

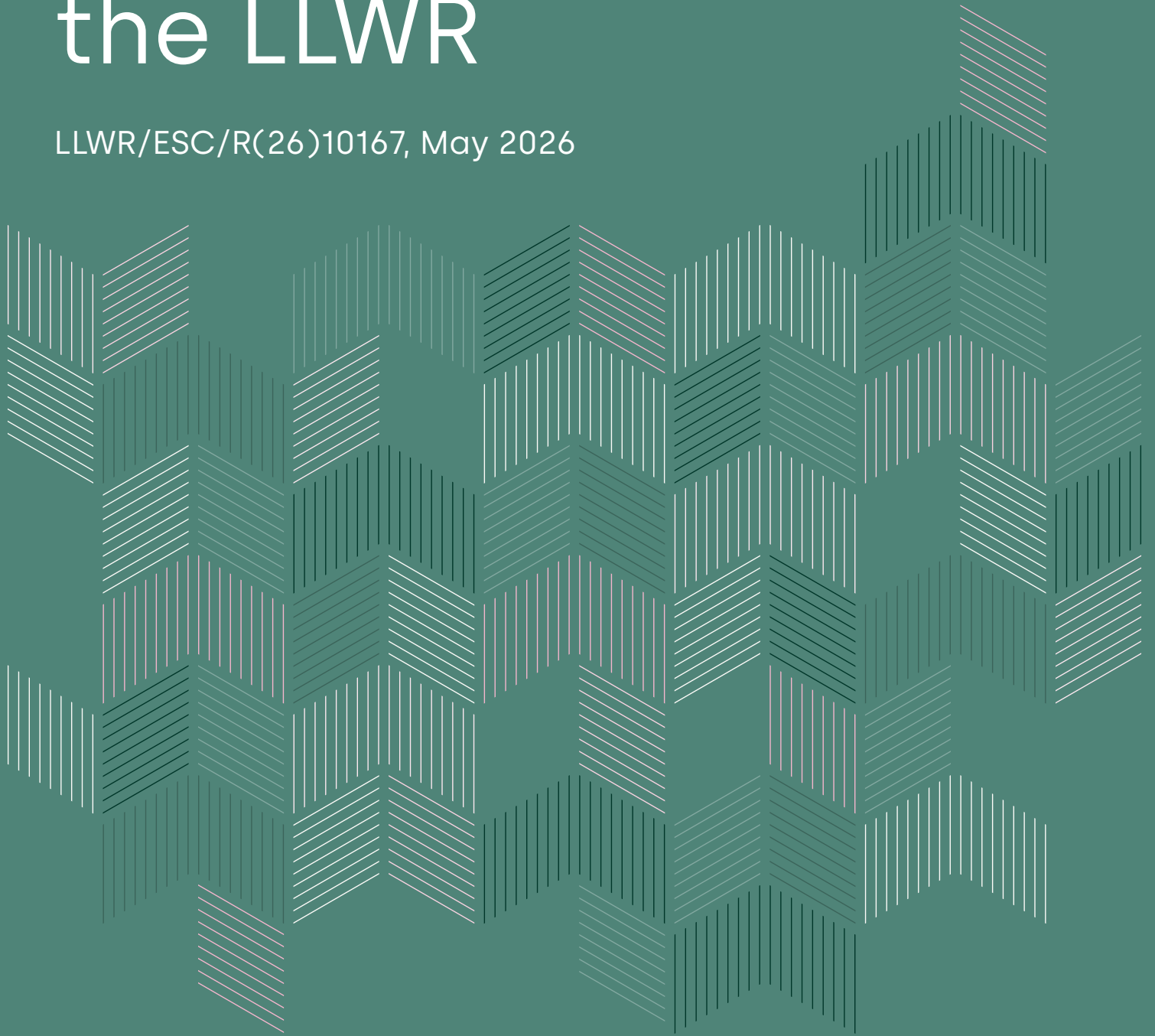


Nuclear Waste
Services

MANAGEMENT AND DIALOGUE

2026 Environmental Safety Case for the LLWR

LLWR/ESC/R(26)10167, May 2026





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Preface

The Low Level Waste Repository (LLWR) is the United Kingdom's principal facility for the disposal of solid Low Level Waste (LLW). It is a near-surface disposal facility in which waste was disposed in trenches and is now being disposed in vaults excavated into the ground surface. The LLWR is owned by the Nuclear Decommissioning Authority (NDA) and operated on their behalf by a wholly-owned subsidiary division, Nuclear Waste Services Ltd.

We, Nuclear Waste Services, are committed to operating the LLWR as a safe and efficient facility that provides a continuing option for the disposal of LLW in the United Kingdom. This will be achieved consistent with good practice for the near-surface disposal of radioactive waste, in accordance with environmental, health and safety, and security regulation and guidance, and in compliance with the terms of our Nuclear Site Licence and Permit to dispose of radioactive waste. We are also committed to working with the NDA to ensure optimal use is made of the LLWR to support the NDA's mission, in accordance with government policy. This may involve the disposal of a broader range of wastes than just LLW as currently defined in the United Kingdom.¹

One of the means we use to operate the LLWR safely is to maintain and implement an Environmental Safety Case for the site. This is one of the reports presenting the 2026 Environmental Safety Case for the LLWR – the 2026 ESC. The 2026 ESC is a major update based on a comprehensive review of our previous 2011 ESC and subsequent developments. The 2026 ESC addresses both the environmental safety of the disposal facility and the rest of the site. It considers the disposal of both LLW and some less-hazardous Intermediate Level Waste (ILW). Assessing the disposal of some less-hazardous ILW does not imply any decision has been made to dispose of such waste at the LLWR. The work has been undertaken to understand the safety implications if such a decision were made and hence support consideration of the option by the NDA.

The 2026 ESC is issued under the authority of the Nuclear Waste Services' Executive Director of Sites and Operations.

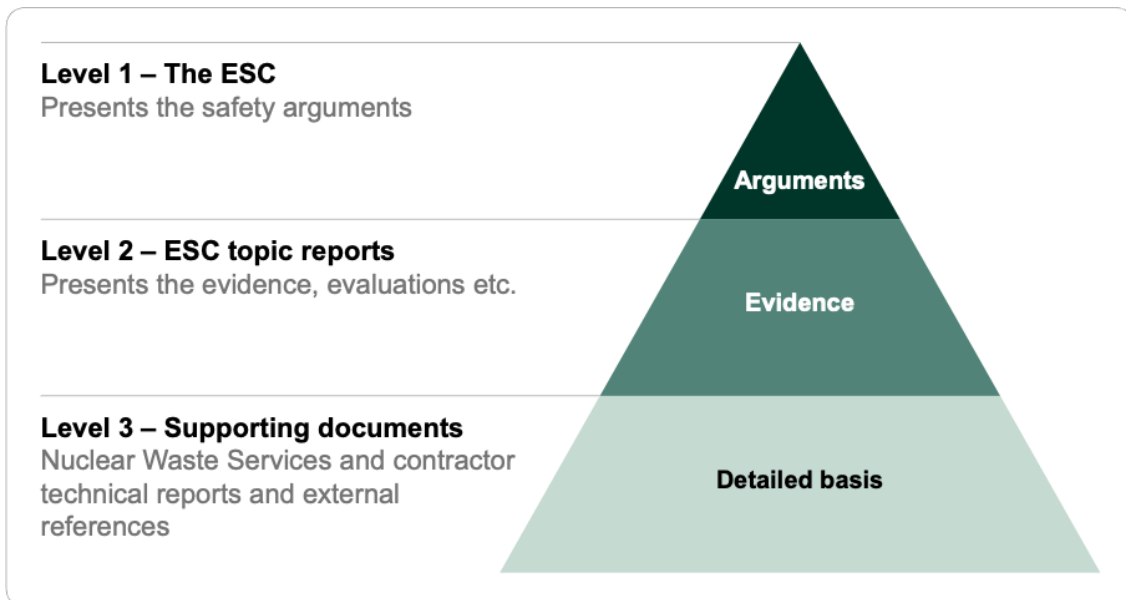
The 2026 ESC consists of documents at two levels:

- A single 'Level 1' report outlines the plan for the development of the LLWR and the main arguments concerning environmental safety and how it is achieved.
- A series of 'Level 2' reports present the evidence that underpins our safety arguments, including descriptions of our management framework, system understanding, design and management choices, assessments and implementation.

This is the Level 2 report '*Management and Dialogue*'. The ESC Level 1 and 2 reports are listed in the table below, which also shows for the Level 2 reports the set of arguments for

¹ In government policy, LLW is defined as radioactive waste having a radioactive content not exceeding four gigabecquerels per tonne (GBq t⁻¹) of alpha or 12 GBq t⁻¹ of beta/gamma activity.

which each report mainly provides evidence. A brief description of the contents of each Level 2 report is also given. The ESC is supported by a large number of technical and scientific reports and references that we refer to as 'Level 3' documents. We have also produced a Guide to Key Points of the ESC, to help a wider group of stakeholders understand its nature, conclusions and implications.



Level 1	
Main Report [1]	
Level 2	
Management and dialogue	
Management and Dialogue (this report)	Describes our environmental management systems and interactions with regulators and stakeholders
System characterisation and understanding	
Site History and Description [2]	Provides a history and description of the site
Disposal Facility Inventory [3]	Describes the wastes already disposed and wastes that may be disposed at the facility
Engineering Design [4]	Presents the engineering design of the current facility and proposed changes as further disposal vaults are built and the disposal facility is closed

Near Field [5]	Describes our understanding of the chemical and physical evolution of the engineered disposal system
Hydrogeology [6]	Describes our understanding of the geology and hydrogeology of the site
Site Evolution [7]	Describes our understanding of how the site will evolve, with a focus on coastal erosion
Monitoring [8]	Presents our programme of environmental monitoring supporting the ESC
Optimisation and Site Development Plan	
Optimisation and Site Development Plan [9]	Describes our approach to optimising the design and management of the disposal facility and wider site, and sets out our Site Development Plan
Waste Management Plan [10]	Presents our plans for managing the wastes produced by previous uses and operation of the site
Assessments	
Safety Functions [11]	Presents our understanding of how the different aspects of the repository system and its management contribute to the safety of the facility
Engineering Performance Assessment [12]	Presents our analysis of how the various components of the engineered disposal system will perform, which is an input into our impact assessments
Environmental Safety During the Period of Authorisation [13]	Presents evidence that the LLWR is currently being operated safely and will continue to be so during the period that the facility is permitted
Assessment of Long-term Radiological Impacts [14]	Presents evidence that, if the LLWR is managed in accordance with the Site Development Plan, the site will remain safe in the long term
Hydrogeological Risk Assessment [15]	Presents evidence that the disposal facility protects groundwater from both radiological and non-radiological contaminants in the disposed wastes now and will continue to do so in the future

Assessment of Radiological Impacts on Non-human Biota [16]	Presents evidence that the LLWR does not have adverse consequences for non-human biota populations now and will not in the future
Implementation	
Implementation [17]	Sets out how we use the ESC to manage the site, including setting Waste Acceptance Criteria and other controls on the types and quantities of waste accepted for disposal
Audit	
Addressing Regulatory Requirements and Feedback [18]	Provides a cross-reference between the contents of the ESC and regulatory guidance and feedback

Executive Summary

Purpose and scope

This report describes the systems, processes, arrangements and approach to environmental safety management at the Low Level Waste Repository (LLWR). It describes our regulatory interactions, established governance arrangements and how we maintain effective stakeholder engagement.

Regulatory interaction

We have a formal, structured regulatory meeting framework that provides a basis for interaction with the Environment Agency and the Office for Nuclear Regulation (ONR). The framework has four tiers of meetings covering senior strategic meetings down to working level topic meetings. Regular discussions have taken place throughout the development of the 2026 Environmental Safety Case for the LLWR – the 2026 ESC, covering the feedback from 2011 ESC, implementation of the 2011 ESC and approaches and methods for development of the 2026 ESC. We expect that such interactions will continue once the 2026 ESC is submitted and we will discuss and agree with the Environment Agency how best to engage over the future development of the ESC.

Stakeholder dialogue

The LLWR has a wide range of stakeholders, from the Nuclear Decommissioning Authority (NDA) which owns the site to the local community who live near to the site. We undertake a significant programme of engagement activities to ensure all our stakeholders are aware of the activities on the LLWR site and to provide the information they require. Our engagement with NDA, as owners of the LLWR site, ranges from strategic discussions on the management of the site to technical discussions regarding waste disposal. In addition to our structured regulatory meeting framework, we engage with Cumberland Council in relation to all aspects of planning, building on earlier engagement with its predecessor authorities. We regularly engage with a wide range of national and international organisations including local government and international waste management organisations (WMOs). We also have a dedicated Community Engagement team who liaise with the local community to provide regular updates on construction works on the site, any proposed future works and community funding.

Environmental safety policy, culture and management system

Our commitment to a high standard of environmental safety is embedded in our Environment, Health, Safety, Security and Quality (EHSSQ) Policy which states that *'above all, nothing is more important to us than protecting people and the environment.'*

Our ISO-accredited management system contains all the policies, processes and procedures that govern the planning, control and assurance of our activities. Regular reviews of the arrangements are undertaken to ensure they remain effective and fit for purpose.

The management system and organisational arrangements support the planning and control of work, the application of sound science and good engineering practice, and the effective use of appropriately resourced and competent teams. These arrangements ensure that environmental safety considerations are systematically embedded in decision making and in the development of the ESC.

Planning and control of work

Responsibility for Permit compliance is delegated through our organisation to managers and individuals holding key environment, health and safety roles, such as to support our Corporate Radioactive Waste Advisor arrangements. We have processes in place to ensure that activities are only undertaken by Suitably Qualified and Experienced Persons (SQEP) and to ensure succession planning and knowledge retention. The work to support the 2026 ESC has been delivered by SQEP individuals and has drawn on learning from previous safety case work, related programmes and international experience.

Application of sound science and good engineering practice

The development of the ESC is supported by defined technical, scientific and engineering processes, including structured checking, verification, challenge and review of assessments. International learning and good practice are incorporated through engagement with recognised standards, research programmes and international waste management experience. Engineering design and assessment activities are undertaken by SQEP personnel, supported by structured requirements management, design verification, construction assurance and independent checking.

Quality management, documentation and records

We have defined systems for information and quality management, including data management. Our Data Management Procedure provides a structured method to ensure data used in more than one assessment or supporting calculation are managed and recorded. We have an ESC-specific document control system where all information generated by the ESC team is logged and tracked. We have arrangements in place for providing information to the Environment Agency. Once information has reached the end of its local retention time, the information will be managed according to our long-term management arrangements, including the retention at the NDA archive as appropriate.

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1 Introduction

1.1 Objectives

This report describes the arrangements for environmental safety management and regulatory engagement, including stakeholder dialogue, and the approach taken to meeting Requirements R1, R2 and R4, of the environment agencies' *'Guidance on Requirements for Authorisation for Near-Surface Disposal Facilities on Land for Solid Radioactive Wastes'* (GRA) [19]. It also provides evidence of how Requirements R1 to R6 of the Environment Agency's *'Management of Radioactive Waste from Decommissioning of Nuclear Sites: Guidance on Requirements for Release from Radioactive Substances Regulation'* (GRR) [20] are met. Relevant Requirements from both GRA and GRR are defined in Boxes 1.1 and 1.2 respectively.

Box 1.1: Relevant Requirements from the GRA [19]

Requirement R1: Paragraph 5.2.3

Process by agreement

The developer should follow a process by agreement for developing a disposal facility for solid radioactive waste.

Requirement R2: Paragraph 5.7.1

Dialogue with local communities and others

The developer should engage in dialogue with the planning authority, local community, other interested parties and the general public on its developing ESC.

Requirement R4: Paragraph 6.2.5

Environmental safety culture and management system

The developer/operator of a disposal facility for solid radioactive waste should foster and nurture a positive environmental safety culture at all times and should have a management system, organisational structure and resources sufficient to provide the following functions: (a) planning and control of work; (b) the application of sound science and good engineering practice; (c) provision of information; (d) documentation and record-keeping; (e) quality management.

Box 1.2: Relevant Requirements from the GRR [20]**Requirement R1: Paragraph A3.2****Optimisation of waste management options**

Operators should use a proportionate process to select options, for managing radioactive waste arising from decommissioning and clean-up, that are optimised. This process shall ensure that the radiological risks to individual members of the public and the population as a whole are kept as low as reasonably achievable (ALARA) taking account of economic and social factors. The process should also consider the need to manage radiological risks to other living organisms and to manage the non-radiological hazards associated with radioactive waste.

Requirement R2: Paragraph A3.16**Waste management plan**

Operators should prepare a waste management plan (WMP) to manage the programme of disposals of radioactive waste from their nuclear site, and implement the plan to achieve the site reference state.

Requirement R3: Paragraph A3.25**Early engagement**

Operators should engage as early as possible with the relevant environment agency.

Requirement R4: Paragraph A3.29**Engagement with local communities and others**

Operators should engage with local communities, ONR, the planning authority, other interested parties and the public on their developing WMP and SWESC.

Requirement R5: Paragraph A3.31**Environmental safety culture and management system**

Operators should maintain a positive environmental safety culture appropriate to the activities being undertaken on-site and should have a management system, organisational structure and resources sufficient to provide the following functions: (a) planning and control of work; (b) the application of sound science and good engineering practice; (c) commissioning of appropriate research and development; (d) provision of information; (e) documentation and record-keeping (see also Requirement R6); and (f) quality management.

Requirement R6: Paragraph A3.37**Preservation of knowledge and records at the time of release from radioactive substances regulation**

Operators shall manage and retain adequate records of their site's journey to completion of all planned work involving radioactive substances and also, where necessary, provide adequate records of the controls applied up to the site reference state being achieved

along with the required validation monitoring data. Operators should provide these records in a form suitable for long-term preservation and access, and should propose arrangements for the long-term safe-keeping and management of the records.

