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Generic design assessment of new nuclear power plants

Strategic considerations for radioactive waste management for the UK HPR1000 design - AR02

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 strategic considerations for radioactive waste management 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 4 of our Process and Information Document (P&ID) (Environment Agency, 2016).

Our assessment has considered the RP's submission in relation to relevant UK policy, legislation and guidance, including the Environment Agency's Radioactive Substances Regulation (RSR) Environmental Principles (REPs) (Environment Agency, 2010).

Our conclusions are that:

- The RP has provided an acceptable waste strategy for all waste streams within the scope of the GDA. The details underpinning the Integrated Waste Strategy (IWS) in this respect are considered in greater detail in our relevant assessment reports for individual waste streams and disposability (Environment Agency, 2022a, 2022b, 2022c)
- The RP's IWS, together with its other submissions, will help to ensure people and the environment are properly protected. The details underpinning the IWS in this respect are considered in greater detail in our assessment report on the assessment of doses to the public and to wildlife (Environment Agency, 2022d)
- the IWS is consistent with government policy statements (DECC, 2014) and current regulatory expectations

We have not identified any generic design assessment (GDA) Issues.

We note that detailed operational aspects necessary to develop a full integrated waste strategy cannot be provided by the RP at this time. The IWS presented by the RP is as comprehensive as it can be with the information currently available and is therefore appropriate for the GDA stage. A future operator is expected to develop its own strategy from the RP's IWS by adding site-specific detail when it is available.

We have identified an Assessment Finding that we will expect a future operator to address:

Assessment Finding 2: If a future site operator has multiple sites, an assessment of best available techniques (BAT) should be produced which covers all of its sites, noting the proximity principle, economies of scale and other efficiencies in disposal of solid and incinerable liquid wastes. The assessment should form part of a future operator's submissions for its second and subsequent environmental permit applications.

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1. Introduction

This report provides our detailed assessment of the Requesting Party's (RP) submission in relation to strategic considerations for radioactive waste management in the UK HPR1000 design for GDA purposes.

This report is based on the latest 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, 2018a). Our conclusion from the initial assessment, at the principle level, was that strategic considerations for radioactive waste management required further development. The Requesting Party needed to demonstrate how it has addressed the UK strategic considerations in its UK HPR1000 design.

This detailed assessment has built on that initial assessment and is based on additional submissions and technical engagement with the Requesting Party (RP). We held a public consultation on our preliminary detailed assessment findings 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 report.

The guidance on our GDA process that we used for this assessment was our 'Process and Information Document for Generic Assessment of Candidate Nuclear Power Plant' (P&ID) published in October 2016 (Environment Agency, 2016). Table 1, Item 4 of the P&ID requires the Requesting Party (RP), among other things, to:

- identify the strategic considerations for radioactive waste management that underpin the design
- describe how radioactive wastes and spent fuel will arise throughout the facility's life cycle (including decommissioning) and give plans on how they will be managed to include:
 - sources of radioactivity and matters that affect wastes arising
 - gaseous, aqueous and other wastes

We expect new nuclear power plant designs to be developed in line with a radioactive waste and spent fuel strategy that seeks to:

- minimise the production of radioactive waste
- manage unavoidable wastes and spent fuel so as to achieve an optimal level of protection for people and the environment

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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 Radioactive Substances Regulation Environmental Principles (REPs) (Environment Agency, 2010) set out the matters that this type of strategy should take into account. For new nuclear power plant designs, the strategy also needs to be consistent with government policy statements (DECC, 2014) in that:

- the disposal of intermediate level radioactive waste (ILW) to a future geological repository, from any new nuclear power plants, is unlikely to occur until late this century
- any nuclear power plant that might be built in the England should proceed on the basis that spent fuel will not be reprocessed

In preparing its Integrated Waste Strategy (IWS), the RP has made reference to the specification and guidance published by the Nuclear Decommissioning Authority (NDA) (NDA, 2012). This document provides guidance on how to develop an integrated waste strategy that describes an optimised approach to waste management, the waste streams generated throughout the life of the site and ongoing improvements in how waste is managed. Despite it not being a requirement for the RP to follow the NDA specification and guidance, it is considered appropriate to use it as a guide in preparing an integrated waste strategy for the UK HPR1000.

The Integrated Waste Strategy (GNSL, 2021d) also includes other strategic level plans relating to decommissioning and spent fuel.

