the receiving surface water environment. For this reason, it was agreed to be out-of-scope of this GDA (see 'Executive Summary' and section 3.2.2 'Assumptions'). This is an important area that would be assessed at a site-specific stage when the information necessary for this to be done would be available.

Comment is also made about our assessment of the potential impact on fish and invertebrates during GDA. This is an area that requires detailed information on the environment around the site, which is not available at GDA for a generic site. The assessment for GDA ensured the RP was clear on the importance of this issue and that it is aware of what needs to be taken into consideration in the choice of fish deterrent and recovery and return systems for site-specific permitting.

While we understand the concerns raised and the desire for the Environment Agency to assess the environmental impacts at Bradwell, GDA is based on a generic site. We have carried out an appropriate assessment for the GDA stage.

In addition, reference is also made in this comment to visual impact and emissions to air and sea from a hybrid cooling design at the Bradwell site. These aspects are outside the scope of GDA as they are site-specific. This GDA is for a once-through cooling system at the generic site. It should also be noted that visual impact is not within the Environment Agency's remit and is a matter for the relevant planning authority.

We received comment UKHPR1000-027 regarding water use and abstraction.

The comment suggests that we should consider the difference between UKHPR1000 and other PWR technologies in terms of water abstraction. This GDA is for the UKHPR1000 design at a generic site location. Comparison with other technologies and consideration of the potential sites selected for development are outside of the GDA scope. However, generally we would expect PWRs to have similar requirements for cooling water where once through cooling is being used. This assessment applies our well-established

abstraction licensing regime to this design to conclude whether an abstraction licence may be required for the generic site (which, in this case, is a coastal or estuary location).

10.2.2. Comments on discharges to surface water

We received comment UKHPR1000-011 regarding discharges to surface water.

The comment queried whether a GDA decision will remain valid if an alternative to direct (once-through) cooling is chosen. This aspect is covered in this report in section 3.2.4 ‘Cooling water system requirements’. If proposals were to come forward from a future operator for a specific site, we would require them to address any changes to the GDA design arising from the site characteristics or the operator’s detailed proposals.

We received comment UKHPR1000-014 regarding discharges to surface water.

The comment asks us to consider asking the RP for more information on the potential acceptability of emissions and discharges using an estuarial site as the basis for assessment. The screening approach for the environmental impact assessment is described in section 4.2.4 of this report. The screening assessment the RP carried out used our guidance to compare predicted discharges against environmental quality standards (EQSs). The EQSs used in this assessment were for ‘estuaries or coastal waters’ so are appropriate for the generic site. More detailed modelling can only be carried out when more information on the environment at a specific site is available. Our Assessment Finding 41 is included to highlight this.

The comment also states that discharges should not be allowable into a marine conservation zone (MCZ). The generic site assessed for GDA was not an MCZ, so this has not been considered. If an MCZ has been designated at any future specific location chosen for the UK HPR1000, then it would be considered appropriately in our determination of an application for a water discharge activity permit.

The comment also questions how we could issue a statement of design acceptability (SoDA) without considering discharges into the ‘specified estuarial site’, and that considering a generic site for a generic design assessment is ‘inadequate’. The scope of the GDA is well publicised and is limited to the generic site presented by the RP. All of the specific aspects raised in the comment (such as thermal impact, MCZ) are all part of our assessment at a site-specific permitting stage.

We received comment UKHPR1000-043 regarding discharges to surface water.

The comment raised a concern that using hydrazine introduces additional toxicity. We have covered the use and treatment of hydrazine during GDA, and our assessment is described in section 4.2.4 ‘Environmental impact assessment’. In response to our Regulatory Queries, the RP has provided a number of ways in which hydrazine could be managed to minimise its discharge. The outcome from the GDA process is that hydrazine has been highlighted as a substance requiring particular attention at the site-specific permitting stage.

We received comment UKHPR1000-043 regarding discharges to surface water.

The comment raised a concern about the amount of detail in the assessment carried out for the list of substances on page 107 of the Consultation Document (Environment Agency 2021b). The extent of the screening assessment is explained more fully in section 4.2.4 of this report. The list referred to in this comment includes those substances that are screened out of the assessment carried out for GDA. It should be noted that Assessment Finding 41 requires that all substances would be assessed more fully at site-specific permitting stage.