While this report provides a summary of the management, quality and record-keeping systems implemented to support Requirements R1 and R2 of the GRR, these requirements are addressed within the respective '*Optimisation and Site Development Plan*' [9] and '*Waste Management Plan*' [10] Level 2 reports.

The objectives of this report are therefore to provide evidence that we:

- interact appropriately with the regulators during operation of the LLWR and during development of the 2026 Environmental Safety Case for the LLWR – the 2026 ESC;
- have engaged in dialogue with the planning authority, local community, other interested parties and the general public during the development of the ESC;
- have a positive environmental safety culture, a management system, organisational structure and resources sufficient to provide for the planning and control of work, the application of sound science and good engineering practice, provision of information, documentation and record-keeping, and quality management.

Our management system is an integral part of our Environmental Safety Strategy (described in Section 3 of the '*Main Report*' [1]) and helps us to ensure that the necessary management and control measures are properly implemented. These control measures include, for example, waste acceptance, installation of the final engineered cap and cut-off wall, access restrictions during the Period of Authorisation and environmental monitoring.

1.2 Scope

This report describes the systems, processes and arrangements that demonstrate our approach to environmental safety. It describes our regulatory interactions, established governance arrangements and how we maintain effective stakeholder engagement. We set out how we have addressed the environment agencies' Requirements R1, R2 and R4 of the GRA [19] and Requirements R3 to R6 of the GRR [20]. Each requirement is underpinned by further guidance and this report explains how our Integrated Management System and associated activities enable compliance with these provisions.

The scope of this report encompasses:

- the ongoing management of environmental safety at the LLWR;
- activities undertaken during the development of the 2026 ESC.

In addition, this report outlines how these requirements will continue to be met in the future. Where relevant, cross-references are made to other ESC reports listed in the Preface, demonstrating adherence to principles such as the application of sound science and good

engineering practice. Conversely, other ESC reports refer to this document to confirm that our environmental safety management is governed by robust and properly implemented management procedures.

1.3 Structure

This report describes how we interact with regulators and stakeholders and how our environmental safety culture is supported by our management system. It is structured as follows:

- Section 2 explains how we interact with regulators, particularly the Environment Agency;
- Section 3 provides evidence of our engagement in dialogue with local communities and other stakeholders;
- Section 4 presents evidence of our environmental safety culture;
- Section 5 describes how work to demonstrate compliance with the current Environmental Permit and to support the ESC is planned and controlled;
- Section 6 demonstrates our commitment to applying sound science and good engineering practice;
- Section 7 outlines our quality management arrangements;
- Section 8 details the established processes for providing information to the Environment Agency;
- Section 9 describes our documentation and records management systems.

1.4 Transformation of LLWR Management Systems

Nuclear Waste Services (NWS) was created in January 2022, bringing together the expertise of LLW Repository Ltd, Radioactive Waste Management Ltd (RWM) and the Nuclear Decommissioning Authority (NDA) Group's Integrated Waste Management Programme (IWMP). Prior to NWS being formed, both LLW Repository Ltd and RWM had their own management systems.

The LLW Repository Ltd management system comprised Repository Site Manuals and Repository Site Policies, supported by a suite of Repository Site Procedures (RSPs) and associated guidance. Together, these documents defined the approved arrangements for planning, controlling and delivering work activities. The management system was accredited by Lloyd's Register Quality Assurance (LRQA).

The majority of the work undertaken to develop the 2026 Environmental Safety Case (ESC) was carried out in accordance with the LLW Repository Ltd management system arrangements. The principal processes underpinning the development of the 2026 ESC are described throughout this report and are focused on ensuring compliance with the Permit.

Processes were originally established to support the implementation of the 2011 ESC and subsequent activities associated with the application for a revised Permit. Building on these arrangements, a dedicated repository procedure, RSP 2.25 [21], was introduced to manage the development and implementation of the ESC as a 'live' safety case. As described above, the 2026 ESC was predominantly developed in accordance with the LLW Repository Ltd management system, principally through the application of RSP 2.25.

We have developed a new NWS Integrated Management System (IMS) that is being populated in a controlled and managed manner with the policies, processes, procedures and records required to operate as a capable organisation. The IMS provides the overarching framework for the management of all organisational activities, ensuring compliance with regulatory requirements, corporate standards and recognised good practice in safety, quality and environmental performance. It establishes the principles for planning, executing and controlling work across the organisation.

The IMS has been audited and has retained accreditation to BS EN ISO 9001 [22] (Quality Management Systems), BS EN ISO 14001 [23] (Environmental Management Systems) and BS EN ISO 45001 [24] (Occupational Health and Safety Management Systems). As part of the programme to enhance and standardise the IMS, the former RSP 2.25 has been incorporated within the IMS as Nuclear Waste Services Standard Operating Procedure (NWSSOP) 40.07.01 [21]. This procedure remains a key control document supporting permit compliance.

The transition to the new IMS is being undertaken in a controlled manner to ensure continuity and to minimise risk. Given the scale and importance of the IMS, the development, transfer, harmonisation and withdrawal of management arrangements will take place over an extended period. Throughout this transition, defined arrangements are in place to ensure continued compliance with all regulatory requirements.

Where new NWS site-wide documents introduced into the IMS have relevance to the ESC, these are briefly described within this report. All changes to the management system that could affect permit compliance are managed through the Management of Change process [25] and are escalated to the Environment Agency where required [26].

The IMS is a live system that evolves as circumstances change. As a result, references within this report to LLW Repository Ltd documents may have been updated following submission of the 2026 ESC.

2 Regulatory Interactions

This section describes how we interact with the organisations with regulatory responsibility (the regulators) for the operation of the LLWR:

- the Environment Agency;
- the Office for Nuclear Regulation.

In particular, we focus on our regulatory interactions with the Environment Agency, as this submission has been developed to address the Environment Agency's regulatory requirements for the management of environmental safety at the LLWR and the development and maintenance of the ESC. Interaction with Cumberland Council, the planning authority with responsibility for regulating developments such as future vault construction at the LLWR, and with other stakeholders, is discussed in Section 3.

Requirement R1 of the GRA [19] states that '*The developer should follow a process by agreement for developing a disposal facility for solid radioactive waste*'. The process by agreement was established under Section 37 of the Environment Act [27], for use by the environment agencies to provide advice and assistance to the developer of a new facility and to charge for that service. GRR Requirement R3 has a similar aim [20]. As the LLWR is not a new development, a full process by agreement is not needed. However, features of the process have been used as a guide to the Environment Agency's expectations during the development of the ESC.

As an operating site for the disposal of Low Level Waste (LLW), we hold a Permit [28]² and a Nuclear Site Licence. As part of our compliance arrangements, we have well-established processes for regulatory interaction at the LLWR. These processes are described in Subsection 2.1. Interaction with the Environment Agency during the development of the ESC and following ESC submission are described in Subsections 2.2 and 2.3, respectively.

The regulatory interactions described in this section are supported by established, formal arrangements for the provision, control and submission of information to the Environment Agency. The detailed arrangements governing the preparation, management and submission of the ESC and associated regulatory information, including Permit-required notifications and formal submissions, are described in Section 8.

² Our Permit (EPR/YP3293SA), issued under the Environmental Permitting (England and Wales) Regulations 2010 [28], replaced our Authorisation for Disposal of Radioactive Waste (BZ2508), which was issued under the Radioactive Substances Act 1993 [122], on 1st January 2011 (following variation and consolidation on 21st December 2010 [123], effective from 1st January 2011). The Permit has subsequently been varied and consolidated in 2015 [32], 2020 [124], 2021 [36], and most recently in 2025 [28], to reflect regulatory and operational changes, including the requirement to submit a Site-wide Environmental Safety Case (SWESC) and Waste Management Plan (WMP) by 1 May 2026. Each variation resulted in a consolidated permit, with the current version effective from 1 September 2025, superseding all previous versions.

2.1 Regulatory Interaction During Operations at the LLWR

Since publication of the 2011 ESC, arrangements have been maintained to support effective, transparent and timely engagement with regulatory authorities. Over this period, processes have been established and applied to promote a clear and shared understanding of regulatory expectations and requirements across NWS and relevant stakeholders. These arrangements support appropriate regulatory engagement with NWS activities, including the provision of pre-application advice and the exercise of regulatory oversight. The approach also reflects an ongoing commitment to openness and constructive engagement with regulatory bodies.

Consistent with the approach described in Subsection 1.4, regulatory engagement has long been supported through our established management system arrangements, including the processes that underpinned development of the 2026 ESC. We recently developed an organisation-wide Regulatory Engagement Topic Manual [29] as part of the ongoing maturation of the IMS. This manual brings together relevant experience and legacy processes from our predecessor organisations, providing a consolidated framework intended to promote consistency and good practice in regulatory engagement across NWS.

In addition to formal meetings and topic-specific engagement, regulatory interaction with the Environment Agency also takes place through a range of routine, permit-required submissions, notifications and approvals. These arrangements include:

- routine returns and reports required under the Permit;
- notification of events, changes or emerging issues in accordance with Permit conditions and management-system processes;
- submissions requiring Environment Agency agreement or approval prior to implementation.

Such interactions provide an important mechanism for ongoing regulatory oversight of our operations and ensure that compliance with the Permit and the assumptions of the ESC is maintained on a day to day basis.

2.1.1 Environment Agency

Our regulatory engagement is structured through a formal Level 1 to Level 4 meeting framework, as shown in Figure 2.1 taken from the Regulatory Engagement Topic Manual [29]. This framework provides a clear and consistent basis for interactions with the Environment Agency and other regulators, as appropriate. The four tiers comprise:

- **Level 1:** Senior-level regulatory meetings involving NWS and the Environment Agency, focused on high-level strategic themes and the overall regulatory relationship across NWS activities.

- **Level 2:** Senior-level regulatory meetings involving NWS and the Environment Agency, addressing strategic themes across NWS while also considering specific topics or issues in greater detail.
- **Level 3:** Routine regulatory overview meetings, which includes an LLWR site-focused meeting.
- **Level 4:** Working level topic meetings, such as for the ESC and capping operations.

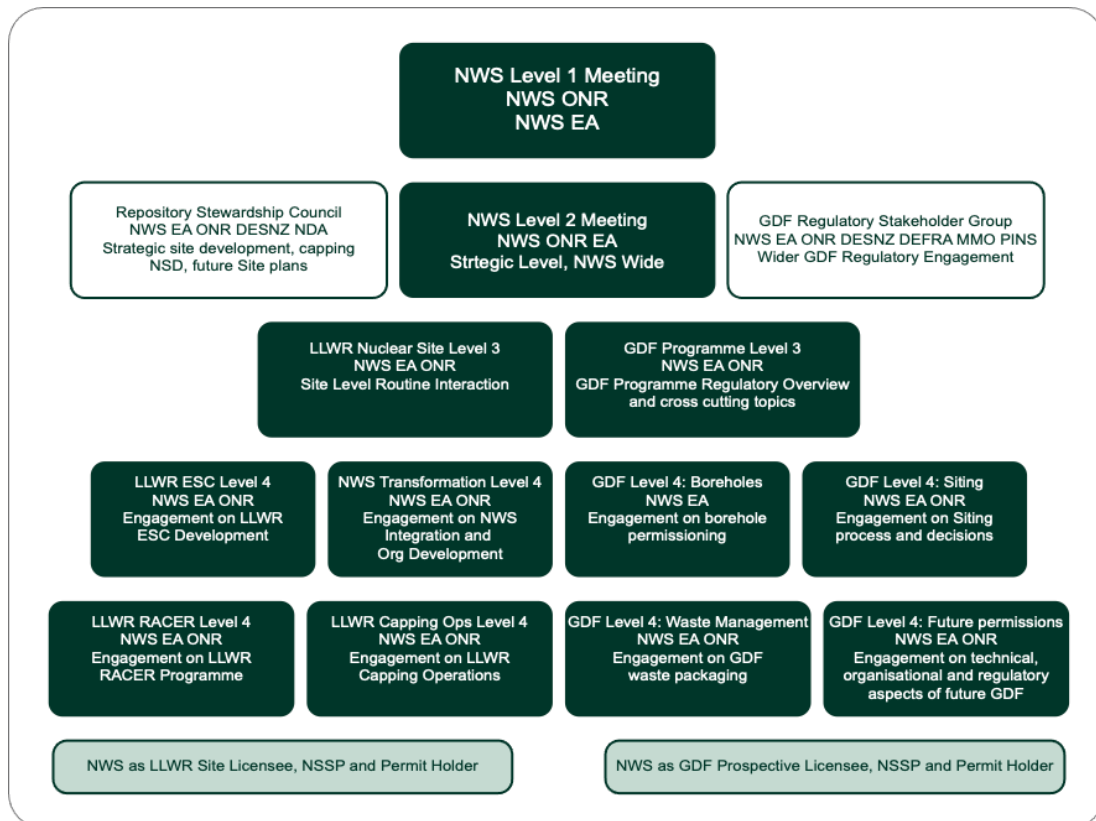


Figure 2.1: Regulatory Meeting Structure

Level 1 meetings provide the forum for strategic engagement between NWS and the regulators at a senior level. These meetings are focused on identifying and managing strategic risks and opportunities associated with the LLWR, Geological Disposal Facility (GDF) Programme and other NWS activities, and resolving any issues escalated from Level 2 meetings. The Level 2 meetings are similar in remit to the Level 1 meetings, focusing on identifying and managing strategic risks and opportunities but with different representatives from the regulators.

Whereas the Level 1 and Level 2 meetings cover the whole of NWS, the Level 3 and Level 4 meetings focus on the LLWR or the GDF. The LLWR Level 3 meetings are intended to facilitate collaboration between NWS and the regulators to address operational and regulatory challenges, risks and successes to facilitate compliance with regulatory requirements and expectations. Routine regulatory engagement for the LLWR site is

undertaken through Level 4 meetings. These meetings provide a forum for information exchange between NWS and the regulators and are used to:

- clarify regulatory requirements and expectations associated with the LLWR site Permit;
- provide pre-application advice;
- support the resolution of technical and scientific issues;
- enable the regulators to remain informed of relevant site activities and projects.

The ESC Level 4 meetings involve the ESC team, the Environment Agency and the Office for Nuclear Regulation (ONR), and are convened on a planned, working-level basis to support detailed regulatory engagement. These meetings provide an opportunity for each organisation to provide progress updates and to discuss specific technical matters. Updates from the LLWR site Environmental Monitoring team are also provided, including discussion of any monitoring results with potential relevance to the ESC. Formal minutes are issued for each meeting and an action log is maintained.

Routine interaction with the Environment Agency also includes the use of Regulatory Advice for Safety Case Assessment and Review (RASCARs), where appropriate, to seek regulatory advice or agreement on proposed approaches, changes or emerging issues relevant to the ESC and site operations. RASCARs complement the meeting framework by providing a documented route for clarifying regulatory expectations and recording advice or positions outside formal meetings.

Forward plans, ongoing programme activities and relevant elements of the site's Life Time Plan (LTP) [30, 31] are also discussed at an appropriate level within this structure, ensuring that the Environment Agency is aware of key programmes and dependencies without implying a formal approval role.

Engagement with the Environment Agency also includes their participation in wider stakeholder fora where appropriate (see Section 3) and activities undertaken under the process by agreement mechanism (see Subsection 2.2.4). Provision of information to the Environment Agency, including the arrangements for submissions associated with the ESC, is described in Section 8.

2.1.2 Office for Nuclear Regulation

ONR attends site regulatory liaison meetings where this is appropriate to the matters under discussion. These include quarterly liaison meetings, which provide a forum for routine engagement with the planning authority and the NDA; ONR is an invitee to these meetings and attends where appropriate. In addition, ONR undertakes a programme of site inspections and observes emergency response exercises held to test relevant arrangements. ONR also participates in the West Cumbria Site Stakeholder Group and the Environmental Health and LLW Repository Subcommittee meetings described in Section 3.

2.1.3 Ad Hoc Regulatory Liaison

Alongside the routine regulatory interactions linked to running a permitted site, such as sharing information on any relevant events and updates to processes, procedures and management systems, see Subsection 2.1.1, we have also responded to the Environment Agency's consultation on the, now issued, GRR (May 2016), the Joint Agencies Groundwater Directive Advisory Group (JAGDAG) methodology (May 2016) and the revised GRA (March 2025), discussed further in Subsection 2.4.

Both the ONR and the Environment Agency retain the right to enter the site to conduct an inspection at any time, outside the agreed inspection programme.

2.2 Regulatory Interaction During Preparation of the 2026 ESC

In 2021, the LLWR site's Permit [28] was varied to require submission of a Site-wide Environmental Safety Case (SWESC) and Waste Management Plan (WMP) in addition to a Major Review of the ESC, to the Environment Agency by 1st May 2026. We have prepared a combined submission addressing both these requirements, referred to as the 2026 ESC. GRA Requirement R1 requires dialogue between the developer and the regulator. The GRR has a similar requirement, Requirement R3, '*Operators should engage as early as possible with the relevant environment agency*' [20]. GRA Requirement R1 was primarily written to provide the Environment Agency with a means of interaction with developers prior to the issue of a permit. However, the underlying requirements (paragraphs 5.2.4 to 5.6.3 of the GRA) contain guidance on interaction with the regulator, in particular highlighting the benefits of early dialogue between the operator, the regulator and the planning authority to ensure that sufficient attention is focused on regulatory requirements and that the planning authority can seek the regulator's views on environmental issues. This guidance was relevant to us during the development of the 2026 ESC.