For decommissioning, in line with government policy (DECC, 2009b, 2011 & 2014), our REPs (Environment Agency 2010) and guidance (Environment Agency, 2013), we expect:

- the radioactive waste and spent fuel strategy to address decommissioning
- the design to use the best available techniques (BAT) to:
 - facilitate decommissioning
 - minimise arisings of decommissioning waste
 - minimise the impacts on people and the environment of decommissioning operations and the management of decommissioning waste

For spent fuel, we expect the strategy to be in line with government policy (DECC 2011 and 2014) and our REPS (Environment Agency, 2010).

There are a number of documents in the RP's submission that we assessed (see Appendix 1). This report is mainly based on our assessment of the Integrated Waste

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Strategy document the RP submitted (GNSL, 2021d). The development of an Integrated Waste Strategy is introduced in Pre-Construction Environmental Report (PCER) Chapter 4 'Radioactive Waste Management Arrangements' (GNSL, 2021a). The Integrated Waste Strategy document (GNSL, 2021d) is a supporting document to Chapter 4 of the PCER (GNSL, 2021a). It is important to note that there are significant overlaps with some of our other assessment reports, most notably 'Solid waste, spent fuel and disposability - AR05' (Environment Agency, 2022c) and 'Best available techniques - AR03' (Environment Agency, 2022a).

Our assessment of the submissions and the supporting documents throughout the GDA process generated a number of Regulatory Queries (RQ) and one Regulatory Observation (RO) (RO issued by the Office for Nuclear Regulation (ONR)). The RQs and RO specifically related to this assessment of strategic considerations for radioactive waste management are summarised in Appendix 2. Subsequent responses to these RQs and RO and discussions at meetings with the RP have been incorporated into the Integrated Waste Strategy document (GNSL, 2021d).

2. Assessment

2.1. Assessment method and process

The basis of our assessment was to:

- examine and understand the IWS and its supporting documents
- hold technical meetings with the RP to clarify and better understand the information presented and to identify and explain any concerns that we had with that information
- raise Regulatory Observations (ROs) and Regulatory Queries (RQs) where we believed information the RP provided was insufficient or needed clarifying. During our assessment, we issued 5 RQs but did not issue any ROs
- assess the IWS the RP provided using available guidance and regulatory experience and decide if the chosen strategy will minimise the production of radioactive waste and manage unavoidable wastes to ensure people and the environment are properly protected
- 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 objectives

We started our assessment with 3 main questions:

- Does the IWS cover all waste streams that a UK HPR1000 would be likely to produce?
 - The details underpinning the IWS in this respect are considered in greater detail in our relevant assessment reports for individual waste streams and disposability (Environment Agency, 2022a, b & c)
- Will the IWS help to ensure proper protection of people and the environment?
 - The details underpinning the IWS in this respect are considered in greater detail in our relevant assessment report on the assessment of doses to the public and to wildlife (Environment Agency, 2022d)
- Is the IWS consistent with government policy, regulatory expectations and current industry good practice?

2.3. Assessment limitations and scope

We have carried out a detailed review of the RP's IWS and the documents that support it. The purpose of an IWS is to set the strategy for how wastes will be managed at all stages

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of a nuclear power plant's life cycle, from construction, through commissioning and operation, to final decommissioning.

We note that detailed operational aspects necessary to develop a full integrated waste strategy cannot be provided by the RP at this time. The IWS presented by the RP is as comprehensive as it can be with the information currently available and is therefore appropriate for the GDA stage. A future operator is expected to develop its own strategy from the RP's IWS by adding site-specific detail when it is available. There are 2 main areas where the information submitted for GDA is likely to be less detailed than we would expect for an operational facility.

Firstly, proximity of disposal. As the submission for GDA relates to a generic site, it could never be clear where the most suitable disposal facility for a given waste stream is relative to the UK HPR1000 in geographical terms. For example, for low level radioactive waste (LLW), it is possible that a suitable disposal facility may be located closer to the eventual site than the Low Level Waste Repository (LLWR) near Drigg in Cumbria.

Secondly, there are commercial factors which may influence the choice of disposal route for a particular waste, as well as other considerations such as the potential for economies of scale for fleet disposals.