10.2.3. Comments on discharges to groundwater

We received comment UKHPR1000-043 regarding discharges to groundwater.

The comment states that there is insufficient evidence that discharges to groundwater would not be polluting. It is confirmed in section 5.2.3 of this report that there will be no intentional discharges to groundwater, therefore a permit will not be required. In GDA, we ask the RP to focus its response on how leaks and spills would be prevented from entering groundwater. The RP has appropriately described the use of primary, secondary and tertiary containment.

10.2.4. Comments on the operation of installations

We received UKHPR1000-014 regarding the operation of installations.

The comment acknowledges that further work will be required at the site-specific permitting stage, but considers this to be inadequate. The site-specific nature of the topics covered in this report means that further work would have to be carried out at each site-specific permitting stage. Assessment Finding 42 requires a BAT assessment for the specific combustion plant chosen. Assessment Finding 43 requires the discharges to air from the combustion plant to be risk assessed at the site-specific stage.

We received comments UKHPR1000-041 and UKHPR1000-047 regarding the operation of installations.

The comments state that diesel generators should not be used due to emissions, and that alternative cleaner fuels should be sought. The diesel generators are required for nuclear safety and need to respond immediately to a loss of power if required. One of the main considerations is the availability of supply in such situations, and diesel fuel stored on-site provides a more robust supply when compared to other currently available options. Diesel has been proposed and assessed at GDA as the most appropriate fuel for the back-up generators, but it should be noted that the final choice is a site-specific choice for an operator to make. The site-specific choice must be demonstrated to be BAT at the time of a site-specific application, and Assessment Finding 42 highlights this.

Comment UKHPR1000-043 raised a similar concern to the one above, but also expressed concern that the modelling for EDGs showed levels exceeding requirements. The Environment Agency screening tool used for this assessment is noted as being very conservative. It is generally used at site-specific permitting to screen out substances that

are genuinely insignificant and highlight those that require additional consideration. Any substance that doesn't screen out using this tool is usually required to be subjected to more detailed air dispersion modelling.

It is not possible to carry out meaningful detailed modelling at GDA because the necessary input parameters for the air dispersion models are not available for a generic site. The levels, "exceeding requirements" were picked up during GDA, and we asked the RP to carry out a detailed sensitivity analysis to better understand the conservativeness of the screening tool. This work met our expectations and is described more fully in section 6.2.6 of this report. In addition to this, we also included Assessment Finding 43 to ensure a detailed assessment of emissions to air from the combustion plant is carried out at the site-specific permitting stage.

10.2.5. Comments on COMAH

We received comment UKHPR1000-014 regarding COMAH.

The comment raises concerns in relation to nuclear accidents and the release of radioactivity. At GDA this area of assessment lies with ONR. The COMAH Regulations are concerned with major accidents associated with the release of non-radioactive hazardous chemicals. Our assessment of the UKHPR1000 design in relation to the COMAH Regulations is covered in detail in section 7 of this report.

We received comment UKHPR1000-021 regarding COMAH.

The comment stated that containment of hazards within the boundary fence is an unrealistic scenario. From the assessment carried out for GDA, our conclusion is that the UKHPR1000 will not fall under the COMAH Regulations. Assessment Finding 44 requires a future operator to keep quantities of COMAH dangerous substances under review. If any storage quantity thresholds are ever exceeded then the site will fall under COMAH regulation. At this point the potential impacts of a COMAH major accident (defined in the introductory paragraph of section 7 in this report) both on and off-site will be assessed and the future operator will be required to take all measures necessary to reduce the risk to the environment and people.

We received comment UKHPR1000-027 regarding COMAH.

The comment questioned what powers the Environment Agency has to consider the control of major accidents. In England, the COMAH Competent Authority is the regulator, which is made up jointly by the Environment Agency and the Office for Nuclear Regulation (ONR). This requirement for a COMAH Competent Authority is set down in the COMAH Regulations 2015.

We received comment UKHPR1000-043 regarding COMAH.