2.2.1 2011 ESC

The previous full Environmental Safety Case (the 2011 ESC), which followed the earlier 2002 Safety Case, was submitted to the Environment Agency on 1st May 2011. This submission was significant for the LLWR site as the previous submission in 2002 was not fully accepted by the Environment Agency. This led to the issue of a Permit that restricted disposals to a small area in Vault 8, with Vault 9 being only for storage. One of the main outcomes of the 2002 Post-closure Safety Case review, which focused on post-closure performance, was the requirement for an '*ESC, covering the period up to withdrawal of control and thereafter*' to be submitted to the Environment Agency by 1st May 2011. In support of delivering this regulatory requirement, a significant programme of regulatory engagement was undertaken prior to the 2011 ESC submission. This helped ensure that the submission complied with the Environment Agency's requirements and addressed their feedback from the 2002 Post-closure Safety Case. The engagement programme included regular meetings with representatives from the Environment Agency, detailed reviews of

previous feedback and collaborative workshops designed to resolve outstanding concerns from the 2002 Post-closure Safety Case.

The 2011 ESC submission provided the underpinning for a Permit variation, leading to the issue of a revised Permit in 2015 [32], providing permission for disposal to restart and for the installation of the closure engineering over Vault 8. One of the conditions in this revised Permit was that a major review of the ESC should be submitted to the Environment Agency by 1st May 2021.

2.2.2 ESC Implementation

Since the submission of the 2011 ESC, and prior to the 2026 ESC, a number of changes have been made to the ESC and to the associated arrangements for managing the site. These changes reflect the continued evolution of the approach, drawing on the Environment Agency's review of the 2011 ESC, experience gained during its implementation and operational Learning from Experience (LfE) activities (see Subsection 4.9.)

For example, two revisions to the Waste Acceptance Criteria (WAC) have been issued to introduce revised and new controls, including those relating to Discrete Items, Active Particles and asbestos. In addition, a capacity management approach has been implemented to support effective management of the volumetric, radiological and non-radiological capacities of the vaults (see Subsection 5.1.1).

Changes have also been introduced to the site's management processes, including the development of the Disposal System Specification (DSS), supported by a requirements management system (RMS), as described in Subsection 6.1.1. Enhancements have also been made to the site change-control process to ensure that potential implications for the ESC are systematically identified and assessed (see Subsection 5.3.1). In addition, an Environmental Clearance Certificate (ECC) has been established to provide the formal, top-level mechanism through which the site is managed in a manner consistent with the Permit and the assumptions and results of the ESC. The ECC defines the Environmental Operating Rules (EORs) and Environmental Operating Instructions (EOIs) that support safe, compliant and well-controlled operations across the site.

In line with our management arrangements (see Subsection 2.3.1), we provided the Environment Agency in February 2014 with the draft WAC, the ECC [33], the ECC implementation plan and the supporting ESC memorandum [34], which explained how the EORs, EOIs and Environmental Operating Assumptions were derived from the ESC. The ECC defines the environmental limits and conditions for operation. The Environmental Operating Assumptions used in the ESC are derived from, and demonstrated to be consistent with, these limits, but are defined and justified within the ESC rather than the Certificate itself. The revised Permit came into effect on 1st November 2015 and removed a number of previous restrictions on the WAC, including the prohibition on the disposal of complexing agents. This provided the basis for a further update to the WAC, and a draft revised version was submitted to the Environment Agency and implemented in 2016. As part of customer consultation, a series of briefing workshops was held to explain the changes

and their underpinning rationale, including a dedicated session for Environment Agency regulators.

The revised Permit also enabled us to start the development of the Vault 8 closure engineering and a structured programme was initiated to develop the design. This work led to an improved understanding of container performance, which demonstrated that emplacement of the proposed profile material and engineered cap would result in deformation of the containers. After discussing this new information and the implications for the closure design with the Environment Agency, we requested in 2020 that the Major Review of the ESC be postponed until 1st May 2026. This would allow the submission to be based on an optimised closure design for Vault 8 and to incorporate the outputs of a wider optimisation programme examining the potential for an enhanced disposal facility on the site. The request also proposed aligning the submission date for the SWESC with the Major Review.

To support this request, we submitted our Enhanced Periodic Review [35], which summarised the work completed to date, the updates made to the 2011 ESC and the programme of further work required to underpin the Major Review. Following its review, the Environment Agency concluded that delaying the ESC submission represented the best overall environmental option. In 2021, the Environment Agency issued a permit variation [36] that introduced Improvement Conditions³ (IC) requiring delivery of the Major Review of the ESC (IC7) and the SWESC (IC8) by 1st May 2026.

2.2.3 Environment Agency Requirements

The Environment Agency undertook a comprehensive and iterative regulatory review of the 2011 ESC. Early in this process, the Environment Agency issued a series of Information Request Forms (IRFs) seeking clarification or additional evidence to support particular elements of the ESC. These IRFs covered a range of technical topics (such as waste inventory, engineered barriers, hydrogeology and near-field processes) and were used to ensure the Environment Agency had the necessary information to progress its assessment. We provided detailed responses to each IRF, supplying the additional technical material, justification or explanation requested.

As the review progressed, the Environment Agency formalised its assessment through a set of regulatory review documents, which provided detailed technical commentary, identified regulatory expectations and set out the conditions required for continued disposal activities [37], [38], [39], [40], [41], [42]. These documents formed the overarching framework for the Environment Agency's evaluation and provided a clear statement of the regulatory position on key aspects of the ESC.

Alongside these review reports, the Environment Agency issued a series of Forward Issue Forms (FIs) [43] to highlight specific queries, issues or actions that required further work.

³ Improvement Conditions are formal Permit requirements that require us to submit certain information to the Environment Agency by the specified date, see also Subsection 2.2.3.

The FIs were organised into formal technical categories: Safety Case Management; Assessments; Site Understanding and Evolution; Inventory and Near Field; and Optimisation and Engineering, ensuring a systematic and transparent process for tracking review issues. These categories included, for example:

- **Hydrogeology**, covering groundwater flow modelling, conceptual understanding and uncertainties in groundwater transport pathways.
- **Waste Inventory**, addressing the completeness, representativeness and treatment of radionuclide and non-radiological inventories.
- **Engineered Barriers**, focusing on the design, function and performance of engineered components such as container integrity, caps and vault structures.
- **Near-field Behaviour**, covering degradation processes, gas generation, leachate chemistry and wastefrom performance.
- **Environmental Safety Functions**, relating to containment, isolation, retardation and other performance functions that underpin the safety case.
- **Monitoring and Site Evolution**, reviewing the adequacy of environmental monitoring, observational evidence and long-term site behaviour.

Each FI represented a discrete regulatory concern or expectation, and the Environment Agency requires that all FIs receive formal responses prior to submission of the 2026 ESC. The 2026 ESC includes a clear explanation of how each issue has been addressed, resolved or incorporated into the updated safety case (see Subsection 4.9.2).

In addition to the FIs, the Environment Agency also provided recommendations based on its review work. While these recommendations are not subject to the same formal closure process as the FIs, we have taken them into account in the development of the 2026 ESC. The 2026 ESC describes how these recommendations have shaped, informed or reinforced elements of the ESC, with a structured mapping of each recommendation to the relevant ESC sections provided in the crosswalk report, '*Addressing Regulatory Requirements and Feedback*' [18].

Beyond IRFs, FIs and recommendations, the Environment Agency required further submissions in the form of ICs listed in Schedule 1 of our Permit [28].

Submission of the 2026 ESC, including the SWESC and WMP (see Subsection 2.2.3), will complete Improvement Conditions 7 and 8, the last of the current ESC-related ICs.

2.2.4 Process by Agreement

After the review of the 2011 ESC, both we and the Environment Agency undertook lessons learnt reviews [44]. Both organisations agreed that a more formal approach to recording reviews and positions would be beneficial for the next Major Review of the ESC. A 'process by agreement' is described in the GRA [19] for the period prior to the regulator issuing an authorisation for the disposal of waste. It allows the regulator to provide advice prior to the start of a formal regulatory process. To support the development of the 2026 ESC we agreed

to follow such a process with the Environment Agency. This entailed the submission of documents to the Environment Agency to gain regulatory assessment of the acceptability of approaches, methods and options as they were developed. We also held meetings to discuss technical topics with the Environment Agency to brief them on our developing arguments and gain their feedback.

2.3 Future Regulatory Interaction Following Submission of the 2026 ESC

Once the 2026 ESC is submitted we expect there will be a period of interactions with the Environment Agency to discuss key topics and outcomes from the 2026 ESC. The form of these interactions will be discussed and agreed with the Environment Agency but we expect they may include workshops, topic-specific meetings and briefings. As part of the formal review of the 2011 ESC, the Environment Agency issued us with a series of IRFs (see Subsection 2.2.3) that we responded to and we envisage a similar process may be put in place to support the review of the 2026 ESC. We expect that our Level 4 meetings, as described in Subsection 2.1.1 will also continue throughout the review period. Following completion of the formal review, we may seek a variation to the Permit following discussion with the Environment Agency, once proposals are sufficiently developed and aligned through the established liaison process.

2.3.1 Implementation

Management and maintenance of our ESC is integrated into our management system. The ESC is implemented on site and is a live safety case with changes implemented through controlled Annual or Periodic Reviews, subject to appropriate change control. The 'live ESC' refers to the change controlled, set of documents that together comprise the current, authoritative ESC baseline. It does not mean that each document is live or frequently updated. Instead, as new reports are issued they become part of the baseline over time. As described in Subsection 4.6, new information is evaluated to determine whether it has implications for the safety arguments, assumptions or conclusions of the ESC. Such information is incorporated into the ESC by the creation of new reports that are then also added to the ESC document baseline with any implications for previous ESC documents recorded. This cumulative set of changes are captured each year in the Annual Review, which we discuss in Subsection 5.2. The Annual Review itself becomes part of the baseline.

As described in Subsection 4.5, the ESC, including the WAC, is controlled via NWSSOP 40.07.01 [21] (formerly RSP 2.25 [21]). Our Permit requires us to inform the Environment Agency if we propose any change to the management system or to site resources that could affect how compliance with the Permit is achieved. We are also required to inform the Environment Agency if we propose to make a change to the ESC or to the WAC that may have an impact on the quantity or nature of the wastes to be disposed. This notification requirement is implemented through NWSSOP 40.07.01 [21]. These arrangements include routine permit-required submissions, notifications and (where necessary) the use of RASCARs or formal approval processes to support the implementation and maintenance of the ESC as a live safety case.

The management system ensures that all activities are carried out in compliance with regulatory requirements and corporate standards. Any changes to the management system that could affect compliance with our Permit are managed through the Management of Change process [25] and, where necessary, escalated to the Environment Agency [26].

At an appropriate point, and following discussion with the Environment Agency, we may submit a permit variation request where proposed changes fall outside the scope of what can be managed under our existing Permit and change-control arrangements. Updates such as further revision of the WAC (see reference [17]) or adjustments to the waste acceptance process, including capacity-management arrangements, can be developed under NWSSOP 40.07.01 [21], which requires us to notify the Environment Agency of any proposed change that could affect Permit compliance. For these changes, our approach, consistent with GRR Requirement R3, is to engage early with the Environment Agency, sharing developing proposals and refining them collaboratively.

However, some changes would specifically require a formal Permit variation, as set out in the '*Implementation*' report [17]. For example, if we wanted to update or change the total vault capacities to reflect the latest ESC assessment calculations, we would require a Permit variation as the repository capacities are stated in the Permit. Our engagement process is therefore structured to ensure that emerging proposals are discussed with the Environment Agency early so that any such formal variation requests can be prepared on an agreed and well-supported basis.

2.4 Guidance on Requirements for Authorisation

During preparation of the 2026 ESC, the Environment Agency commenced the process to update the GRA [19] (see Subsection 2.1.3). We responded to the formal consultation in February 2025. Given the submission timeline for the 2026 ESC and the expected publication date of the revised GRA, we developed our submission (following consultation with the Environment Agency) based on the existing 2009 version of the GRA. After submission, we will work with the Environment Agency to agree a programme to align the ESC with the guidance in place at that time and we would fully support and engage in any such discussions.

2.5 Continued Interactions

This subsection is intended to clarify the purpose and scope of the information presented, and to explain how it relates to, and should be interpreted alongside, the wider ESC and associated reports. As a live ESC, development will continue, to account for new information and to reflect changes on the LLWR site such as capping or new vaults, to ensure that it is fit for purpose as a site management tool. We will discuss and agree with the Environment Agency how best to engage over the future development of the ESC.

Section 6 of the '*Main Report*' [1] provides an overview of a planned future programme of work that will be undertaken to ensure effective maintenance and application of the ESC and

to further reduce uncertainties. This programme provides the basis for the work required to maintain the ESC as a 'live' case and to ensure that it continues to reflect operational experience, new information and changes to regulatory guidance. As part of the post-submission process, the programme will be reviewed and may be adapted to take account of the Environment Agency's feedback on its review of the 2026 ESC, including any requirements or recommendations arising from that review.

Consistent with this approach, any additional work needed to align the ESC with revised regulatory guidance or updated policy will be incorporated into the programme. This will ensure that required actions, whether technical assessments, updates to ESC controls or supporting operational changes, are planned, governed and delivered in a transparent and traceable way through an agreed and structured sequence of activities. The programme of work will be discussed with the Environment Agency through our established liaison arrangements and incorporated into the site's workstream.

We understand that the Environment Agency may need to undertake public consultations or briefings related to any subsequent Permit variation application and we would support those if requested by the Environment Agency.

The formal engagement meetings, structured within the Level 1 to Level 4 framework, outlined in Subsection 2.1.1, will continue as part of our established regulatory engagement process.

3 Stakeholder Dialogue

We attach a high priority to stakeholder engagement, and the views of stakeholders are sought and considered for a wide range of issues. Our stakeholders and our engagement activities with external organisations that have an interest in the LLWR site are described in the section. Once the 2026 ESC is submitted to the Environment Agency we will use these ongoing engagement activities to brief our stakeholders on the submission.

3.1 Stakeholders and Engagement Activities

Stakeholder dialogue associated with the development of the ESC is undertaken within our established organisational framework for communications and stakeholder engagement. This framework is set out through our communications and engagement strategy and is supported, for the ESC, by a dedicated Stakeholder Engagement and Communications Plan. Together, these arrangements provide a structured, proportionate and consistent approach to engagement, aligned with regulatory expectations and the role and interest of different stakeholder groups. Within this framework, engagement activities are planned and delivered to support transparency, to inform stakeholders of the development and conclusions of the ESC, and to ensure that relevant views are understood and taken into account where appropriate. The subsections that follow describe how this framework has been applied in practice for specific stakeholder groups during the development of the ESC

We engage with a range of stakeholders in relation to the LLWR, including statutory bodies, local authorities, community groups and local residents. This subsection provides an overview of the key stakeholder groups and the nature of our engagement with them.

3.1.1 Nuclear Decommissioning Authority

The NDA is a non-departmental public body that has a long-term mission to clean up the UK's earliest nuclear sites safely, securely and cost-effectively with care for people and the environment.

The NDA is the strategic body responsible for four operating companies that include Sellafield Ltd, Nuclear Restoration Services, Nuclear Transport Solutions and NWS.

The NDA owns the LLWR site and provides funding for the operation and management of the LLWR. We engage directly with the NDA on a regular basis and NDA staff are also available for technical discussions on an ad hoc basis, for example on the implications of the ESC for waste disposal capacity and national strategy. The NDA also attends the West Cumbria Site Stakeholder Group - NWS working group meetings and gives presentations on national or policy issues, see Subsection 3.1.6.

The NDA acts as the interface with other Government departments, for example, the Department for Energy Security and Net Zero (DESNZ), but we respond directly to Government consultations on subjects of interest or relevance.

3.1.2 Regulators

Engagement with our regulators is delivered through a structured regulatory meeting framework managed by the Environment, Health, Safety, Security and Quality (EHSSQ) team, see Subsection 2.1.1.

In addition to the meeting framework, regulatory engagement includes coordination with communications and stakeholder-engagement peers, as well as joint participation in broader fora such as site stakeholder groups, community forums, liaison meetings with local Parish Councils, business and industry events, NDA Group activities and other Government-channel engagements. The Environment Agency is a regular attendee at the community events described in Subsection 3.1.6.

3.1.3 Planning Authority

Cumberland Council is the planning authority for the LLWR site. It is a unitary authority that was formed on 1 April 2023, replacing the former upper-tier authority of Cumbria County Council and the former lower-tier councils in Copeland, Carlisle and Allerdale. The Council is responsible for preparing the Local Development Plan and for determining planning applications, including minerals and waste planning applications, within its administrative boundary. Certain applications may, however, be subject to intervention by the Secretary of State⁴ or determined under the Nationally Significant Infrastructure Projects regime.

In July 2016 planning permission reference 4/15/9012 was granted by Cumbria County Council (the waste planning authority at the time) for the construction of Vault 9a (an extension to Vault 9), Vault 10 and Vault 11 at the LLWR site. The planning permission also grants consent for the permanent disposal of LLW in the new vaults and in the existing Vaults 8 and 9, along with installation of a cap to be constructed over Vaults 8 to 11 and Trenches 1 to 7. Under the planning permission, waste disposal operations are consented until the end of 2045, with capping and restoration works consented until the end of 2051.

Future development at LLWR, including changes of use of parts of the site, would need to be authorised by Cumberland Council through the town planning process (unless the development constitutes permitted development under the General Permitted Development Order, 2015).

Liaison meetings are held with Cumberland Council, on an as-needed basis, to discuss town planning matters and provide the Council's planning team with advanced notice and information about potential upcoming planning submissions.

⁴ While Cumberland Council acts as the local planning authority for the LLWR site, certain planning applications may be subject to intervention by central government. Under the Town and Country Planning Act 1990, the Secretary of State for Levelling Up, Housing and Communities retains powers to 'call in' applications for determination at national level. Additionally, projects classified as Nationally Significant Infrastructure Projects (NSIPs) under the Planning Act 2008 are determined by the Secretary of State following examination by the Planning Inspectorate. These provisions ensure that decisions with wider national implications are considered at the appropriate level.