Clearly for a generic site for GDA, it is unreasonable to expect these issues to be fully resolved. Therefore, we consider the following Assessment Finding to be appropriate:

Assessment Finding 2: If a future site operator has multiple sites, an assessment of best available techniques (BAT) should be produced which covers all of its sites, noting the proximity principle, economies of scale and other efficiencies in disposal of solid and incinerable liquid wastes. The assessment should form part of a future operator's submissions for its second and subsequent environmental permit applications.

It should be noted that although the Assessment Finding specifically refers to multiple sites, the requirement can apply equally to multiple reactors at the same site. Future operators and regulators are to ensure any opportunities in the scope of this Assessment Finding are not missed (for example when reactors are added to a site over many years).

Non-radioactive solid wastes are out of scope of GDA but have been included in the Integrated Waste Strategy to ensure it adequately integrates radioactive and non-radioactive wastes. We consider this approach of including non-radioactive wastes in this part of GDA to be good practice as it results in a more meaningful GDA for this topic area.

The IWS sets out, in broad strategic terms, how the RP intends to comply with legal obligations and industry good practice as they relate to waste management. The strategy considers the requirements of environmental legislation (such as the Environmental Permitting Regulations 2016) and industry good practice (such as applying the waste hierarchy). The RP has set out its waste hierarchy in its Integrated Waste Strategy document and this is reproduced below in Figure 1.

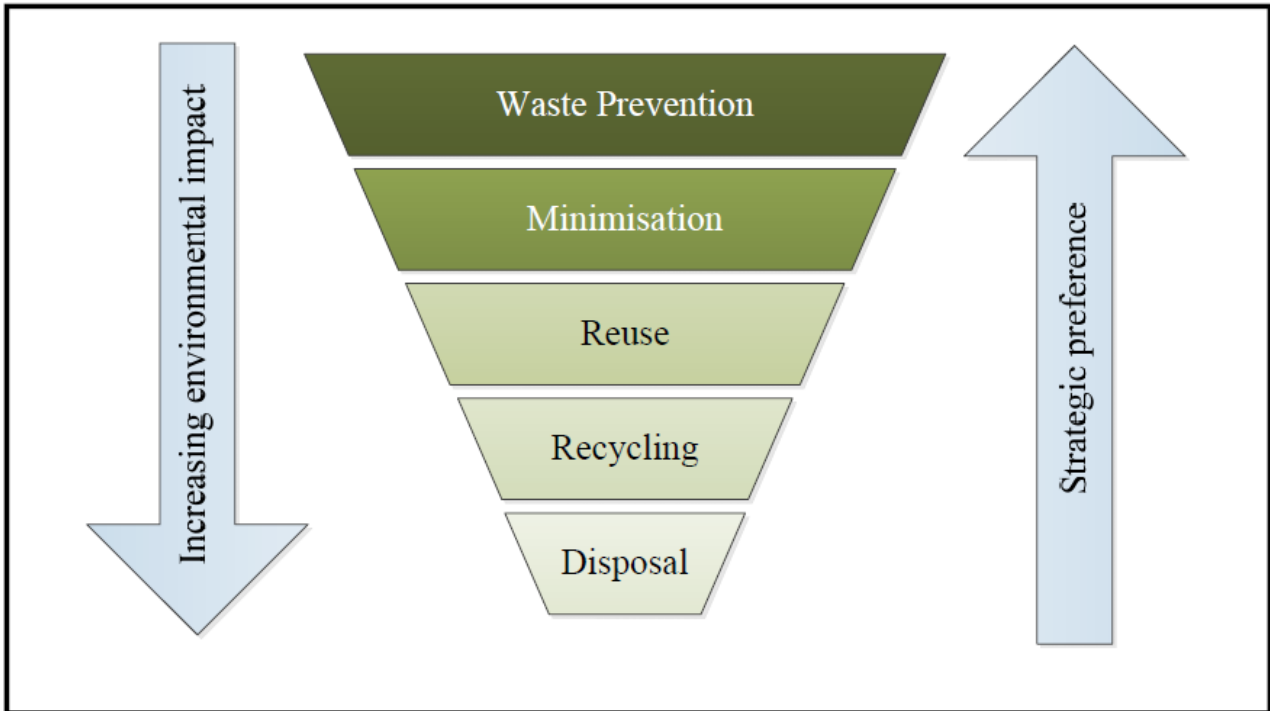


Figure 1. Schematic representation of the waste hierarchy (GNSL, 2021d)

2.4. Integrated Waste Strategy

The RP's IWS outlines its current strategy for managing radioactive and non-radioactive waste, including spent fuel, arising from the construction, operation and decommissioning of the UK HPR1000. The strategy is supported by:

- radioactive waste management arrangements
- a decommissioning plan
- methods to assess BAT and to define the approach to optimisation
- impact assessments for humans and wildlife

The UK HPR1000 IWS has been derived for a single reactor unit situated at a generic site. This approach is consistent with previous GDAs.