The comment raised a concern that the strategy to monitor a change of status (under COMAH) is unclear. The strategy will be the responsibility of future operators to develop and, as such, does not currently exist. When a site becomes subject to COMAH, the

regulations place the responsibility to notify the COMAH Competent Authority onto the operator, failure to do so is a breach of the regulations. Assessment Finding 44 is intended to highlight to a future operator that it must keep its chemical inventories under review to ensure the point at which any of the COMAH thresholds are crossed is identified. This would trigger the requirement to notify the COMAH Competent Authority. This type of inventory management is common throughout many industrial sectors that store and use COMAH dangerous substances (for example, hazardous waste or chemical manufacturing industries).

10.2.6. Comments on fluorinated greenhouse gases and ozone depleting substances

We received comments UKHPR1000-039 and UKHPR1000-040 regarding fluorinated greenhouse gases (F-gas) and ozone depleting substances (ODS).

The comments question why F-gases and ODSs are proposed to be used at a future site. Our conclusion in section 8.3 of this report states that no ODS will be used in the design. The proposed use of F-gases in the UKHPR1000 design is similar to the approach currently taken in other industry sectors for the purposes of refrigeration, fire protection systems and as insulating gases. Section 8.2.3 (‘Equipment using F-gas’) of this report explains how some F-gases are being phased out over time and that alternatives will need to be sought. The RP is clear that the choice of gases is a site-specific matter, and Assessment Finding 45 is intended to ensure any gases chosen by a future site operator are legally permitted for use at that time.

We received comment UKHPR1000-043 regarding fluorinated greenhouse gases (F-gas) and ozone depleting substances (ODS).

The comment stated that the F-gases should be independently monitored and catalogued. We would expect a future operator to work within the regulatory regime in place at that time, and any failure to do so could result in enforcement action.

We received comment UKHPR1000-047 regarding fluorinated greenhouse gases (F-gas) and ozone depleting substances (ODS).

The comment raises concern that the Environment Agency hasn’t asked for alternatives to be specified. Identifying alternatives to F-gases is an ongoing process that any future operator would have to adhere to. Section 8.2.3 of this report discusses the potential alternatives that the RP proposed, but is clear that the choice of gases for refrigeration, fire protection systems and as insulation are decisions for a future operator, who would be required to comply with the legislative controls in place at that time. Assessment Finding 45 is included to ensure that this is done.

11. Conclusion

We have come to the following conclusions from our assessment of the other environmental regulations topic area for the UK HPR1000.

Water use and abstraction

Following the assessment of water use and abstraction, our conclusions are that:

- an abstraction licence would not be required for fresh water supply (for example, process and drinking water) if it is provided by a local water company
- an abstraction licence would not be required if cooling water is abstracted from open coastal waters, but it is likely to be required if an estuary location is chosen
- the choice of once-through sea water cooling could be considered appropriate for the UK HPR1000 based on a coastal or estuary location. However, other options could be considered at the site-specific stage depending on site-specific characteristics (including ecology and biodiversity)
- the final design of the abstraction intake and fish deterrent and return systems for the UK HPR1000 to minimise fish ingress and injury and meet the requirements of the Eels (England and Wales) Regulations 2009 (UK Parliament, 2009), and other legislation as relevant, is a site-specific issue and can only be determined once the local environmental conditions are known

We consider the following 2 Assessment Findings to be appropriate:

Assessment Finding 37: A future operator shall engage with the local water supply company early in the site-specific stage. This is to ensure that sufficient quantities of fresh water can be supplied to meet the requirements of the UK HPR1000 or to determine whether an alternative source of fresh water will need to be identified.

Assessment Finding 38: A future operator shall ensure that the siting of the cooling water intake and outlets are BAT for the UK HPR1000 design at each specific site.

Discharges to surface water

Following our assessment of the surface water discharges, our conclusions are that:

- the UK HPR1000 will have non-radioactive discharges to surface water and will require an environmental permit for a water discharge activity
- the information the RP provided for GDA is sufficient for us to conclude that the impact from discharges to surface waters could be at levels low enough to enable a reasonable application for a water discharge activity permit. However, the risk assessment work carried out for GDA must be revised with greater detail at the site-specific permitting stage to reduce the level of uncertainty that exists in the work

carried out to date. At a site-specific stage, the future operator must apply for and obtain all necessary permissions.