Cumberland Council is currently consulting on its issues and options draft of the new Cumberland Local Plan. Once adopted, the new plan will incorporate strategic, development management, and minerals and waste planning policies and will form the basis for determination of all planning applications in Cumberland. The Local Plan is currently programmed for submission to the Secretary of State in 2027 and adoption by the Council in 2028. We are engaging with the Council in the plan-making process, including through a working group that has been set up by the NDA.

3.1.4 Waste Customers

Waste consignors or customers are represented by the UK civil and military nuclear radioactive waste producing sites, and other organisations (for example, universities and medical companies) that require LLWR site capacity to dispose of radioactive waste generated through research, operations and decommissioning activities.

We have a dedicated Waste Services team, which manages the relationship with our customers and a dedicated Waste Acceptance team that are responsible for the waste acceptance processes that govern waste disposal at the LLWR site. These teams also support various waste assurance activities, such as site-based and desktop audits.

The ESC team also supports Site Operations, Waste Services and Waste Acceptance in dealing with requests to dispose of wastes, including attending meetings with consignors to address specific issues.

If we plan to implement changes that would affect consignors, for example changes to the WAC, the team engages with its customers at the earliest opportunity, unless changes need to be introduced more rapidly to ensure compliance with legal or regulatory conditions.

We also aim to reduce the impact of WAC changes for customers by appointing a dedicated project manager and delivering a detailed implementation plan that considers any implications associated with a WAC revision, such as complementary training, updated guidance materials, or modifications to customer software used to generate our waste acceptance procedure forms. These arrangements form part of our commitments under NWSSOP 40.07.01 [21], which requires that any proposed change with potential implications for Permit compliance is managed through a controlled and well-communicated process, including early notification to the Environment Agency and structured support for customers affected by the change.

3.1.5 National and International Organisations

We engage regularly with a wide range of national and international organisations including local government and international waste management organisations (WMOs). Some examples are given below.

Nuclear Legacy Advisory Forum - The Local Government Association (LGA) represents nearly all the local authorities in England and Wales. It has established a Special Interest Group, the Nuclear Legacy Advisory Forum (Nuleaf), and is the voice of local government on nuclear decommissioning and radioactive waste management. It works with Government,

the NDA, NWS, regulators and the wider industry and promote the best economic, social and environmental outcomes for nuclear communities. The Nuleaf steering group meets four times a year.

There is also a Radioactive Waste Planning Group (RWPG) for officers of member authorities. The RWPG meets four times a year and the meetings offer an opportunity to engage with the NDA Group (including NWS), Government and other regulators on all aspects of land use and waste strategy, policy and practice. Nuleaf engages with the NDA Group to represent the local authority perspective on a number of issues including: the impacts of NDA's work on local communities and wider sustainability; stakeholder engagement; and the implications of decommissioning and waste management proposals, particular in terms of land use and waste planning and proposals for the future use of sites.

NWS Non-Governmental Organisations (NGO) Exchange - We consider NGOs to be important stakeholders who can contribute to the success our programme. NGOs also provide an important opportunity to reach a wide range of stakeholders, both national and local, who are often seldom heard in the normal run of activity. There are several ways that we engage with NGOs.

- The DESNZ NGO forum is typically held three times a year, covering policy issues including nuclear new build and we attend as an observer.
- The NDA NGO forum covers topics related to decommissioning excluding GDF and we attend as an observer.
- The NWS NGO Exchange is a forum which has been specifically set up by NWS to share insights and views on technical and social aspects of the geological disposal programme, and this has now been extended to include NWS-wide activity (with a revised Terms of Reference currently being developed).

Continuing to build on this open and transparent dialogue with its NGO community, we, along with the NDA and Sellafield, jointly hosted site visits to Sellafield and the LLWR site in April 2025. Actively encouraging challenge, scrutiny and wider understanding of the NDA's mission, members of the NDA NGO Forum and the NWS NGO Exchange, including several organisations opposed to the nuclear industry, were able to see first-hand some of the decommissioning work taking place and better understand how nuclear waste is safely managed, stored and disposed of.

NDA National Stakeholder Summit - As an NDA Group operating company, we participate in the NDA National Stakeholder Summit, which is held annually and brings together key local, regional, and national stakeholders from across the UK to discuss general nuclear estate and site-specific issues.

International Waste Management Organisations (WMOs) - We have strong international links with other WMOs and we participate in a wide range of research programmes, technical meetings and conferences. This provides us with opportunities to share knowledge and learn from international WMOs who are managing LLW disposal in other countries.

International Atomic Energy Agency (IAEA) - We participate in technical meetings and fora set up by the IAEA such as the International Low-Level Waste Disposal Network ([DISPONET](#)). DISPONET provides us with the opportunity to share knowledge and also learn from international peers to ensure the application of safe and sustainable solutions in the disposal of low and intermediate level waste.

National and international visits - We also regularly host visits to the LLWR site for national and international delegations, providing further valuable opportunities to exchange knowledge, explore best practice and strengthen ties with our international counterparts. Recent visits include a delegation from Slovenia's Agency for Radwaste Management (ARAO) and the Slovenian Nuclear Safety Administration (SNSA), supported by the IAEA in May 2025. In addition to participation in workshops, the delegates were also given a tour of the LLWR where key projects, for example, the Southern Trench Interim Membrane (STIM) project were discussed as well as the ESC.

Throughout 2024 and into 2025, we also hosted delegations from KORAD (Korea Radioactive Waste Agency), the Australian Radioactive Waste Agency (ARWA), the Federation of Electric Power Companies in Japan, the Nuclear Safety Committee (NSC) and Management of Environmental Health & Safety Committee (MEHSC) Independent Safety Persons (ISP) and Canada Nuclear Laboratories.

3.1.6 Local Communities

A dedicated Community Engagement team provide support by ensuring regular updates on construction, proposed future works, community funding are disseminated and discussed with the local community. The Community Engagement team have an 'open door' policy where local residents are able to contact us directly with any queries.

West Cumbria Site Stakeholder Group (WCSSG) and associated working group - The WCSSG is an independent body that provides opportunities for members of the public and interested parties to comment on and influence future strategies and plans, and to provide views and feedback to the NDA on the future of nuclear sites in West Cumbria. The NWS Working Group focuses on operations and activities relating to the LLWR and other NWS programmes. Members of the working group include representatives from NWS, the NDA, the ONR, the Environment Agency, Cumberland Council and local town and parish councils, including Drigg and Carleton Parish Council and Seascale Parish Council.

The group typically meets biannually and reports back to the main WCSSG meetings, which are held quarterly, alternating focus between NWS and Sellafield. The working group meeting is deliberately sequenced to sit between the NWS-focused main meetings, ensuring consistent flow-through of information. All meetings are open to members of the public, reinforcing transparency and accessibility.

The 2026 ESC has been a presentation topic at several of these working group meetings, reflecting the importance of keeping local stakeholders informed of progress, key areas of focus and the developing evidence base. This ongoing dialogue provides an important channel for explaining the ESC's role in maintaining long-term environmental safety at the

LLWR, sharing updates on progress toward the 2026 submission, and addressing questions raised by local representatives, regulators and the public.

Parish Councils - We meet monthly with Drigg and Carleton Parish Council to engage and inform the local community and discuss any concerns or opportunities with them.

Community drop-in days - Regular community drop-in days have and continue to be held in local village halls to update on the work being carried out at the LLWR and to discuss potential areas of concern, including traffic, southern trench interim membrane work, trench cap installation and the future use of the site after closure (site end state). It is also an opportunity for the community to meet representatives from across the site outside of the Community Engagement and Leadership teams.

Site tours - Local stakeholders and residents are regularly invited on to site and listen to presentations from the team about what is happening and progress being made.

We also support wider community initiatives such as STEM activities in local schools and colleges, the Dream Placement scheme, student placements and apprenticeships.

Other communications channels

A quarterly newsletter 'On the Level' is sent out to over 2,200 properties in the local community and is also available online. The newsletter includes articles and information relating to site operations, construction activities and community stories, and periodic updates relating to the ESC.

In addition to the newsletter, if appropriate, specific communications relating to upcoming activities that may impact the community or local residents are issued in advance of the works. If there are any emergency or short notice works, these are communicated directly to those impacted.

NWS website – repository community page

Launched in Autumn 2024 the community pages on the NWS website [45], provides a space for us to share updates on our work and is part of our commitment to being a good neighbour.

4 Environmental Safety Culture and Overview of Management System

The GRA [19] and GRR [20] require that the operator of a disposal facility should maintain a positive environmental safety culture to support the activities undertaken on site. This includes having a management system, organisational structure and sufficient resources.

This section of the report covers; environmental safety culture (Subsection 4.1), management system (Subsection 4.2) and organisational structure (Subsection 4.3) and the management of resources, competences and succession planning (Subsection 4.8), and how we promote review and learning (Subsection 4.9).

4.1 Environmental Safety Culture

Our EHSSQ Policy states that *'above all, nothing is more important to us than protecting people and the environment.'* This is a direct evolution of LLW Repository Ltd's earlier principle that *'nothing is more important than the protection of the environment and the health and safety of the workforce, contractors and the public.'* This principle is embedded throughout the organisation and actively driven from board level through clear policies, governance arrangements and leadership commitment. Evolving from the practices embedded in LLW Repository Ltd, we have established a set of values, standards and expectations that are communicated to all employees.

An example of how this culture is reinforced is the introduction of our enhanced Environmental Awareness training. This training was designed in direct response to lessons emerging from the 2011 submission and subsequent regulatory engagement, recognising the need for wider business familiarity with the ESC and how it was implemented operationally across the site. The training is provided to all new staff and key contractors to ensure everyone working on or supporting the LLWR site has an understanding of permit compliance, ESC implementation and the role of the ESC in decision making. This training rollout was repeatedly highlighted by EHSSQ leadership as a key improvement action, ensuring that ESC concepts were understood not only within the safety case team but across operations, engineering, waste management and supporting functions.

4.2 Management System at the LLWR

Environmental, health, safety and quality matters are managed as integral components of our IMS. Responsibility for implementing these arrangements is delegated throughout the organisation to managers and individuals holding defined EHSSQ and Intelligent Customer roles, see Subsection 4.8.1.

Our IMS contains all policies, processes, procedures and records that govern the planning, control and assurance of our activities.

However, the majority of the work to develop the 2026 ESC was undertaken in accordance with the established LLW Repository Ltd management system arrangements, including the procedures governing ESC development, change control, quality assurance and regulatory engagement. These arrangements provided the relevant governance and controls throughout the development of the ESC, ensuring consistency with permit requirements and regulatory expectations at the time the work was undertaken.

Following the formation of NWS, these arrangements have been transitioned in a controlled and managed manner into the NWS IMS to ensure continuity, clarity of accountability and ongoing regulatory compliance. While the organisational framework, document hierarchy and system ownership have evolved, the fundamental controls governing environmental safety, permit compliance and ESC management have been retained and are now embedded within the NWS IMS. The IMS therefore provides the framework for the ongoing implementation, periodic review and future development of the ESC.

The IMS includes:

- our mission statement and objectives [46];
- the Management Prospectus, which summarises system-wide governance arrangements and signposts detailed procedures and guidance [47];
- corporate policies, including the EHSSQ Policy [48] and additional policies located in the Governance section of the IMS;
- defined EHSSQ roles, process owner roles and Intelligent Customer roles, listed within [49].

The Environmental Management Topic Manual [50] , forming part of the Environmental, Health and Safety section of the IMS and supported by the relevant Organisational Manual (OM) [51] , provides the framework for managing environmental risks and ensuring compliance with applicable legislation, including environmental permits and, where required, environmental enhancement obligations under the Energy Act. Underpinning the topic manual is a Permit Compliance Table [52], which documents the environmental permits applicable to our operations and supports compliance with relevant regulatory requirements, see Subsection 4.4.

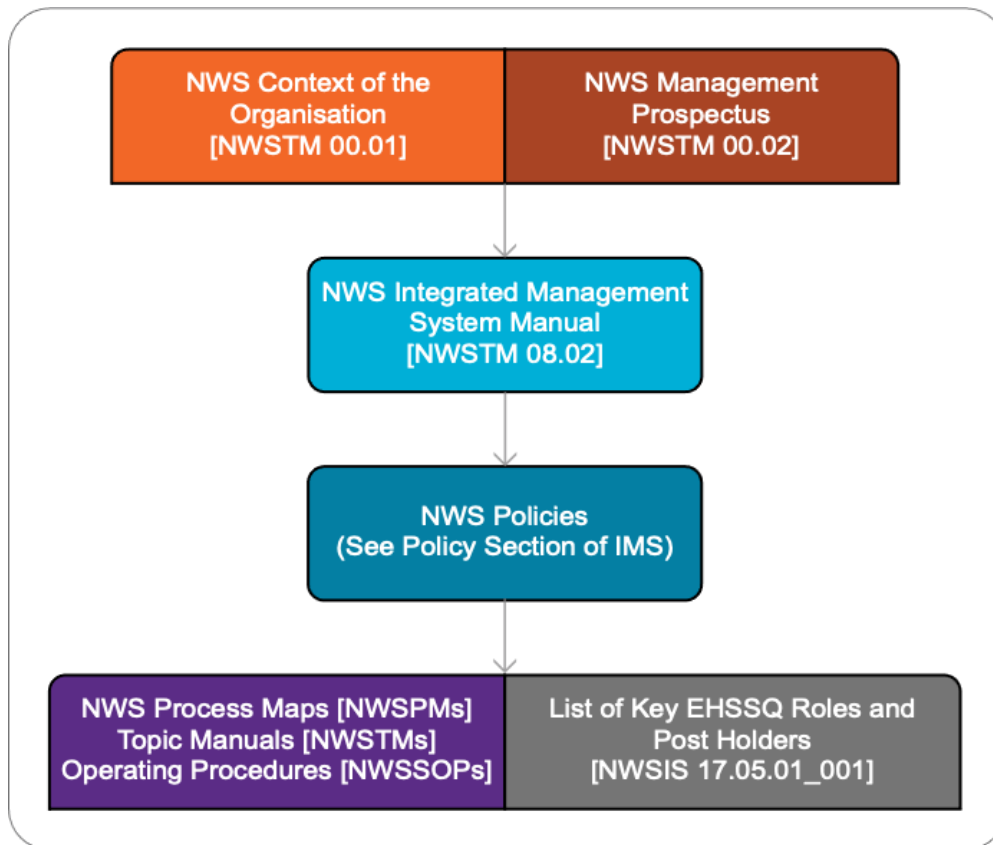


Figure 4.1: Hierarchy of our Management System documentation

Figure 4.1 sets out the hierarchy of IMS documentation, illustrating how corporate governance flows from high-level organisational standards through to site-specific implementation. Within this structure, Repository Site Procedures (RSPs), which operate at the same tier as the NWS Standard Operating Procedures (NWSSOPs) shown in the bottom layer of Figure 4.1, form the procedural level, establishing formal requirements for compliance with the Permit and the accompanying Compilation of Environment Agency Requirements (CEAR). Beneath these, instructions provide task-level operational guidance, ensuring that day-to-day activities are performed in accordance with the requirements specified in the NWSSOPs/RSPs.

4.2.1 Certification of Management Arrangements

Our management arrangements are certified to BS EN ISO 9001 [22] (Quality Management Systems), BS EN ISO 14001 [23] (Environmental Management Systems) and BS EN ISO 45001 [24] (Occupational Health and Safety Management Systems) [53]. These certifications are maintained through a programme of regular internal and external audits, as described in Subsection 7.1.

The LLWR has operated under independently accredited management systems for over a decade. Following its separation from Sellafield Ltd in 2007, LLW Repository Ltd established its own Quality Management System, which was subsequently certified to ISO 9001 and formally recognised by the Environment Agency as meeting the requirements of a competent permit holder under the Environmental Permitting Regulations (EPR). These arrangements

formed the foundation for LLW Repository Ltd's Environmental Management System and Occupational Health and Safety arrangements, which were progressively aligned with ISO 14001 and ISO 45001 as those standards evolved.

Under NWS governance, these legacy systems have been integrated and re-certified as part of a unified organisational management system (see Subsection 1.4). Although the structure, ownership and documentation of the system have evolved, the organisation has continuously operated under accredited management arrangements that meet the relevant international standards. Current arrangements are aligned with the EPR and are documented within the Environmental Management Topic Manual [50].

In accordance with BS EN ISO 14001, our Environmental Management System includes a maintained Significant Environmental Aspects Register (SEAR)⁵, which is used to set and track environmental objectives and targets. This framework ensures that environmental performance is systematically monitored, reviewed and improved in line with legal, regulatory and corporate requirements.

4.2.2 Regular Review of Management Arrangements

Management arrangements are subject to a formal annual management review, undertaken in accordance with reference [54] and the requirements of ISO 9001, ISO 14001 and ISO 45001. The review assesses the IMS to ensure its continuing suitability, adequacy, effectiveness, and alignment with the strategic direction of the organisation. Outputs from the review are documented in accordance with IMS requirements and communicated to relevant stakeholders, prior to submission to the Nuclear Safety Committee. The outputs of the review inform organisational risk, opportunities, change management, resourcing and implications to the strategic direction of the organisation.

Individual Process Owners are responsible for ensuring that their processes are designed and maintained so that they adequately cover the activities controlled by their process. Process Owners undertake periodic reviews of their process to ensure they are current, appropriate and adequate.

⁵ NWSSOP 02.04 [125] describes how SEAR is derived and maintained.