The RP covers the following aspects in the scope of its IWS (GNSL, 2021d):

- the facilities that generate, store, treat and process the wastes and waste packages
- design features that have been incorporated to prevent or minimise waste arising
- design features that have been incorporated to monitor and minimise the radioactive and non-radioactive discharges

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- UK HPR1000 waste management principles and how they align with UK national policies and regulatory context
- outline of UK HPR1000 waste management organisation and arrangements to ensure that the wastes can be managed safely and in an environmentally responsible way
- engagements with external stakeholders in developing this integrated strategy
- how the approach to waste management is developed and optimised in an integrated way
- strategy for managing all radioactive, non-radioactive waste and spent fuel, from construction through operation to decommissioning
- links to other underpinning documents and references
- areas requiring further development

The extent of the strategy covers:

- non-radioactive solid, liquid and gaseous construction wastes
- radioactive solid, liquid, gaseous and airborne wastes generated during operation (including spent fuel)
- non-radioactive solid, liquid, gaseous and airborne wastes generated during operation
- radioactive solid, liquid, gaseous and airborne wastes generated during decommissioning (including spent fuel)
- non-radioactive solid, liquid, gaseous and airborne wastes generated during decommissioning

Both the scope and extent of the IWS described above are in line with our expectations based on the available guidance outlined in section 1 above. The scope of the IWS is wider than some other aspects of this GDA in that it includes decommissioning wastes. We ask the RP to prepare an IWS at GDA stage to ensure that wastes produced during decommissioning have been considered at the design stage and so that a framework is in place for a future operator to develop a more site-specific IWS.

The first principle of the RP's IWS is to apply the waste management hierarchy to all wastes and that this should be fundamental when considering subordinate strategies and processes. The IWS then goes on to outline 10 general waste management principles that apply to all wastes and 12 additional principles that apply specifically to radioactive waste. The general principles include using BAT to minimise the impact of discharges and

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disposals, and the importance of good characterisation, sorting and segregation at source to ensure subsequent effective management and disposal.

The radioactive waste-specific principles include the main principles of waste minimisation, optimisation of decay storage to reduce the activity of radioactive wastes and using the 'concentrate and contain' principle. 'Concentrate and contain' involves trapping the radioactivity in a solid, concentrated form for storage and eventual disposal rather than the 'dilute and disperse' option that involves the direct discharge of gaseous or liquid radioactivity into the environment (DECC, 2009a). The waste management principles the RP presented are appropriate for a nuclear power plant's Integrated Waste Strategy.

We, and ONR, have issued a number of Regulatory Queries (RQ) throughout the GDA process. Following assessment, these responses have been incorporated into the RP's Integrated Waste Strategy document (GNSL, 2021d).

ONR issued RQ-UKHPR1000-0107 on 24 May 2018 (see Appendix 2) with environment as a related technical topic (note that this referred to an earlier revision of the IWS). The response to the RQ confirmed that the IWS would be independently developed to comply in England rather than evolving from a strategy that complies with Chinese requirements. Our review has found that the IWS is compliant with the UK requirements for an IWS. The RQ response also identified the main differences between the UK and Chinese practice and presented a number of potential design modifications. ONR issued a subsequent Regulatory Observation (RO-UKHPR1000-0005) in October 2018 which deals with the gaps/differences between UK practices and UK HPR1000 design/Chinese practices in radioactive waste management (see Appendix 2). This is considered more fully in our assessment report 'Solid waste, spent fuel and disposability - AR05' (Environment Agency, 2022c).

We issued 2 RQs on 18 November 2019 which were linked to our assessment of PCER Chapter 4 (GNSL, 2021a) and the IWS (GNSL, 2021d).