To ensure that the main elements are picked up at the site-specific stage, we have included the following 3 Assessment Findings:

Assessment Finding 39: A future operator shall review the calculations for emissions of chemicals as part of the site-specific environmental risk assessment. Particular attention should be focused on the application of possible treatment techniques for hydrazine to reduce the amount discharged to the environment and arrangements to minimise any impact.

Assessment Finding 40: A future operator shall ensure that the storage, treatment and monitoring systems for the 3 non-radioactive effluent streams provide the appropriate level of environmental protection for the receiving environment in terms of quality of effluent discharged. This would be regulated by a water discharge activity permit.

Assessment Finding 41: A future operator shall provide in an application for a water discharge activity environmental permit a site-specific environmental impact assessment for discharges to water. The modelling shall use site-specific parameters based on the environmental setting and the specific chemicals selected for use.

Discharges to groundwater

Following our assessment of discharges to groundwater, our conclusions are that:

- there should be no intentional discharges to groundwater and an environmental permit for a groundwater activity will not be required
- the pollution prevention techniques specified in the design should prevent contamination of groundwater. If any of the generic design assumptions change at a site-specific stage, then this conclusion will need to be reconsidered

Operation of installations (combustion plant and incinerators)

Following our assessment of the operation of installations, our conclusions are that:

- the UK HPR1000 combustion plant (diesel generators) is likely to be a Part A(1) installation as described in Section 1.1 of Chapter 1 in Part 2 of Schedule 1 of The Environmental Permitting (England and Wales) Regulations 2016 and will, therefore, require an environmental permit from the Environment Agency
- several aspects of the GDA submission will need to be revised and updated when site-specific data are available. The main aspects that will need further consideration are:
    - a BAT assessment for the chosen diesel generators

- the application of the legal requirements for medium combustion plant. This may require the necessary monitoring infrastructure to be included in the design (in line with technical guidance note M1 (Environment Agency, 2017))
- site-specific modelling to demonstrate compliance with air quality objectives
- the UK HPR1000 combustion plant will also require a permit under the Greenhouse Gas Emissions Trading Scheme Order 2020 (UK Parliament, 2020)

To ensure that the main elements are picked up at the site-specific stage, we have included the following 2 Assessment Findings:

Assessment Finding 42: A future operator shall provide in an application for an environmental permit a BAT assessment of the specific combustion plant selected for use against the relevant BAT guidance at the time of application.

Assessment Finding 43: A future operator shall provide in an application for a combustion activity environmental permit a site-specific environmental impact assessment for discharges to air. The modelling shall use site-specific parameters based on the environmental setting and the specific combustion plant selected for use.

Control of Major Accident Hazards Regulations

Following the assessment of substances relevant to COMAH, based on the information submitted, our conclusions are that:

- the UK HPR1000 is unlikely to be subject to the COMAH Regulations. If any of the generic design assumptions change at a site-specific stage, then this conclusion will need to be reconsidered
- changes in inventory at the site-specific stage need to be kept under review to ensure a relevant threshold for the COMAH Regulations isn't exceeded

We have also concluded that one Assessment Finding would be appropriate:

Assessment Finding 44: A future operator shall keep the chemical inventories on its site under review so any applicability of COMAH can be identified early and the necessary major accident prevention measures can be installed.

Fluorinated greenhouse gases and ozone-depleting substances

Following our assessment of the use of fluorinated greenhouse gases and ozone-depleting substances, based on the information submitted, our conclusions are that:

- no ozone-depleting substances are proposed to be used in the design

- the proposed quantities of specific fluorinated greenhouse gases to be used in the design are currently acceptable under the relevant legislation and in common with current UK practice

- the level of detail in the proposed measures to prevent and minimise leakage is considered acceptable for GDA

We have also concluded that one Assessment Finding would be appropriate:

Assessment Finding 45: A future operator shall keep the fluorinated greenhouse gases proposed for use in the UK HPR1000 under review to ensure they continue to be legally acceptable for use.