4.3 Organisational Structure

The NWS Board holds responsibility for strategic direction and ensuring compliance with environmental and regulatory obligations. The Board comprises the Chair of Nuclear Waste Services, four Independent Non-Executive Directors, two NDA Non-Executive Directors, the Chief Executive Officer (CEO), the Director of EHSSQ and the General Counsel and Company Secretary. The Board is supported by the Environment, Safety and Security Committee (ESSC), chaired by an independent Non-Executive Director, providing advisory input on safety and environmental matters but not holding executive authority. The main purpose of the ESSC, as set out in the Terms of Reference [55]: *'The main purpose of the ESSC is to provide independent advice to the Board to assist it in carrying out its responsibilities in relation to health, safety, security and environmental protection'*.

The CEO leads the Executive Team, comprising senior functional directors, who are collectively responsible for the day to day management of NWS. The executive team are accountable for implementing the strategy and operational plans approved by our Board. The CEO is also responsible for delivering our mission, vision and values.

Our Management Prospectus demonstrates that we maintain an adequate management structure, capability and resource base to fulfil the obligations associated with operating the LLWR nuclear licensed and permitted site. Our updated NWS Management Prospectus supersedes the former LLW Repository Ltd prospectus which consisted of the LLW Repository Ltd Governance and Management System Manual. The accountabilities of the Executive Directors are defined in the Management Prospectus [47], with particular emphasis on the roles and responsibilities that are critical to ensuring safe, secure and environmentally responsible delivery.

Organisation charts and baseline role descriptions are maintained by the Compliance and Management of Change Team and are accessible via 'The Vault', our internal SharePoint site for internal communication.

We operate through an organisational structure built around a set of directorates that collectively deliver our core mission (summarised in Table 4.1). Each directorate is responsible for a distinct portfolio of activities. Oversight of this structure is maintained by our Board, as set out in the Corporate Governance Manual [56], which confirms the Board's responsibility for strategic direction and adherence to NDA governance and statutory obligations.

Table 4.1: NWS Organisational Structure

Directorate	Associated Teams (summarised)
Commercial & Business Services	Commercial; Enterprise Portfolio Management Office; Communications & Stakeholder Engagement; Information Technology and Business Improvements.
Human Resources	Human Resources; Transformation; Organisational Effectiveness; Learning & Development; Inclusion, Culture & Engagement and HR Operations.
Corporate Integrated Waste Management & Strategy	Integrated Waste Management; Business Development; Portfolio; Waste Services; Sustainability and Strategic Review.
Environmental, Health, Safety, Security & Quality	Security & Resilience; Performance, Learning & Regulatory Liaison; Independent Assurance; Environmental, Health & Safety; Information Security; Quality and NWS/Environment Agency Engagement Strategy.
Finance & Reporting	FP&A & Efficiency, Performance Reporting & Facilities Management and Business Partnering; Financial Control; Finance Transformation and Business Case & Sanction.
Legal, Governance & Business Support	Legal; Company Secretariat; Enterprise Assurance & Risk and Business Support.
Operations & Programmes	Contractor Validation; Facilities Management; GDF Programme; Site & Waste Operations; Siting & Communities; and Major Permissions.
Technical	Design Authority & Technical Control; Safety Cases; Engineering; Site Characterisation & Research & Development; Waste Management & Inventory and Technical Development and Support.

4.4 Taking Safety into Account in Policy and Decision Making

The GRA requires that policies and decisions affecting environmental safety take into account all relevant considerations (GRA paragraph 6.2.16). Our structure flows down accountability for EHSSQ matters from our Board and CEO through to senior management [47]. The CEO holds overall responsibility for fulfilling the requirements of the Permit and Nuclear Site Licence Conditions, Subsection 4.3.

Governance and oversight

Our Board, supported by the ESSC, provides strategic oversight and advisory input on safety and environmental matters. In addition, the Nuclear Safety Committee for the site meets the requirements of both the Nuclear Site Licence Conditions and environmental legislation, specifically the Permit and the CEAR. These governance arrangements complement the organisational structure described in Subsection 4.3, which sets out the roles and responsibilities of the Board, Executive Team and directorates.

Permit compliance and assurance

The Permit [28] and accompanying CEAR document [57] require the operator to:

- maintain arrangements for compliance with each limitation and condition of the permit;
- manage and operate activities in consultation with a suitable Radioactive Waste Adviser (RWA).

To meet these requirements, we have established a formal process, defined in NWSSOP 02.01.02 [58] (formerly RSP 02.01: 'Compliance with the LLWR Permit for Radioactive Substance Activities' [59]), supported by a compliance matrix. This process assigns Permit Condition Holders for each condition, to provide senior oversight of compliance with specific permit conditions. Permit Condition Holders carry out periodic checks to confirm that the supporting arrangements are current, suitable and being applied as intended. The results of these checks are reported to the Nuclear Safety Committee (NSC) [60].

Corporate RWA arrangements

Our Permit requires that the organisation manages and operates the LLWR in consultation with an appointed RWA. The role of an RWA is to provide advice to the Permit holder on radioactive waste management and environmental radiation protection. This permit requirement can be met by appointing individual RWAs or by applying for Corporate RWA status, where a group of individuals provide the RWA function. Corporate RWA involves the appointment of Suitably Qualified and Experienced Persons (SQEP) who, collectively, fulfil all the capabilities the Environment Agencies expect of an individual RWA [61].

We successfully applied for Corporate RWA status and our arrangements [62] set out the process for how we assess and appoint SQEP to ensure that all aspects of the Environment Agency's RWA syllabus is met. For example, the ESC Manager is a member of our

Corporate RWA for aspects of the syllabus relating to the ESC and optimisation, discussed further in Subsection 4.8.2.

Independence of key EHSSQ roles

To strengthen governance, an Independent Non-Executive Director with extensive nuclear industry experience sits on our Board. Additionally, an Independent Site Inspector, reporting to the Head of Independent Assurance, conducts inspections across the business without operational responsibilities, Subsection 4.9.3.1 describes the Independent Site Inspector's role in the 2026 ESC. Key EHSSQ Roles and Responsibilities are summarised in Table 4.2.

Table 4.2: Key EHSSQ Roles and Responsibilities

Role	Responsibility
Chief Executive Officer (CEO)	Overall responsibility for compliance with Permit and Nuclear Site Licence Conditions; delivery of our mission, vision and values.
NWS Board	Strategic oversight of governance, safety, and environmental performance; ensures alignment with NDA strategy and statutory obligations.
Environment, Safety and Security Committee (ESSC)	Provides advisory input on safety and environmental matters; reviews performance and processes (non-executive authority).
Nuclear Safety Committee (NSC)	Ensures compliance with Nuclear Site Licence Conditions and relevant environmental legislation; endorses safety case changes and regulatory submissions prior to implementation or submission to the regulators.
Permit Condition Owners	Accountable for compliance with assigned permit conditions; conduct regular audits and assurance activities; report findings to NSC [60].
Radioactive Waste Adviser (RWA)	Provides expert advice on radioactive waste management and compliance with regulatory requirements.
Independent Non-Executive Director	Strengthens governance with nuclear industry expertise; sits on Nuclear Waste Services Board to provide independent oversight.
Independent Site Inspector	Conducts inspections across the business without operational responsibilities; reports to Head of Independent Assurance.

4.5 Management of the ESC

The management of the ESC is an application of the IMS principles described in Subsection 4.2. This has been achieved through the use of NWSSOPs/RSPs, notably NWSSOP 40.07.01 [21] (formerly RSP 2.25 [21]), which sets out the governance and

management requirements for ESC development. This subsection explains how these principles have been implemented in practice for development of the 2026 ESC.

Since 2020, due to its importance to the business, the development of the ESC has been managed as a programme called the ESC Development Programme, which is part of the Waste Operations Portfolio. The ESC Development Programme is overseen by the LLWR ESC team, supported by specialist expertise as required. Managing it as a programme has enabled the work to be delivered through a structured application of project management processes with progress tracked and reported against a formal schedule. All of the individual tasks were included in the schedule and progress updates reported monthly. This enabled the ESC Manager to track progress towards submission of the 2026 ESC and take any corrective actions as necessary. There have been several hundred individual tasks undertaken to support development of the 2026 ESC and each one has been monitored and managed by the Project Management team. Programme progress and performance has been reported monthly to the Waste Operations Portfolio Board in addition to our management team.

Current structure of the ESC Development Programme team

The ESC Manager is a formal SQEP role under the IMS, requiring the necessary knowledge and experience to be appointed, Subsection 4.8.1. The appointment of the current ESC Manager was undertaken by our Chief Operating Officer⁶, based on an interview [21]. The ESC Manager also fulfils a role in the corporate RWA arrangements [59] as discussed in Subsection 4.4. The ESC Manager is responsible for the development of the ESC, on behalf of the ESC Owner, the Site and Waste Operations Director. The Head of Repository Site Enhancements acted as the programme Sponsor. ESC team members report to the ESC Manager. Specialist resources supporting the programme work as part of the ESC team and are accountable to the ESC Manager for delivery. The Site Investigation Manager (LLWR) formally manages the Environmental Monitoring and Site Characterisation (EM&SC) team but is also embedded in the ESC team and has a management role for geology and hydrogeology within the ESC.

The ESC Development Programme had a monthly programme board attended by the ESC Manager, the ESC Sponsor, the Chief Technical Officer and Head of Safety Cases. The ESC Programme Board operated to a Terms of Reference [63] with the main scope being to provide strategic direction to the programme.

4.5.1 ESC Project Management Arrangements

RSP 2.25 [21] was introduced as part of the implementation of the 2011 ESC and was first issued in September 2013. NWSSOP 40.07.01 [21] has replaced RSP 2.25 in the current IMS to cover development and application of the LLWR's ESC, SWESC and WAC. The main purpose of NWSSOP 40.07.01 is to ensure that the ESC and SWESC are developed and

⁶ At the time of appointment, the ESC Owner was the NWS COO, since that time the ESC Ownership has transferred to the Site and Waste Operations Director.

applied such that the relevant requirements set out in the Permit are met. The scope of the NWSSOP covers:

- appointment of the ESC Manager;
- development and review;
- effecting changes;
- update of tools and records.

NWSSOP 40.07.01 also defines the responsibilities of the ESC Owner; to ensure the LLWR is designed, operated and closed in accordance with the ESC.

Proportionate approach

The level of detail in the 2026 ESC, and the resources invested in the underpinning work are proportionate to the impacts that might arise from the LLWR. The level of detail is generally greater than that for ESCs and assessments undertaken for many other near-surface waste disposal repositories. The development and planning process for the 2026 ESC was centred on integrating updates to our understanding of the repository site, incorporating feedback from the Environment Agency's review of the 2011 ESC, and addressing key uncertainties identified thereafter [64].

Decisions taken during the development of the ESC that affect environmental safety are recorded in the '*Engineering Design*' [4], '*Optimisation and Site Development Plan*' [9] and '*ESC Implementation*' reports [17]. The reasons for the choices made, the other choices considered and reasons why choices were rejected are also recorded.

ESC internal stakeholder engagement

The development and documenting of the ESC have been led and largely undertaken by the ESC team and its contractors, but with support and input from other teams in the Technical Directorate, such as Engineering, Site Characterisation and Research, Nuclear Safety Case and Waste Management and Inventory. The ESC submission is made on behalf of the LLWR site and as such there has been input and support from a wide range of teams across the business, both to directly support the 2026 ESC submission and the work that underpins it. The ESC Manager held regular progress meetings with each of the teams providing support to the development of the ESC and reported progress to our Executive Team.

The Site and Waste Operations Director, as Duty Holder and ESC Owner, has responsibility for submission of the ESC after taking advice from the NSC and sign-off by the ESC Manager. The NSC (see Subsection 4.4) was responsible for advising the Duty Holder on the:

- appropriateness of the proposed checking, review and assurance;
- Safety Strategy and draft Safety Arguments;
- adequacy of the ESC team's response process to address issues raised by the peer review team;

- the ability of the site to implement the safety case;
- overall acceptability of the dose, risk and safety arguments presented in the safety case, i.e. does the 2026 ESC present an acceptable case for the continued operation of the Site?

An assurance strategy for the 2026 ESC that set out the plans for the checking, review, assurance and governance of the ESC was implemented [65] (see Subsection 4.9.3.1).

During the development of the 2026 ESC, in addition to the assurance strategy mentioned above, the responses to Permit ICs, the ESC Periodic Reviews and the Annual Reviews were all presented to the NSC. This ensured that internal stakeholders were kept informed of the key aspects, and progress during development of the 2026 ESC. In addition, during the final year of the development of the 2026 ESC, the ESC Manager gave verbal progress updates to the quarterly NSC meetings. NWS Board and the ESSC were briefed on the ESC assurance strategy, key outcomes of the 2026 ESC and implications for operations resulting from the 2026 ESC.

The development of the ESC is not undertaken in isolation. It requires close integration with, and alignment to, the processes, controls and activities of a number of teams across NWS to ensure consistency with organisational strategies, engineering design, operations, assurance and regulatory engagement. The ESC therefore describes and integrates the arrangements that govern this work, explaining how they support the safe operation and development of the LLWR. The teams identified in Table 4.3 have defined interfaces with the ESC Development Programme and either contribute directly to, or operate within, the processes and controls described by the ESC.

Table 4.3: NWS teams with defined interfaces to, and integration with, the ESC Development Programme

Teams	Role and Contribution to the ESC Development Programme
Engineering	Engineering activities are integrated and aligned with the plans and assumptions set out in the ESC, consistent with the requirement for the ESC to demonstrate optimisation of LLWR operations and engineering design. The Engineering team provides input to the ESC submission and undertakes formal review of the ' <i>Engineering</i> ' [4] and ' <i>Optimisation and Site Development Plan</i> ' [9] reports.
Waste Operations - Site Projects	Responsible for the delivery of projects at the LLWR. The team implements engineering designs informed by ESC optimisation recommendations and is consulted on key design and operational commitments identified within the ESC.
Environmental Monitoring and Site Characterisation	Provides the environmental monitoring and site characterisation data that underpin ESC assumptions relating to site evolution and environmental performance. The team provides input to the ESC submission and undertakes formal review of the ' <i>Monitoring</i> ' [8] report.
LLWR Site Operations	Responsible for day to day operations at the LLWR and for implementing operational aspects of the ESC, including waste emplacement strategies. The Duly Authorised Person within Site Operations, provides the final compliance check prior to waste emplacement, confirming compliance with all applicable safety case requirements.
Waste Compliance	Responsible for the waste acceptance and compliance process, which is a key component of the ESC. This process implements the WAC, emplacement strategies, and capacity management approach defined within the ESC, and provides assurance that waste consignments comply with applicable safety

Teams	Role and Contribution to the ESC Development Programme
	case requirements. The team also undertakes formal review of the Implementation report.
Waste Inventory	Manages the disposed and future waste inventory that underpins the ESC. Provides input to the ESC submission, including the ' <i>Implementation</i> ' report [17], and is responsible for production of the ' <i>Disposal Facility Inventory</i> ' report [3].
Requirements team	Manages the requirements framework supporting the ESC, including the Disposal System Specification [66]. The team supports transition from the legacy requirements management system.

4.6 Future Management of the LLWR

The ESC is maintained as a 'live' safety case. This means that it is not treated as a static submission produced solely to demonstrate regulatory compliance at a single point in time, but as an active site management tool that is applied, reviewed and updated throughout the life of the facility.

The ESC is implemented through defined operational and management arrangements, including waste acceptance, capacity management, environmental clearance and engineering change control. These arrangements ensure that the assumptions, limits and controls derived from the ESC are applied in day to day decision making and site operations. The ESC therefore provides the basis against which proposed changes to waste disposals, engineering designs, operational practices and management arrangements are assessed.

Maintenance of the ESC as a live safety case is achieved through formal governance and review processes. New information arising from environmental monitoring, operational experience, design development, assessment work or regulatory feedback is systematically evaluated to determine whether it has implications for the safety arguments, assumptions or conclusions of the ESC. Where relevant, such information is incorporated into the ESC in a controlled and auditable manner through established change control, periodic review and document management processes.

This approach ensures that the ESC continues to reflect current site conditions, understanding and regulatory expectations, and that it remains fit for purpose as a basis for both regulatory engagement and the safe management of the LLWR over time.

Subsequent to formal acceptance by the Site and Waste Operations Director, the 2026 ESC will become the official baseline for safety arguments and operational decision-making.

Implementation will occur through our established change control processes, ensuring that any updates to procedures, operational controls, or supporting documentation are managed in a controlled manner.

Updates are anticipated to the WAC, the ECC and the associated capacity management processes to ensure alignment with the updated ESC. As set out in the 2026 ESC '*Implementation*' report [17], a structured programme is being established to update the WAC, the associated waste acceptance process and other relevant operational arrangements, with changes introduced in a planned and phased manner and prioritised where necessary to maintain environmental safety. These updates will be developed in consultation with stakeholders and, in accordance with our Permit, all revisions to the WAC and waste acceptance arrangements will be discussed with the Environment Agency.

Consistent with Subsection 2.5 and our wider management system requirements, any changes to management arrangements or resources that could affect Permit compliance will be raised with the Environment Agency.

Development of the ESC will continue beyond submission of the 2026 ESC to incorporate new information and to reflect changes on the LLWR site, such as capping activities, ensuring that the ESC remains a fit-for-purpose site management tool. As described in Section 6 of the Level 1 '*Main Report*' [1], we will establish a forward work programme to implement and further develop the ESC, taking account of Environment Agency feedback on the 2026 submission. This programme includes revisions to the WAC, waste emplacement strategies and capacity management arrangements, supported by a formal change control process.

In addition to these operational updates, we will continue to maintain and strengthen the technical basis of the ESC, including updating assessments, models and underpinning scientific evidence as new data become available (see also Section 8). This ongoing technical development forms part of the continuous cycle of ESC maintenance and will directly inform the next Major Review.