1. RQ-UKHPR1000-0550 questioned how the RP had covered risk and opportunity management in the IWS (See Appendix 2). The RP's response (10 January 2020) provides us with confidence that risk will be managed. The RP states that the assumptions within the IWS will be managed by the requirements/assumptions management process, which is the subject of Assessment Finding 1 in our assessment report on management systems (Environment Agency, 2022e). The RP states that the main radioactive waste opportunities for improvement relate to developing future techniques within the supply chain for treating and conditioning wastes. The RP will manage opportunities for improvement as commitments and these will be reviewed regularly. We would also keep this under review as part of our ongoing regulatory activities if we receive a site-specific application. The response meets our expectations as being appropriate for GDA.
2. RQ-UKHPR1000-0552 sought clarification on how the RP was dealing with our 'Guidance on Requirements for Release from Radioactive Substances Regulation' (GRR) (Environment Agency, 2018b) in its documentation (See Appendix 2). GRR is

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our process for surrendering a nuclear site environmental permit at the end of operation and decommissioning. The RP's response (10 January 2020) made the commitment to incorporate it into the next revision of the Preliminary Decommissioning Plan. The same question was raised in a subsequent RQ (RQ-UKHPR1000-0946 - see Appendix 2) to ensure reference to GRR is also made in the 'Integrated Waste Strategy' Document (GNSL, 2021d). The RP has subsequently revised its IWS (GNSL, 2021d) and Preliminary Decommissioning Plan (GNSL, 2021c) and we are satisfied that both now reference GRR appropriately.

We issued RQ-UKHPR1000-0946 on 10 July 2020 to ask a number of questions mainly related to the management strategy for non-radioactive wastes (see Appendix 2). Questions covered topics such as the waste management hierarchy, waste legislation, options for the recycling or re-use of excavation and construction wastes and clarification of the term 'out-of-scope'. The RP's responses were generally satisfactory and included commitment to revise the IWS accordingly. Three points, however, required further clarification and a subsequent RQ (RQ-UKHPR1000-1557) was issued on 24 February 2021. This RQ requested further consideration of the non-radioactive waste legislation that would apply, options for recycling and re-use of excavation and construction wastes, and definition of the term 'out-of-scope' used in the IWS. This RQ gave the RP the opportunity to develop its understanding and propose further revisions to the IWS. Our assessment of the revised IWS (GNSL, 2021d) confirms that all the changes proposed in response to these 2 RQs have been made. We are now satisfied that all the queries raised have been addressed in the IWS document (GNSL, 2021d).

The IWS also explains that higher activity solid radioactive waste will be stored on site in dedicated buildings pending disposal at an appropriately permitted facility, which will be the geological disposal facility (GDF) once that is available. This is in line with current government policy as set out in its document on 'Implementing Geological Disposal' (DECC, 2014). In the case of lower activity solid radioactive waste, disposal will be to an appropriately permitted facility as soon as is practicable.

The IWS document has developed throughout the GDA process. We have engaged with the RP throughout the GDA process and provided comments to help it develop the strategy. We are now satisfied that the RP has sufficiently developed its IWS to meet GDA requirements (GNSL, 2021d).

2.5. Matters specific to decommissioning strategy

The IWS also considers decommissioning and introduces the decommissioning strategy. The details of the decommissioning strategy are developed in a number of supporting documents, which include a Preliminary Decommissioning Plan (GNSL, 2021c) and a Decommissioning Waste Management Proposal (GNSL, 2021b).

The Preliminary Decommissioning Plan (GNSL, 2021c) presents the optioneering work the RP carried out to determine that an immediate, rather than deferred, decommissioning strategy is the preferred option.

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The Decommissioning Waste Management Proposal (GNSL, 2021b) provides more detail on specific waste streams. In this document, the RP acknowledges that the majority of the decommissioning wastes will be different from the operational waste streams generated throughout most of the plant's life cycle. However, it should be noted that some waste streams will remain the same between the operational and decommissioning phases (that is, ion exchange resins and filters). The proposal document covers the following decommissioning waste streams:

- radioactive gaseous and airborne wastes
- radioactive liquid wastes
- radioactive solid waste, which includes:
 - spent resins
 - spent filter cartridges
 - reactor pressure vessel and intermediate level waste concrete
 - reactor pressure vessel internals
 - lower activity waste (out of scope of GDA but covered at a high level in the Decommissioning Waste Management Proposal (GNSL, 2021b) for completeness).

Non-radioactive solid wastes (being out of scope of GDA) are only covered in the main IWS document (GNSL, 2021d) and are not developed any further in the supporting documents, which focus on radioactive decommissioning wastes only.