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List of abbreviations

AEVF	Allowable effective volume flux
BAT	Best available techniques
BREF	Best available techniques reference
COMAH	Control of Major Accident Hazards
EAL	Environmental assessment levels
EDG	Emergency diesel generator
EPR	Environmental Permitting Regulations
EQS	Environmental quality standard
EU	European Union
EVF	Effective volume flux
FCG3	Fangchenggang Unit 3 (reference plant)
GB	Great Britain
GDA	Generic design assessment
GNSL	General Nuclear System Limited
HFC	Hydrofluorocarbons
HVAC	Heating, ventilation and air conditioning
MATTE	Major accident to the environment
MCPD	Medium Combustion Plant Directive
ODS	Ozone-depleting substances
ONR	Office for Nuclear Regulation
P&ID	Process and Information Document
PCER	Pre-Construction Environmental report
PM	Particulate matter
PNEC	Predicted no-effect concentration
SBO DG	Station blackout diesel generator

RI	Regulatory Issue
RO	Regulatory Observation
RP	Requesting Party
RQ	Regulatory Query
TRO	Total residual oxygen
UK	United Kingdom

Appendix 1: Requesting Party documentation assessed

We referred to the following documents to produce this report:

- Pre-Construction Environmental Report Chapter 8 - Conventional Impact Assessment - V0 (HPR/GDA/PCER/0008 Rev. 000-1 November 2018)
- Pre-Construction Environmental Report Chapter 8 - Conventional Impact Assessment - V1 (HPR/GDA/PCER/0008 Rev.001 January 2020)
- Pre-Construction Environmental Report Chapter 2 - Generic Site Description - V1.1 (HPR/GDA/PCER0002 Rev.001-1 October 2020)
- Pre-Construction Environmental Report Chapter 8 - Conventional Impact Assessment - V1.1 (HPR/GDA/PCER0008 Rev.001-1 October 2020)
- Pre-Construction Environmental Report Chapter 8 - Conventional Impact Assessment – V2 HPR/GDA/PCER0008 Rev 002, October 2021)
- Fresh Water Requirements Calculation (GH000500001DCSG02GN Rev C June 2019)
- Chemical Inventory for Water Discharge (GHX00530002DOHB02GN Rev C November 2019)
- Environmental Risk Assessment on Liquid Chemical Discharge (GHX00530005DOHB02GN Rev D May 2020)
- Environmental Risk Assessment on Air Emission (GHX00530006DOHB02GN Rev C May 2021)
- Chemical Inventory for UK HPR1000 (GHX00100012DOHB03GN Rev E December 2019)
- COMAH Assessment for UK HPR1000 (GHX00100013DOHB03GN Rev F July 2020)
- Scope for UK HPR1000 GDA Project (HPR-GDA-REPO-0007 Rev 001 July 2019)

Appendix 2: Summary of Regulatory Queries relating to other environmental regulations

The RQs that are most relevant to other environmental regulations for the UK HPR1000 are shown below (There are no Regulatory Observations or Regulatory Issues relevant to this topic area).

RQ-UKHPR1000-0546 (18-Nov-2019): Discharges to surface waters – the RP was asked to clarify a number of points regarding the liquid waste management systems.

RQ-UKHPR1000-0680 (13-Mar-2020): Medium combustion plant – the RP was provided with the relevant guidance on medium combustion plant.

RQ-UKHPR1000-0821 (26-May-2020): COMAH general queries – the RP was requested to provide further information on various aspects of its COMAH assessment.

RQ-UKHPR1000-0822 (26-May-2020): Combustion installation and air emission risk assessment – the RP was requested to provide further information on various aspects of its submission related to the operation of installations.

RQ-UKHPR1000-0823 (30-Jun-2020): Discharges to surface waters and supporting documents – the RP was asked to clarify various points regarding its discharges to surface water submissions.

RQ-UKHPR1000-0824 (26-May-2020): Water use calculations – the RP was asked to clarify some of the water use calculations it had provided.

RQ-UKHPR1000-1559 (24-Feb-2021): Environmental risk assessment of liquid chemical discharges – the RP was asked to clarify some of the changes made from revision C to revision D.

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