The forward programme of work and lifecycle framework within which the ESC is maintained as a live safety case are established in the '*Main Report*' [1] (Section 6), with this report describing the supporting management arrangements.

4.7 Management System

Our management arrangements are assessed against the requirements of a competent holder of a Permit under the EPR 2016; they were approved by the Environment Agency in 2007 when LLW Repository Ltd separated from Sellafield Ltd in 2007. At that time, LLW Repository Ltd established its own Quality Management System and governance processes, which were certified to ISO 9001 and formally accepted by the Agency. As previously described in Subsection 1.4, development and maintenance of the ESC is governed within this formally controlled management system that has evolved from the legacy LLW Repository Ltd arrangements and is now being transitioned into the NWS IMS.

Legacy LLW Repository Ltd management system

For many years, the ESC was developed, maintained and governed through the LLW Repository Ltd Management System, as documented in the LLW Repository Ltd Management System Manual (RSM Manual) [67]. This system provided the structured arrangements required under the Site Licence and Permit, covering safety, security, environment, health and quality management functions. It specified the organisational responsibilities and governance structures necessary to maintain oversight of the LLWR as a Nuclear Licensed Site, aligned with the principles of the UK Corporate Governance Code. The LLW Repository Ltd Corporate Governance Manual [68] further established decision-making hierarchies, delegation of authority and the audit trail needed for regulatory accountability.

The 2026 ESC was predominantly developed against the LLW Repository Ltd management system arrangements, predominantly RSP 2.25, [21] which sets out the requirements for managing ESC development activities.

The NWS Integrated Management System (IMS)

Our Integrated Management System, described in detail in Subsection 1.4, and documented in the NWS Integrated Management System Manual [69], provides the overarching framework for the management of all organisational activities.

We have produced management system 'signposting' documents to ensure that legacy LLW Repository Ltd and RWM arrangements continue to be applied correctly while being mapped to the new organisational structure. These documents clarify applicable procedures, define changes in role responsibilities and support the harmonisation of technical governance during transition to the integrated system.

Even though we are transitioning to the NWS IMS, the fundamental procedures and arrangements that govern the ESC and environmental management of the site remain unchanged. RSP 2.25 has been incorporated into the IMS as NWSSOP 40.07.01 [21] and remains a key control document for permit compliance.

4.8 Management of Resources, Competence and Succession planning

4.8.1 Management of Competence within Nuclear Waste Services

We need to ensure that only SQEP perform any roles or tasks that may directly affect nuclear safety, security, emergency arrangements and environmental permit activities [70].

The Organisational Baseline (OB) represents the configuration of a fully capable organisation, encompassing the resources, competencies and structures required to deliver all operational, regulatory and strategic commitments effectively. It is not intended to reflect the minimum staffing or capability necessary for safe operation, nor the reduced arrangements applicable during shutdowns or emergency situations; rather, it represents the arrangements necessary to sustain nuclear safety during normal operations and reasonably foreseeable events [71]. The suite of baseline documents is reviewed monthly and updated

as required. These documents define all key EHSSQ roles and set out our plan for maintaining appointments and ensuring that all required training remains current and valid. Key roles include:

- RWA;
- Duly Authorised Persons (DAP);
- Radiation Protection Advisers (RPA);
- Radiation Protection Supervisors (RPS);
- Intelligent Customers;
- Process Owners.

Operators are specifically assessed to confirm SQEP status [72], ensuring they possess the necessary qualifications and experience for operations and maintenance tasks in compliance with safety case requirements. Individual employees, in conjunction with their line managers, evaluate the competencies required for their current role and identify training needs for future development.

In certain specialist disciplines (e.g. radiation protection or development of the ESC) or to address fluctuating resource requirements, SQEP subcontractors are engaged in accordance with standards and arrangements defined in reference [73] and RSP 8.02 [74]. As a minimum, we maintain sufficient in-house expertise across all relevant technical disciplines to act as an informed and Intelligent Customer for externally sourced technical services. Intelligent Customers understand the safety significance of procured expertise (goods and services) and possess the capability to define and monitor technical standards for external suppliers or contractors [75].

With the formation of NWS, we now have access to Geological Disposal Facility ESC expertise, which provides additional capability and technical depth to support the development, maintenance and review of our ESC and related safety case activities. This integration strengthens our ability to manage complex safety case requirements and ensures alignment with best practice across the organisation.

Changes to key EHSSQ roles, process owners, or Intelligent Customers are controlled, assessed and monitored through the Management of Change process RSP 22.02 [25]. Significant changes are subject to review by the Management Environment, Health and Safety Committee and the Nuclear Safety Committee prior to implementation.

4.8.2 Management of Competence During the Development of the ESC

The ESC Manager is a SQEP role under our management system, formally defined in reference [76]. Appointment to this position is made by the COO⁷ following an assessment of the individual's knowledge, experience and understanding of:

⁷ At the time of appointment, the ESC Owner was the NWS COO; since that time, ESC Ownership has transferred to the Site and Waste Operations Director. Historically, under LLW Repository Ltd arrangements, the

- NWSSOP 40.07.01 (ESC governance);
- WAC;
- regulatory liaison processes;
- activities permitted at NWS;
- development and application of ESCs.

NWSSOP 40.07.01 [21] sets out the responsibilities of the ESC Manager, which include:

- leading the ESC Development Programme and ensuring delivery of work packages;
- overseeing independent peer review and ensuring technical adequacy of ESC deliverables;
- managing change control, including updates to ESC documentation and implementation plans;
- authorising modifications with potential consequences for the performance of the disposal system.

The ESC Manager also contributes to corporate RWA arrangements, supporting compliance with Permit conditions and environmental safety oversight (see Subsection 4.4).

Our staff and contractors provide SQEP resources to the ESC Development Programme as required to meet programme timescales for development and review. The ESC Manager, Technical Integrator⁸ and other members of the ESC team bring extensive experience from UK, overseas and international programmes (including IAEA initiatives) (see Subsection 6.2).

In line with the approach described in Subsection 4.8.1, SQEP ESC subcontractors are engaged in accordance with standards and arrangements defined in reference [73] and RSP 8.02 [74]. Wherever possible, contracted work for ESC development is procured through ESC-specific routes with specialist providers of repository ESC services. As a minimum, we maintain sufficient in-house expertise across all relevant technical disciplines to act as an informed and Intelligent Customer for externally sourced technical services. Intelligent Customers are responsible for ensuring that externally procured technical expertise is provided by SQEP and for defining and monitoring the technical standards applied by external suppliers and contractors [75]. The ESC Manager acts as the Intelligent

Managing Director (MD) held ownership of the ESC and appointed the ESC Manager. With the formation of NWS, the former LLW Repository Ltd MD became the NWS Chief Operating Officer (COO). As part of the management-of-change process, it was formally recognised that the COO role subsumed the MD responsibilities for ESC ownership until these were subsequently reassigned within the new NWS organisational structure.

⁸ The Technical Integrator is responsible for ensuring the technical content and consistency of the ESC. This includes reviewing and signing off every ESC report to confirm alignment with the overall safety case and development programme.

Customer for the ESC, responsible for procuring specialist technical support where in-house resources or expertise are insufficient.

To enhance organisational capability and strengthen the ESC team, additional staff were recruited, including ESC Technical Specialists and Technical Managers.

4.8.3 Future Management and Succession Planning

Relevant competencies must be maintained throughout the lifetime of the facility, including the remainder of the Period of Authorisation after cessation of disposal operations and installation of the repository's closure engineering, in accordance with the Management of Change procedures [25] and as referenced in our current Management Prospectus [47]. It is the responsibility of line managers to ensure that a deputy is identified for all key EHSSQ posts and roles, and that longer-term succession plans are in place [77].

The ESC-related management arrangements will be updated as necessary to reflect ongoing requirements and improvements. The ESC has been developed by a team comprising NWS staff and contractors. The ESC team has a succession plan covering the ESC Intelligent Customer role, which will ensure the smooth transition of ESC management to the ongoing team of NWS staff, who will continue to develop and apply the ESC as a site management tool. In addition, we intend to continue utilising the supply chain to support ongoing ESC development, as external specialists bring international experience and best practice that enhance the quality and robustness of our work.

Knowledge management in ESC planning

Effective knowledge management is essential to the long-term success of the ESC, ensuring continuity, resilience and traceability throughout the repository's lifecycle. Our approach recognises that sustaining capability over time depends on two equally important elements: the people who hold expertise and the systems that capture and preserve it.

We have an established in-house ESC team supported by a succession plan. Contractors working under framework agreements are also required to contribute to this process by training staff and sharing knowledge throughout delivery, reinforcing capability development across the programme.

We have a Retention of Critical Knowledge (RoCK) process. RoCK is a structured approach designed to identify, capture and secure essential knowledge assets, ensuring they remain accessible and usable for the duration of the programme and beyond.

The process operates through two tiers: RoCK Lite, a streamlined method typically completed within one to two weeks for less complex knowledge, and Knowledge Retention and Facilitated Transfer (KRAFT), a comprehensive methodology requiring one to three months for capturing high-value, complex expertise. Both approaches focus on preserving tacit knowledge held by subject matter experts as well as explicit knowledge contained in documents and systems.

For example, when the former Head of Science and Engineering left the organisation, the RoCK process was formally enacted to support the continuity and preservation of expertise

essential to the ESC. In accordance with the knowledge management framework, the process identified key knowledge domains where he had been a principal contributor, particularly his role in developing technical and structural aspects of the ESC in earlier iterations (including the 2011 safety case). These insights were subsequently captured and applied during preparation of the 2026 ESC *'Main Report'*, notably in supporting the integration of Level 2 assessment outputs and refining the overarching safety arguments. Through the controlled capture of this material within the ESC document suite and supporting records, the RoCK process ensured that his contributions remained accessible to the wider programme, mitigating the risk of knowledge loss associated with leadership transition and supporting continuity in the development and delivery of the ESC.

Our systems and tools, including structured document control and legacy indexing, support the systematic management of ESC-related data. Platforms such as our OSHENS system are utilised to record operational events, observations and conditions, feeding trends and lessons learnt into our ESC.

4.9 Review and Learning

4.9.1 Lessons Learnt at Nuclear Waste Services

During the development of the ESC, learning was captured through structured activities designed to identify improvements and inform subsequent phases of work. These activities included systematic experience capture, discussions focused on areas requiring refinement and retrospective reviews that enabled contributions from all disciplines. Collectively, these methods supported the identification of practical improvements that were incorporated into the ongoing development of the ESC.

Learning was also informed by engagement with external organisations. The team participated in inter-industry and cross-sector groups, including the Environment Agency's Requirements Working Group (EARWG) and the Clearance and Exemption Working Group, contributing to shared understanding of regulatory requirements and operational practice. Broader engagement included the Society for Radiological Protection (SRP), safety case and Organisational Experience Feedback (OEF) forums and the Nuclear Industry Liaison Group on Land Quality (NIGLQ). Additional interaction with Environment Agency industry fora, such as the Nuclear Industry Environmental Liaison Group, ensured up-to-date awareness of regulatory developments. The organisation also provided representation on the Environment Agency's RWA approval panel. Participation in the Safety Directors' Forum (SDF) enabled exchange of experience across senior industry groups and supported coordinated consideration of sector-wide issues.

Since integration into NWS, these established learning practices have been incorporated into the organisation's formal management arrangements [78]. The IMS provides the framework through which learning is recorded, reviewed and implemented across programmes, ensuring that insights from project delivery and external engagement are applied consistently.

4.9.2 Lessons Learnt During Production of the 2026 ESC

Building on previous experience

The development of the 2026 ESC has drawn on learning from previous safety case work, related programmes and international experience. Lessons learnt were captured through structured reviews of earlier ESCs, feedback from experienced colleagues and consideration of past exercises. This included evaluation of the 2002 PCSC [79] and the 2011 ESC [80], where formal lessons-learnt activities identified improvements relevant to the scope, structure and methods used in the current ESC [44]. Recommendations from earlier reviews, including those relating to clarity of safety arguments and the treatment of uncertainty, were incorporated into the development process. The ESC also addresses the FIs and Recommendations raised by the Environment Agency, as set out in the Regulatory Requirements report [18], described in further detail previously in Subsection 2.2.3.

Iterative development and integration of feedback

The development of the ESC is inherently iterative. Our management process [21] enables us to incorporate new information and feedback throughout the lifecycle of the ESC. Whenever we receive new information or insights, such as significant changes in monitoring results or repository site data, we assess their implications and integrate them into our development programme where appropriate. We maintain a formal Issues Register (see Subsection 5.2.3) to track specific commitments made within the ESC, including our responses to external reviews, feedback from the independent Peer Review Group and recommendations or observations from the Environment Agency.

This iterative approach ensures that emerging data, regulatory feedback and peer review findings are integrated promptly and effectively.

The impact assessments for the ESC were delivered in two formal phases, each applying the relevant procedures. This structure supported the incorporation of feedback into the second phase, including comments from the Peer Review Group (see Subsection 4.9.3) and the Environment Agency Process by Agreement discussions (see Subsection 2.2.4). It also enabled quality-management inspections of contractors between phases (see Subsection 7.3). Specialist subcontractors with relevant experience were engaged to ensure that assessments reflected current practice and benefited from subject-matter expertise (see Subsection 4.8.1).

Learning from other programmes and international best practice

We have embedded learning from other operators and international programmes throughout the 2026 ESC. As active members of the IAEA Forum on the Safety of Near Surface Disposal and DISPONET, we have hosted workshops, contributed to guidance documents (e.g. Design Considerations for Closure of Near Surface Repositories, currently in preparation) and shared technical expertise. In 2023, we hosted the DISPONET network.

Our cooperation agreements with Andra, ENRESA and ONDRAF have informed our understanding of engineered cap design, constructability and long-term performance. This

external experience has been considered alongside our analyses in developing optimisation decisions, particularly in relation to cap durability and closure engineering. (see Subsection 6.2.18 Learning from Other Facilities) of the '*Optimisation and Site Development Plan*' [9])

Commitment to continuous improvement

Following submission of the 2026 ESC, we will undertake a comprehensive lessons learnt review. This activity is included within the forward programme (see Section 6 in the '*Main Report*' [1]) for the next phase of ESC development and will capture feedback from internal teams, regulators and international peers.

4.9.3 Peer Review

4.9.3.1 Independent Assurance at Nuclear Waste Services

We have an Independent Assurance team whose role is to provide independent, proportionate and risk-based assurance to our Executive and Board against an Environment, Health, Safety and Security scope, as part of an organisation-wide assurance framework. The team develops, maintains and delivers an independent assurance programme, with activities selected on the basis of the EHSS risk they present today and could present in the future. In support of the development of the 2026 ESC submission, an assurance strategy was produced that set out the plans for the checking, review, assurance and governance of the submission [65]. The Independent Assurance team reviewed this strategy and advised the NSC on the checking, review and assurance proposed [60]. The Independent Assurance team then reviewed the overall adherence to the strategy and provided advice to the NSC on the outcome of the review [81]. The review considered the application of checking, review and challenge arrangements during development of the 2026 ESC and how assurance activities and independent feedback had been incorporated.

4.9.3.2 Use of Peer Review During Development of the 2026 ESC

An independent Peer Review Group (PRG) for the ESC was first appointed prior to the delivery of the 2011 ESC. The PRG is there to provide independent review and technical challenge of the programme, reviewing both the adequacy of the overall work programme and individual technical reports.

The PRG in place during development of the 2026 ESC consisted of experts of longstanding experience and international reputation, who are independent of the development of the ESC. The PRG included experts with experience of developing safety cases in other countries. The Chair of the PRG was one of the international members. The standing nature of the PRG means that it had a good working knowledge of the LLWR facility and its role, improving the efficiency and effectiveness of its reviews.

The PRG worked to an agreed set of Terms of Reference [82]. The scope of the PRG's work focused on issues that were:

- important to the environmental risks associated with the repository, its operations and post-closure performance;

- important to the development and evaluation of options that may be available to promote the safe and efficient use of the repository;
- important to the clear presentation of evidence and arguments that must be achieved within the ESC.

The objectives of the PRG were to [82]:

- provide a timely independent review of key technical approaches, arguments, designs, assessments and documents;
- work in such a way that it can be demonstrated to stakeholders that an effective and proportionate process of independent technical review and scrutiny is operating.

The work of the PRG was managed as a 'documented dialogue'. This consisted of face-to-face meetings, workshops and review of documents. Members of the PRG were also observers at meetings or workshops at which key technical topics were discussed. The PRG regularly met the ESC team for organisational and technical updates. The Environment Agency also requested meetings with the PRG at points in the development of the 2026 ESC.

When reviewing individual reports, the PRG provided written comments on the documents. These were reviewed by the ESC team and account taken of PRG views. The ESC team formally responded to the PRG comments to indicate how these comments had been considered.

Since the 2011 ESC, the PRG has maintained involvement in the review of a broad range of work; mainly focused on the ESC but also on aspects of the engineering work. During the early phase of the ESC development the PRG reviewed key aspects such as near field, coastal processes and the Engineering Performance Assessment. During Phases 5 and 6 (March 2015 to March 2021) the PRG reviewed approximately 89 documents and attended 16 meetings. The ESC team responded to all the comments and the PRG produced a summary of their reviews [83].

During preparation of the main suite of 2026 ESC reports, the Level 1 and most of the Level 2 reports were reviewed by the PRG. We did not ask the PRG to review Level 2 reports that were focused on our processes, history or where significant PRG review had already been undertaken on the developing approach⁹. For each review, the PRG submitted detailed written comments and these were then formally addressed by report authors and taken into account in the development of the documentation.

As described in Subsection 4.5, the NSC advises the duty holder on the suitability of the ESC submission. The chair and one of the other members of the PRG attended the NSC meeting where the final ESC submission was endorsed to present their findings to the duty holder and provide their overall advice from the PRG on the submission. As part of the 2026

⁹ These were the Level 2 reports that were not reviewed by the PRG '*Management and Dialogue*' (this report), '*Site History and Description*' [2] and '*Engineering Performance Assessment*' [12].