Our assessment of decommissioning wastes is also covered in 'Solid waste, spent fuel and disposability - AR05' (Environment Agency, 2022c).

2.6. Matters specific to spent fuel strategy

The spent fuel management strategy that has been adopted is not to reprocess, but to store, package and appropriately dispose of spent fuel when a disposal route becomes available. This approach is consistent with the UK government 'base case' (DECC, 2011).

The strategy the RP presented in the IWS document consists of the following 3 stages:

- short-term storage in the spent fuel ponds
- interim dry storage on-site
- off-site disposal in a geological disposal facility

Our assessment of spent fuel considered to be waste is also covered in 'Solid waste, spent fuel and disposability - AR05' (Environment Agency, 2022c).

2.7. Matters for a future operator

The IWS presented as part of GDA is intended to carry through to a site-specific stage. The RP does, however, state that this does not prevent a future operator from selecting alternative methods or choosing its own arrangements based on best available techniques (BAT) and as low as reasonably achievable (ALARA).

The RP states (in section 7.2 of the IWS) that information records relating to the management of radioactive waste start during the GDA phase and need to continue throughout the whole life cycle of the plant. The RP will need to ensure that records related to the IWS created during GDA pass effectively to any future operator(s).

In the IWS, the RP also identified some specific actions to pass to a future operator:

- Determine BAT disposal routes for lower activity wastes (LAW), higher activity wastes (HAW) and spent fuel.
- Detailed design and relevant safety case demonstration of the waste auxiliary building, ILW interim storage facility and spent fuel interim storage facility.
- Establish the agreement in principle to ensure disposability acceptance of the LLW.
- Assess the proposals of ILW and spent fuel through the RWM's disposability assessment process, in order to ensure compliance with GDF (this also applies to the GDA phase).
- The development of the 'Radioactive Waste Management Case' (RWMC), which takes into account the long-term safety and environmental performance for management of intermediate level waste (ILW), high level waste (HLW) and spent fuel.
- The development of a Waste Management Plan and Site Wide Environmental Safety Case in accordance with the Environment Agency's Guidance on the Requirements for Release from Radioactive Substances Regulation (GRR) (Environment Agency, 2018b).
- Development of a site-specific IWS based on the strategy developed at GDA.

These follow up actions, which the RP identified, are at quite a high level, but we consider this level of detail in the actions appropriate for this generic assessment. We expect the development of the IWS to continue throughout the site-specific stage and, as it does, for the level of detail to increase.

2.8. Compliance with Environment Agency requirements for GDA

Compliance with the requirements for GDA can be summarised as follows:

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- P&ID item 4 (described in section 1 above) - The necessary information has been supplied in the form of the IWS and supporting documents.
- RSMDP1 - Radioactive Substances Strategy - The Radioactive Substances Strategy forms part of the Integrated Waste Strategy.
- RSDMP3 - Use of BAT to minimise waste - This requirement is primarily being assessed in our assessment reports on best available techniques (AR03) and solid waste, spent fuel and disposability (AR05).
- DEDP1 - Decommissioning Strategy - The IWS contains specific information relating to the Decommissioning Strategy.
- DEDP2 - Decommissioning Plan - Subject to our assessment of the revised version of the 'Preliminary Decommissioning Plan', we can conclude that the IWS contains a level of detail appropriate for GDA, although this will need to be carried through to site-specific permitting stage for further development.

3. Public comments

3.1. General Nuclear System Limited's public comments process

GNSL received no public comments up to 17 September 2021 concerned directly with the strategic considerations for radioactive waste management.

3.2. 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, 2022f). Any points raised that were in GDA scope and relevant to strategic waste management arrangements are also presented here.

We received a comment (UKHPR1000-011) regarding the long-term management of higher activity wastes and the future availability of a geological disposal facility (GDF). The IWS identifies the wastes that would require disposal in a GDF and explains that they would be stored on-site until a GDF is available. On-site, interim storage is regulated by ONR. Provision of a GDF is a matter of government policy as described in its document 'Implementing Geological Disposal' (DECC 2014). The document explains how geological disposal, together with safe and secure interim storage, is considered to be the best approach for the long-term management of higher activity radioactive waste. The IWS the RP presented for the UK HPR1000 GDA is in accordance with the government approach and, as such, meets our expectations. Exploring alternatives to a GDF if government

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policies change or timescales are delayed is outside the scope of a GDA, which applies the relevant government policies in place at the time of assessment.