ESC documentation suite, the PRG has published a review of the 2026 ESC submission [84].

The PRG report describes the process the PRG followed, summarises the review work undertaken and gives the review findings. The PRG recognised the work undertaken to address both the points raised by the Environment Agency in relation to their review of the 2011 ESC and the subsequent PRG comments. The overall conclusion was that much of the work was of a high technical standard and well-directed at the specific issues. The main comments raised by the PRG related to the expected longevity of the cap, the approach to safety functions, modelling strategy complexity and the relationship to landfill best practice.

The PRG concluded that:

'through the ESC, NWS demonstrates that the facility is presently safe and that its impact on the environment in the future will comply with regulatory guidance, even when considering very hypothetical situations. NWS has implemented a robust organisation able to manage the facility in accordance with the ESC as a basis for the safe and optimised management of the LLWR.'

We have produced a companion report in response to the PRG report [85], which outlines how we intend to address the technical points raised by the PRG in our future programme.

4.9.3.3 Chief of Disposal Safety Review

In addition to the PRG review (Subsection 4.9.3.2), our Chief of Disposal Safety also undertook a review of the ESC documentation. Although the Chief of Disposal Safety is part of NWS, they were not involved in the development of LLWR's ESC and operated under agreed Terms of Reference [86].

5 Planning and Control of Work

We have management arrangements in place to plan and control the work involved in complying with our Permit and supporting and developing the ESC. The following subsections demonstrate that we have met the requirements relating to:

- control of work to demonstrate compliance with the current Permit to dispose of radioactive waste (Subsection 5.1);
- control of work to support the ESC (Subsection 5.2);
- change control (Subsection 5.3);
- mitigation measures (Subsection 5.4).

5.1 Control of Work to Demonstrate Compliance with the Current Environmental Permit

Our IMS contains the procedures and management arrangements that underpin our approach to implementing, maintaining and assuring compliance with all permits, consents and licences. These arrangements are supported by compliance matrices and the wider IMS, covering change control, records, people, asset management and governance processes. Further detail on how these arrangements are applied in practice is provided in Section 2 on Regulatory Interaction, Section 8 on the Provision of Information and Section 9 on Documentation and Record Keeping.

As described in Subsection 4.4, we have a formal process, defined in NWSSOP 02.01.02 [58] (formerly RSP 02.01 [59]), for managing compliance with the Permit. Formal Permit Condition Owners have been appointed to provide senior oversight of compliance with specific Permit conditions [58]. As part of this role, they carry out periodic checks to confirm that the supporting arrangements are current, suitable and being applied as intended. The results of these checks are reported to the NSC as discussed in Subsection 4.4. We also operate Corporate RWA arrangement to maintain compliance with permit requirements. These arrangements are integrated into established organisational roles so that regulatory considerations are incorporated into routine decision-making.

For the Permit, the arrangements also include the use of an ECC to support ESC implementation on site [33] (see Subsection 2.2.1). The ECC sets out the relevant ESC and Permit compliance requirements, including the Environmental Equipment (EE) that performs defined Environmental Functions. The ECC uses the same format as Nuclear Safety Case clearance certificates, which supports consistent interpretation across both areas.

5.1.1 Waste Acceptance

Compliance with requirements for waste disposal is ensured through the application of WAC [87] and the waste acceptance process operated for the LLWR site [88]. The WAC define the conditions that must be met for waste to be acceptable for disposal at LLWR and

the associated obligations on consignors. The WAC form part of an integrated waste acceptance process that also includes the following elements: waste forecasting; waste characterisation; waste assurance; waste enquiry; waste consignment; and waste receipt. Through this process, we ensure that:

- wastes are only accepted if they are compliant with the WAC or covered by an agreed variation;
- wastes are appropriately characterised in accordance with all required aspects of the WAC;
- the consignor has considered that Best Available Techniques (BAT) have been applied in the management of the waste and in assessing the need for disposal at LLWR;
- wastes are managed and controlled within an approved and audited management system.

Where proposed waste consignments do not meet the published WAC, consignors may submit a Consignment Variation Form (WCV) [89]. These are considered on a case-by-case basis, assessed by the Waste Acceptance Team and relevant subject matter experts, and the reasons for acceptance or rejection documented [90]. This assessment includes checks for compliance with the ECC [33] and the ESC, as well as consideration of implications for operational practices. Consultation with relevant subject matter experts is undertaken, including the ESC Manager, who must approve or reject all WCVs. Any additional constraints required on the consignor are specified as part of this process.

Our capacity management system governs the derivation, allocation and management of the radiological and non-radiological capacities that constrain waste disposal at the LLWR [91].

Current radiological capacity limits are derived from ESC assessment models covering groundwater transport, coastal erosion, gaseous pathways and impacts during the Period of Authorisation. A sum of fractions (SoF) methodology is then applied. For each disposal, the ratio of its activity to the corresponding capacity is calculated for all relevant radionuclides and pathways. Disposal is acceptable only if each of the cumulative SoF for the LLWR remains below unity.

Non-radiological capacities limit the quantities of contaminants whose environmental impacts could breach groundwater quality requirements. These limits are derived from the groundwater assessment.

Waste consignments are subject to receipt monitoring and associated documentation checks prior to emplacement, undertaken by the Duly Authorised Person within the Site Operations team [92]. In addition to on-site verification, we operate a formal assurance programme that includes auditing of customers and service providers [93].

The requirements for record keeping of radioactive waste consigned to and disposed at LLWR are fully documented, and records of disposals and capacity usage are reported

annually to the Environment Agency via the LLWR ESC Annual Review [94] (see also Section 8).

Waste acceptance requirements and associated process updates are detailed in Subsection 6.3 of the '*Implementation*' report [17]. This subsection covers the requirements for waste control, updates to the WAC and WAP and how these link to the ECC and change management processes. Management of the WAC is further discussed in Subsection 5.2.4.

5.1.2 Monitoring of Discharges and the Environment

Environmental monitoring on the LLWR site and in the surrounding area is undertaken against a defined programme. The programme covers leachate, groundwater, surface water and gas but also other aspects such as container and engineered barrier evolution as well as reassurance monitoring of the surrounding area. Analysis of hazardous and non-hazardous pollutants as well as radionuclides is undertaken. Environment Agency reporting requirements are documented in the CEAR [57]. The ECC [33] details the environmental equipment and associated maintenance requirements. NWSSOP 41.02.01 [95] (formerly RSP 2.26 [96]) provides a formal framework for the management and development of the environmental monitoring programme as delivered by the EM&SC team.

The EM&SC team specifies, reviews, undertakes and reports on the formal monitoring programme, which is designed to provide all information necessary to support the ESC and site operations. This programme is subject to two key reporting mechanisms.

- **Annual Monitoring Report:** This report provides a retrospective summary of monitoring activities and results from the previous year, including details of gaseous and aqueous discharge monitoring locations and frequencies [97].
- **Annual Programme Review:** This review assesses the adequacy of the monitoring programme and identifies any proposed changes. The Environment Agency is notified of the outcome of this review and informed of any changes to the programme.

The EM&SC team are responsible for producing retrospective dose assessment and also supports projects, such as the repository capping programme, by providing advice and guidance on monitoring arrangements.

The EHSSQ team are responsible for monitoring and assessing radioactive discharges from LLWR and levels of radioactivity in the environment [59]. Any breach of Permit conditions or any environmental incident categorised as a significant event (as defined in Subsection 5.3) is also notified to the Environment Agency.

5.1.3 Construction and Closure of the Facility

The specifications for construction projects are developed to take into account all safety requirements and result from a detailed process of requirement specification and optimisation. Construction Quality Assurance (CQA), is applied as best practice in all

relevant aspects of engineering at the LLWR [4]; this is considered of particular importance for the long-term performance of the facility.

The Permit includes a pre-operational measure for future development related to disposal of radioactive waste in any new vault. This measure requires us to provide a written report to the Environment Agency that shall:

- a) provide assurance that the vault has been constructed in accordance with the ESC.
- b) include CQA validation.

As stated in the Permit, this report will need to be agreed by the Environment Agency before disposal takes place.

5.2 Control of Work to Support the ESC

As described in Subsection 4.5, NWSSOP 40.07.01 [21] sets out the governance and management requirements for the control of work in support of the development and application of the ESC. It outlines the steps required to ensure compliance with relevant Permit conditions [28]. In addition, NWSSOP 40.07.01 covers the requirements to produce and maintain a SWESC and associated WMP.

NWSSOP 40.07.01 [21] includes the requirement to produce and submit periodic reviews of the ESC to the Environment Agency. The purpose of these reviews is to provide assurance that the repository remains consistent with the ESC, within its safety envelope and to provide a record of the documents added to the ESC baseline. These updates are presented to the NSC [60] and comprise Annual [94], Periodic [98] and Major Reviews.

The objective of the Annual Review is to provide information on disposals over the previous year, record significant new information and changes at the site and record changes to the ESC (including a list of documents issued in period that have been added to the ESC document baseline). The ESC Annual Review also includes our response to Permit Condition 4.2.2 and provides the information requested in Proforma 2 in the CEAR [57].

The Periodic Review is intended to assess the adequacy of the ESC up to the next Major Review, taking account of significant activities in that period. The Periodic Review also includes the effect of cumulative changes that have occurred since the Major Review of the ESC.

Given the complex, interrelated nature of the ESC, updates and additions to the document baseline in between major reviews are assessed for their implications for the ESC, but do not result in a fully consolidated re-baselined document set.

The Major Review comprises a comprehensive reassessment of the ESC and provides a consolidated, internally consistent baseline that brings together all updates made since the previous Major Review. Between major reviews, the ESC is managed as a live safety case, with changes implemented through controlled Annual or Periodic Reviews and, where

necessary, interim updates that ensure the safety arguments, assumptions, models and controls remain current. Where a significant change, uncertainty or emerging issue is identified through these reviews, or through the assessment of new information in accordance with established ESC control arrangements (NWSSOP 40.07.01 [21, 99]), a major review may be brought forward to ensure that the ESC continues to provide an appropriate basis for the safe operation and development of the LLWR.

An example of the assessment of new information process would be the issue of an updated United Kingdom Radioactive Waste Inventory (UKRWI) that is produced every three years. The Reference Disposal Inventory used in the ESC is based on the UKRWI, so an update to the UKRWI could have implications for the future inventory planned for disposal at the LLWR. As soon as new information on the UKRWI was issued we would review the data, identify any changes and assess any implications for the ESC. This assessment process would compare the new inventory with the inventory used at the latest Major Review. It would include a judgement or calculation-based assessment of the significance of the changes, in terms of doses and risks and also any implications for capacity, rather than re-working all of the aspects of the ESC that use inventory information. If changes were required as a result of the new information, these would be implemented in line with the formal change management arrangements. The assessment of the new information would be reported in the subsequent Annual Review.

Alongside any other new information, the updated inventory information would be considered in the next Periodic Review and any cumulative impacts assessed. If any individual assessment of new information, or the accumulation of new information as recorded in the Periodic Review has sufficiently significant implications, as described above, we may bring forward the next Major Review of the ESC.

Within the Major Review, the new inventory described in this example would then be used throughout, including in design optimisation, near-field modelling and as a basis for assessment calculations.

5.2.1 Appointment of Key Roles

The management of the ESC is described in Subsection 4.5 which covers the appointment of a suitably qualified ESC Manager. The other key role is the WAC Interpretive Authority (IA), the appointment of which is described in Subsection 5.2.4. The ESC Manager is responsible for the development of the ESC, on behalf of the ESC Owner, the Site and Waste Operations Director. The IA is responsible for providing clear direction regarding how the relevant WAC criteria should be interpreted. These roles are critical for overseeing the ESC and WAC development and ensuring regulatory compliance.

5.2.2 Development and Review of the ESC

Process steps in NWSSOP 40.07.01 [21] ensure the ESC remains current and technically robust:

Development Programme: Iterative planning based on monitoring data, regulatory feedback and peer reviews.

Optimisation and Design: Ensures proposals are optimised for radiological safety, guided by BAT principles.

Assessment of New Information: New information that may have implications for the assumptions, conclusions, or uncertainties within the ESC, such as significant changes in monitoring results, is assessed and documented using form NWSF 40.07.01_001 [99]. This form is specifically intended for cases where immediate action is required and waiting for the next ESC Annual Review would be inappropriate.

Reviews: The reviews are to provide assurance that the repository remains consistent with the ESC and within its safety envelope.

Independent Peer Review: All aspects of the development and application of the ESC need to be independently peer reviewed, Subsection 4.9.3.

As part of the ESC process [21], members of the ESC team are appointed as Task Managers by the ESC Manager for specific ESC activities. Their responsibilities include [21]:

- preparing specifications for work and assessing tenders;
- acting as the primary point of contact for contractors once engaged;
- providing technical direction and information as required;
- monitoring technical and financial progress and ensuring timely delivery of draft and final reports to meet project schedules.

All reports and memoranda are reviewed by the appointed Task Manager, the ESC Technical Integrator and ESC Manager before being issued with an ESC front sheet.

In addition to NWSSOP 40.07.01 [21] an ESC-specific data management procedure has been produced which is used to ensure consistency of data across the ESC assessment calculations and key supporting calculations [100], see Subsection 7.2. We have also created an Assessments Manual [101] that provides guidance on key processes for conducting safety assessments for the ESC.

Both the data management procedure and the Assessments Manual are discussed further in Subsection 7.2.

5.2.3 Update of Tools and Records

In accordance with NWSSOP 40.07.01 [21], there is a formal requirement to maintain two key trackers:

- **Register of Significant Uncertainties:** A register of significant uncertainties that may affect the ESC [102]. The register contains the remaining biases and uncertainties we deem to be most significant. For each identified bias or uncertainty,

the register records the name, description, evaluation and how it is treated in the 2026 ESC (or is to be managed subsequently).

- **Issues Register:** This records regulatory actions, peer review outcomes, commitments and changes or enhancements that need to be considered in future work [103]. The Issues Register includes action holders and is subject to a documented quarterly review by the ESC Manager and designated team members.

Records pertaining to the ESC must be sufficient to document decision making and allow analyses and calculations to be repeated. This requirement is supported by a company retention schedule, which has been agreed with the Environment Agency and is reflected in NWSSOP 40.07.01 [21]. The retention schedule ensures that we manage our information and retain the records that are needed to be preserved for the long-term (see Subsection 9.1.1).

5.2.4 Waste Acceptance Criteria (WAC) Management

The WAC IA is a formal SQEP role under the IMS, requiring the necessary knowledge and experience to be appointed. The IA role was introduced after submission of the 2011 ESC and was formally established in August 2019. The appointment of the current IA was undertaken by our Chief Operating Officer¹⁰, based on an interview. The IA is responsible for providing clear direction regarding how the relevant WAC should be interpreted and confirming that a waste consignment is safe for disposal at the LLWR prior to acceptance. The IA is also responsible for producing, approving and publishing the WAC, which set out the acceptance requirements for waste disposal at the repository.

Potential changes or updates to the WAC are collated and reviewed through the Disposal WAC Issues and Improvements Register (RSIS 02.25_005).

The IA ensures that any approved changes are incorporated into the published WAC, controlled via a formal implementation plan.

5.3 Change Control

In addition to the change control processes described earlier in this report, to support any changes to the management system, personnel or processes, we have written change control procedures to ensure that the requirements for safety are considered during operations at the LLWR.

5.3.1 Control of Changes to Buildings, Plant, Operations and Processes

In compliance with Nuclear Site Licence Condition 22, relating to modification or experiment on existing plant, change control procedures to ensure safety requirements are considered during operations at the LLWR are described in RSP 1.27 [104]. Modifications are defined as

¹⁰ At the time of appointment, the ESC Owner was our COO, since that time the ESC Ownership has transferred to the Site and Waste Operations Director.

any alteration to buildings, plant, operations, processes, or safety case documentation; including replacements, refurbishments, repairs and design changes during construction.

Plant Modification Proposals (PMPs) provide a structured, stepwise methodology for managing changes to plant, buildings, systems and processes [105]. Modifications are categorised based on their potential safety and environmental impact, including to the ESC, recognising that some PMPs have no ESC implications. Before any temporary or permanent modification is made, an assessment is undertaken to evaluate its effect on conventional, environmental, radiological and nuclear safety and environmental performance, specifically considering whether ESC assumptions may be affected. The categorisation of the modification must be agreed by appropriate personnel, including the ESC Manager for PMPs that may affect the ESC, authorised by the relevant authority, and considered by the LLWR Management of Environmental Health & Safety Committee (MEHSC).

5.4 Protection and Mitigation of Unplanned Events

We have arrangements in place to identify and mitigate potential hazards and events; hazards are identified and managed via the structured Hazard and Operability Study (HAZOP) process and external-hazard assessments (including flooding). Such events are also considered in our design. When events occur, we sentence reports in our reporting system OSHENS, convene a Learning and Action Review to agree corrective actions, implement and track them to closure and, where relevant, assess and update ESC-related procedures.

5.4.1 Unplanned and Disruptive Events

The Operational (or Nuclear) Safety Case is a core component of the safe operation of the LLWR site. Its primary purpose is to identify, evaluate and control the hazards associated with construction, waste emplacement, routine activities and maintenance, ensuring that the facility operates safely. Through this operational focus, the Operational Safety Case provides assurance that day-to-day activities are undertaken within defined limits and conditions, and that appropriate engineering, administrative and procedural controls are in place to protect workers, the public and the environment. Operational change control processes are implemented as described in Subsection 5.3.1.