We received a comment (UKHPR1000-018) regarding the on-site storage of spent fuel and other radioactive wastes beyond the end of the decommissioning period. Firstly, it is important to note that ONR is the lead authority for the regulation of on-site storage of spent fuel and radioactive wastes. Our involvement in on-site storage relates to protecting the public and ensuring wastes can be disposed of correctly when a facility is available. In terms of our regulation of decommissioning, we define 'decommissioning' in our guidance document 'The decommissioning of nuclear facilities' (Environment Agency 2013) as 'the administrative and technical actions taken to allow the removal of some or all of the regulatory controls from a facility'. A site providing long-term storage of radioactive waste (like Bradwell A cited as an example in the comment) is still regulated by the Environment Agency (that is, it still holds an environmental permit) and cannot be released from regulation until it has been decommissioned and cleaned-up to the relevant standards. (Environment Agency, 2018b).

We received a comment (UKHPR1000-031) stating that discharges should be solidified wherever possible. The IWS highlights the importance of the waste hierarchy and the principle of 'concentrate and contain' in any decision making. This ensures that wastes requiring disposal are minimised as far as possible and are in the least mobile waste form. Nuclear power plants are required to apply best available techniques (BAT) to their activities. BAT applies to the disposal of solid, liquid and gaseous wastes and forms part of our assessment at GDA. The disposal options presented in the IWS (GNSL, 2021d) at GDA can be considered BAT at the time of assessment. However, what constitutes BAT will change over time, and any future operator will be required to apply whatever techniques represent BAT at that time.

We received a comment (UKHPR1000-047) relating to our assessment finding, which requires a future operator with multiple sites to ensure it is applying the proximity principle and economies of scale to its waste disposals. This assessment finding is intended for a future operator of the UK HPR1000 that develops more than one nuclear power station at different locations. The comment highlights the consortium approach which is common in the nuclear industry. This assessment finding applies equally to consortiums and individual companies. Efficiencies in waste disposal are a BAT requirement that applies to all nuclear operators all of the time and, as such, forms part of how we regulate the industry as a whole.

4. Conclusion

We have reviewed the assessment objectives and conclude that:

- the RP has provided an acceptable waste strategy for all waste streams within the scope of the GDA. The details underpinning the Integrated Waste Strategy (IWS) in this respect are considered in greater detail in our relevant assessment reports for individual waste streams and disposability (Environment Agency, 2022a, 2022b, 2022c)
- the RP's IWS, together with its other submissions, will help to ensure people and the environment are properly protected. The details underpinning the IWS in this respect are considered in greater detail in our assessment report on the assessment of doses to the public and to wildlife (Environment Agency, 2022d)
- the IWS is consistent with relevant guidance, government policy statements (DECC, 2014) and current regulatory expectations

We have identified one Assessment Finding:

Assessment Finding 2: If a future site operator has multiple sites, an assessment of best available techniques (BAT) should be produced which covers all of its sites, noting the proximity principle, economies of scale and other efficiencies in disposal of solid and incinerable liquid wastes. The assessment should form part of a future operator's submissions for its second and subsequent environmental permit applications.

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Environment Agency, 2022a

Generic design assessment of new nuclear power plants. Best available techniques for the UK HPR1000 - AR03. Detailed assessment – final report. Version 1, January 2022.

Environment Agency, 2022b

Generic design assessment of new nuclear power plants. Gaseous and liquid discharges of radioactive waste for the UK HPR1000 - AR04. Detailed assessment – final report. Version 1, January 2022.

Environment Agency, 2022c

Generic design assessment of new nuclear power plants. Solid radioactive waste, spent fuel and disposability for the UK HPR1000 - AR05. Detailed assessment – final report. Version 1, January 2022.

Environment Agency, 2022d

Generic design assessment of new nuclear power plants. Generic site, doses to the public and dose rates to wildlife for the UK HPR1000 - AR07. Detailed assessment – final report. Version 1, January 2022.

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Management systems for the UK HPR1000 - AR01. Final detailed assessment. Version 1, January 2022.

Environment Agency, 2022f

Assessing new nuclear power station designs. Generic design assessment of the UK HPR1000. Decision Document. Version 1, January 2022.

GNSL, 2021a

Pre-Construction Environmental Report Chapter 4 - Radioactive Waste Management Arrangements. GHX00510004KPGB02GN, Revision L, October 2021 (V2).

GNSL, 2021b

Decommissioning Waste Management Proposal. GHX71500009DNFF03GN, Rev. F April 2021.

GNSL, 2021c

Preliminary Decommissioning Plan. GHX71500004DNFF03GN, Rev. G April 2021.

GNSL, 2021d

Integrated Waste Strategy (IWS). GHX00100070DNFF03GN, Rev. G April 2021.

NDA, 2012

ENG01 - Specification and guidance on the content and format of an integrated waste strategy.

List of abbreviations

BAT	Best available techniques
CoRWM	Committee on Radioactive Waste Management
GDA	Generic design assessment
GDF	Geological disposal facility
GNSL	General Nuclear System Limited
GRR	Guidance on requirements for release from Radioactive Substances Regulation
HAW	Higher activity waste
ILW	Intermediate level waste
IWS	Integrated Waste Strategy
LAW	Low activity waste
LLW	Low level waste
LLWR	Low level waste repository
NDA	Nuclear Decommissioning Authority
ONR	Office for Nuclear Regulation
P&ID	Process and Information Document
PCER	Pre-Construction Environmental Report
REPs	Radioactive Substances Regulation - Environmental Principles
RI	Regulatory Issue
RP	Requesting Party
RO	Regulatory Observation
RQ	Regulatory Query
RWM	Radioactive Waste Management Limited
RWMC	Radioactive waste management case
SEPA	Scottish Environment Protection Agency
UK	United Kingdom

Appendix 1: Requesting Party documentation

We referred to the following documents to produce this report:

- Integrated Waste Strategy (IWS) (GHX00100070DNFF03GN, Rev G, April 2021)
- Pre-Construction Environmental Report Chapter 4 - Radioactive Waste Management Arrangements V0 (HPR/GDA/PCER/0004, Rev 000-1, November 2018)
- Pre-Construction Environmental Report Chapter 4 - Radioactive Waste Management Arrangements V1 (HPR/GDA/PCER/0004, Rev 001, January 2020)
- Pre-Construction Environmental Report Chapter 4 - Radioactive Waste Management Arrangements V1.1 (HPR/GDA/PCER/0004, Rev 001-1, October 2020)
- Pre-Construction Safety Report Chapter 23 - Radioactive Waste Management (HPR/GDA/PCSR/0023 Rev 001, 2020)
- Pre-Construction Safety Report Chapter 23 - Radioactive Waste Management (HPR/GDA/PCSR/0023 V2, October 2021)
- Preliminary Decommissioning Plan (GHX71500004DNFF03GN, Rev G, April 2021)
- Decommissioning Waste Management Proposal (GHX71500009DNFF03GN, Rev F, April 2021)

Appendix 2: Regulatory Queries and Observations relating to the strategic considerations of radioactive waste management

RQs and ROs that are most relevant to the strategic considerations for radioactive waste management for the UK HPR1000 are shown below (There are no Regulatory Issues relevant to this topic area).

Regulatory Queries

RQ-UKHPR1000-0107 (24-May-2018): RQ issued by ONR - Gaps and differences between Chinese and UK practices in management of solid radioactive wastes and development of the Integrated Waste Strategy (IWS). The RP was requested to provide further information on how it would develop the strategy to address the main differences between UK and Chinese practices.

RQ-UKHPR1000-0550 (18-Nov-2018): Managing opportunities in relation to radioactive waste. The RP was requested to provide further information on risk and opportunity management related to assumptions made in its radioactive waste submissions.

RQ-UKHPR1000-0552 (18-Nov-2018): Release from radioactive substances regulation. The RP was requested to provide further information on how the GDA submission relates to our 'Guidance on requirements for the release from radioactive substances regulation'.

RQ-UKHPR1000-0946 (10-July-2020): Integrated Waste Strategy. The RP was requested to provide further information on a number of queries related specifically to its Integrated Waste Strategy document. The majority of the queries related to non-radioactive waste management.

RQ-UKHPR1000-1557 (24-Feb-2021): Integrated Waste Strategy. The RP was requested to clarify 3 of the responses provided in relation to non-radioactive waste management in RQ-UKHPR1000-0946.

Regulatory Observation

RO-UKHPR1000-0005 (26-Oct-2018): RO issued by ONR. The aspect of this RO relevant to this assessment area relates to the analysis of the gaps/differences between UK practices and UK HPR1000 design/Chinese practices in radioactive waste management.

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