While primarily operational in focus, the Operational Safety Case also provides an important supporting function within the ESC. Operational controls (such as engineered features, waste handling arrangements, infrastructure design and maintenance practices) directly support the validity of key ESC assumptions. By demonstrating that operational hazards are effectively mitigated, the Operational Safety Case helps ensure that the long-term performance of the engineered system is not compromised by activities undertaken during the operational phase.

Our engineering design (see Subsection 2.5.4 of reference [4] for further discussions of disruptive events) accounts for extreme events, such as:

- flooding and extreme rainfall events;
- seismic events;
- tsunamis.

These events may occur during operations or in the longer term but analysis demonstrates the design is secure against such events. We have not identified any passive engineering controls or related designs with the potential to offer significant protection over the long term against disruption of the LLWR by sea-level rise and coastal erosion.

Climate change considerations are integrated into the ESC through assessments of three scenarios that encompass the broad expectation for evolution of the natural environment in terms of future greenhouse gas emissions, and associated impacts on climate and sea-level (see Subsection 2.9 in reference [14] and Subsection 4.1.4 in reference [15]).

5.4.2 Event Assessment and Notification

Any 'off normal' events are recorded in our OSHENS system. These events or Learning Reports are raised primarily to recognise the safety implications, or trending to ensure that any corrective actions are put in place. Learning Reports and events are assessed against defined categories, with the environmental category covering implications to the ESC [106].

Events assessed as having no ESC significance are recorded and addressed through internal review processes. Where an event has potential implications for the ESC, it is escalated for further evaluation (see Subsection 5.2.2) and, where appropriate, notified to the Environment Agency.

6 Application of Sound Science and Good Engineering Practice

The following subsections demonstrate how we meet the requirements relating to the application of sound science and good engineering practice, including:

- good engineering practice (Subsection 6.1), inclusion of passive and active environmental safety measures (Subsection 6.1.2) and use of robust technology;
- use of sound science (Subsection 6.2).

We continue to place a strong emphasis on ensuring that all work supporting the ESC is grounded in sound science, good engineering practice and the highest standards of professional competence. Our activities are delivered by SQEP across scientific, engineering, operational and assurance disciplines, ensuring that evidence, judgement and decision-making are robust, transparent and defensible.

A key feature of our approach is the rigour with which we check, verify, challenge and undertake our technical work (see Subsection 7.3). Quality assurance, internal peer review, independent review and structured learning processes ensure that all scientific and engineering inputs meet the expectations of the regulators and maintain the integrity of the ESC.

We also place strong value on international learning and best practice, drawing on recognised standards, global research programmes, international waste management experience and cross-industry engagement. This enables us to maintain awareness of scientific developments inside and outside the UK, ensuring that emerging knowledge, technologies and lessons learnt are appropriately reflected in our programme. Where gaps in understanding arise, we commit to undertaking timely scientific investigations to address them.

6.1 Good Engineering Practice

Good engineering practice within the ESC is delivered through an engineering management framework that maintains alignment between design intent, safety case requirements and the as-built facility. This framework is defined in the *'Engineering Design'* report [4], which sets out the governing arrangements for design control, verification, construction assurance and change management. These arrangements form the organisational basis for the development, review and assurance of engineering decisions.

A Requirements Management System (RMS) provides a structured framework for capturing, allocating and managing requirements, and for supporting verification and validation activities as engineering designs progress through development, construction and assurance. Our RMS is used as part of the ESC, to demonstrate how optimisation outcomes and design decisions are captured, maintained and updated.

Our governing procedure for requirements management across NWS is described within NWSSOP 36.02 '*Requirements Management Procedure*' [107], which defines requirements management as a lifecycle activity covering identification, documentation, maintenance, communication, traceability, tracking, verification and validation of requirements.

Our RMS employs IBM Engineering Requirements Management DOORS® Next Generation (NG) [108] as the preferred tool for capturing requirements and maintaining traceability, with a controlled Requirements Management Workbook used where DOORS NG is not applied, to ensure an auditable approach.

The RMS records LLWR requirements in a hierarchical structure, from external drivers through to detailed specifications, as described in Subsection 3.2 of the '*Implementation*' Report [17].

Requirements are derived from sources such as the ESC, regulatory obligations and relevant engineering standards, and are captured, organised and controlled through a defined lifecycle. This lifecycle covers derivation and allocation of requirements and supports verification and validation as engineering activities progress. It provides traceability from high-level safety requirements through to detailed design specifications, ensuring that requirements governing engineered barriers, operational controls and long-term performance remain visible and capable of being tested as designs are developed and implemented. Verification and validation activities are planned at key stages, including design review, CQA and post-construction validation, with deviations managed through formal change control. Full lifecycle processes are described in the '*Implementation*' report [17].

Our management system includes processes and procedures for engineering design, which incorporate the findings of reviews of good practice at other sites in the UK and overseas. We apply the following processes, which are cognisant of the relevant British, European and international standards:

- identifying suitably trained, qualified and competent staff for each role (as described in Subsection 4.7);
- basing major decisions on a sound process of optimisation that utilises appropriate information and experts [9];
- the use of CQA procedures [4];
- the independent checking and approval of engineering designs by a chartered engineer;
- post-construction design validation.

Examples of our use of good engineering practice can be found in the '*Engineering Design*' [4] and '*Optimisation and Site Development Plan*' [9] reports.

6.1.1 Role of the Requirements Management System in Good Engineering Practice

As set out in the *'Implementation'* report [17], the RMS provides the traceability that underpins engineering assurance. Design outputs, optimisation studies and supporting analyses are subject to verification against defined requirements as part of progressive engineering assurance. The *'Engineering Design'* report [4] emphasises the intended role of the RMS, noting that *'monitoring, verification and validation of designs or optimisation work is undertaken against the DSS requirements as part of the RMS'*. The RMS aligns with recognised systems engineering principles, including ISO 15288 [109], the international standard for systems engineering, ensuring consistent requirements capture, traceability, configuration control and lifecycle management.

By maintaining a configuration-controlled requirements baseline and linking each design output to the safety functions and assumptions derived from the ESC, the RMS enables the Design Authority to manage change in a transparent and auditable manner. This supports alignment between design decisions, construction activities and post-construction validation with the safety case and provides confidence that the as-built system will demonstrably conform to the requirements that underpin the safety strategy as assurance activities are completed.

6.1.2 Inclusion of Passive and Active Safety Measures

Passive and active safety measures are used during the operational and permitted period of the site; only passive measures remain after withdrawal of the Permit. The Environmental Safety Strategy [1] places emphasis on the long-term role of passive measures.

Examples include:

- the secant pile wall along the eastern side of Vault 9, designed to provide structural support [4];
- the basal liners of Vaults 8 and 9 provide containment for any leachate generated and prevent the release of leachate into the ground during the operational period;
- an active leachate management system for the trenches and vaults during operations and after disposals for as long as required [4];
- a cut-off wall to limit lateral water inflow and reduce potential for contaminant migration to shallow groundwater.

The *'Engineering Performance Assessment'* report [12] describes how degradation of engineered measures is parameterised and assessed. These assessments are supported by expert elicitation and analysis of international practice. For example, the different processes that could lead to degradation of the cap layers, affecting performance, have been systematically considered in detail. With good construction management and CQA, the cap is expected to provide an effective barrier for a prolonged period [110].

6.2 Sound Science: Ensuring Rigour and Best Practice

Our approach to sound science is founded on three principles: the use of SQEP; the application of structured and transparent review processes; and the systematic integration of national and international best practice.

Qualified people

Scientific and technical work supporting the ESC is delivered by individuals with the appropriate qualifications, experience and sector knowledge to make sound professional judgements. The in-house team is supplemented, where beneficial, by specialist consultants who provide additional expertise in areas requiring deeper technical insight. This ensures that all scientific judgements, methodological choices and interpretations of evidence are made by those with the competence to do so, as outlined in Subsection 4.8.

The strength of our scientific conclusions derives from this deliberate matching of tasks to appropriately qualified personnel. Where particular issues require deep specialist knowledge (such as geochemistry, engineering performance or environmental modelling) we draw on experts who select, justify and apply suitable tools and methods.

Internal and external review

A structured, multi-layered review process ensures that all scientific outputs are subjected to appropriate scrutiny. Internally, NWSSOP 40.07.01 [21] sets out the requirements for checking. Subsection 7.3 discusses checking of ESC assessment models, including quality audits. Externally, independent technical reviews, such as the PRG (see Subsection 4.9.3), focus on areas where key assumptions or changes could materially affect the ESC.

Drawing on best practice

Our scientific approach is informed by learning from national and international programmes and by maintaining awareness of developments in the wider field. As described in Subsection 4.9.2 we have embedded learning from other operators and international programmes throughout the 2026 ESC.

7 Quality Management

This section describes our arrangements for quality management, auditing and ESC-specific approaches to data and calculation checking. As described in Subsection 1.4, the majority of the work developed to support the 2026 ESC was undertaken in accordance with the LLW Repository Ltd management system. A new NWS IMS has been developed and is being populated. Subsection 4.2 of this report provides a broader overview of the IMS and its governance, while Subsection 4.2.1 summarises the arrangements for certification of the system. The Quality Management arrangements described here set out how assurance has been established for the calculations and assessments that support the 2026 ESC.

7.1 Internal and External Audit of Quality Management Arrangements

The IMS under which ESC activities are managed is certified to ISO 9001 [22] (Quality Management), ISO 14001 [23] (Environmental Management) and ISO 45001 [24] (Occupational Health and Safety). These certifications require us to maintain an active programme of internal audit covering all relevant processes, including those associated with ESC development, document control, data management and model assurance.

External audit is provided by Lloyd's Register Quality Assurance (LRQA) [53], the certification body appointed by us. LRQA evaluates the IMS against the requirements of the three ISO standards. Surveillance audits are undertaken every six months to confirm the continuing application of the standards, and a full recertification audit is carried out on a three-year cycle.

In addition to this independent certification, the Environment Agency and the ONR conduct their own audits of relevant elements of the management system, including processes governing assessment modelling, record-keeping and control of technical information.

7.2 Data Management, Traceability and Provenance

We have a formal ESC data management system that ensures that consistent data are used in ESC assessments and other supporting calculations. The data management system is implemented through the ESC Data Management Procedure [100], which is part of our IMS.

The purpose of the data management system and the data management procedure is to ensure consistent data usage across multiple calculations. Accordingly, the procedure applies, strictly, to data that are used in more than one assessment or key supporting calculation. The procedure also applies to data that are generated as output from one assessment calculation that are intended for use in another calculation. Where data have only been used in one calculation, inclusion within the data management system may not be necessary; in such cases, the data, data sources and relevant justification are documented in the report associated with the calculation.

Data that are subject to the procedure are filed within the data management system in Data Management Forms (DMFs). The DMF template requires that supporting information is provided alongside any given parameter. The information fields relate to a qualitative or quantitative discussion of the uncertainty associated with the parameter; a justification to show that the data are appropriate for use in the ESC; a description of the provenance of the information, including references to source material; and a judgement of the quality of the data.

DMFs are filed in the data management system according to the technical topic of the information therein. The relevant technical areas are:

- radiological parameters;
- engineering design parameters;
- inventory;
- near-field parameters;
- monitoring parameters;
- biosphere parameters;
- geosphere parameters.

Each technical area is assigned a Technical Data Manager. The Technical Data Managers, in consultation with the ESC Data Manager, are responsible for ensuring that their respective DMFs are authored and checked by suitable individuals and the procedure sets out our expectations for the checking process. The Technical Data Managers approve the DMFs for transmission to the ESC Data Manager only once they are satisfied that the data are appropriate for use in the ESC.

The ESC Data Manager is ultimately responsible for ensuring that consistent and appropriate data are used in ESC assessments and key supporting calculations. A DMF is only authorised for use after it has been approved by the ESC Data Manager (although, provision is made for interim data to be used in 'draft' calculations prior to this approval being obtained).

Each assessment included a data review activity in which assessment teams systematically identified the data required to support the assessment and the likely source of that data. The data review outputs were reviewed by the ESC Data Manager.

Approved DMFs are stored in a central database with auditable version control. DMFs are distributed to data users by a single individual, the ESC Data Controller, who is solely responsible for the control and management of the data management system.

The procedure also lays out how inconsistencies and errors in data are handled.

The individuals responsible for the roles in the data management procedure mentioned previously have remained the same throughout the course of the ESC development

programme. This has fostered a deep and thorough understanding of the data audit trail and equipping those individuals for their role in ensuring consistency.

The data management system also addresses data that are required to support ESC calculations but are not ESC-owned. For example, environmental monitoring data, engineering design information and inventory data. These external datasets are generated under their own formal IMS-governed quality arrangements, including environmental monitoring QA procedures [111] and engineering design [112], but are filed in the ESC data management system in DMFs. Once filed in the data management system, the data are subject to the ESC procedure insofar as we require the same supporting information to be provided alongside the parameters, processes for managing errors and inconsistencies are applied in the same way, and rigorous governance is applied to any form before it is authorised for use in ESC calculations.

We produced an Assessments Manual [101], to support the development of the 2026 ESC, which is an IMS-controlled document, forming part of the formal management system arrangements governing ESC assessment activities. The manual offers guidance on the acquisition, review and use of data in ESC assessment models. This includes guidance on the substantiation of data, the identification and characterisation of uncertainties and ensuring that the evidence supporting parameter choices, including appropriate use of assumptions, is well-documented in either assessment reports or data management forms. Some of the data uncertainties are characterised in terms of probability distribution functions. These are often obtained, via elicitation by consultation with experts. To ensure a rigorous and consistent approach to data elicitation is adopted we have also produced an Elicitation Manual [113] to support facilitators of such meetings. The Elicitation Manual captures learning from previous elicitations for the LLWR, the UK Geological Disposal Facility (GDF) programme, and good practice guidance.

Together, our data management procedure and the guidance provided in our Assessments Manual [101] and Elicitation Manual [113] ensure that data that are used in ESC assessments and supporting calculations are consistent, appropriate, traceable and founded on good science.

7.3 Quality Assurance Applied to ESC Calculations

Our approach to quality assurance of assessments follows the principles set out in the Assessments Manual [101]. The Assessments Manual provides guidance on the key processes that are relevant when carrying out safety assessments. Adherence to the Assessments Manual ensures a consistent approach to the different assessments carried out in support of the ESC, often by different teams of people.

We have required that contractors undertaking assessments work in accordance with the Assessments Manual. We have required them to produce quality plans [114]. The ESC team and the Quality Assurance team reviewed and approved these plans and we have audited contractors for evidence that they are following the quality plan (see Subsection 4.9.2).

The Assessments Manual identifies review, checking, verification and validation as important steps in the process of assurance, and sets out our expectations for how these steps should be fulfilled. The steps are summarised in this subsection.

Review

Review is the process of independently appraising part or all of an assessment to determine whether it meets the desired aims and identifying any necessary changes or amendments. Reviews are undertaken by one or more individuals who are suitably qualified and experienced and who did not undertake the work themselves.

All data are reviewed to confirm their suitability for their intended use, the sufficiency of substantiation and the clarity of the scope for application and origin of the data. Calculations are reviewed to ensure that the software and parameter values have been implemented as intended. Review of reports includes considering whether the scope and objectives are defined and met, the technical content is logically set out, the work is fully documented and is factually correct, results are clearly analysed, the conclusions reflect the outcome of the work and it is supported by appropriate references.

Checking

The term 'checking' describes the activities to determine the correctness of information, calculations and results. It is more specific and detailed than 'review'. Checking is undertaken by one or more individuals who are suitably qualified and experienced and who did not undertake the work themselves.

The process of checking is described in detail in the Assessments Manual. It includes checking of models to ensure that:

- the conceptual description of the system being simulated (the 'conceptual model') adequately describes it for the purpose of the modelling, identifying features of the system, relevant processes, time dependence, interactions between processes and any boundary conditions that may be required;
- the features and processes included in the numerical model are appropriate for the purpose of representing the conceptual model in the context of the assessment, and there is a reasonable justification for any that are excluded;
- the numerical representation of features and processes is appropriate to the scope of the model and consistent with other ESC models of similar scope;
- equations are scientifically correct with balanced units and correspond to the documented specification.

Calculations are checked to ensure that parameter values are correct and consistent with the data management system where appropriate, correctly transcribed into model input files and are clearly documented. Results are also checked to ensure that they are logical and understandable in the context of the understanding of the system being modelled.

In addition to these formal checking, verification and review activities, particular emphasis is placed on developing and maintaining a clear understanding of the results of assessment calculations and their implications for environmental safety. Assessment teams are required to interpret model outputs in the context of the conceptual understanding of the site and the disposal system, ensuring that results are consistent with the assumed system behaviour, boundary conditions and governing processes.

This interpretative review includes consideration of trends, sensitivities and key drivers influencing model outcomes, and an assessment of whether the magnitude, timing and spatial distribution of impacts are physically plausible and consistent with expectations derived from site understanding, monitoring evidence and engineering design assumptions. Where results differ from expectations, the underlying assumptions, data, model structure or parameterisation are examined to understand the cause and to determine whether refinements are required.

These interpretative activities are complemented by additional analyses undertaken to test understanding and support assurance of model behaviour. Where appropriate, simplified or scoping models are used as part of this process to provide independent checks on key pathways to test sensitivities and to support confidence that more complex assessment models are behaving as intended. These scoping analyses are not relied upon for detailed decision-making but are used to support understanding, provide assurance on overall model behaviour and strengthen confidence in the robustness of the conclusions drawn from the ESC assessments.

For example, groundwater transport has been considered using conservative scoping representations to examine potential groundwater transport pathways, confirm which processes and routes could materially influence assessment outcomes and identify the key parameters that determine groundwater behaviour. This approach is used to support proportionate decisions on the level of model complexity required for subsequent, more detailed assessment, and is consistent with international guidance on graded safety assessment and the use of simplified models to explore system behaviour [115].

Verification

Verification is the process of ensuring that the model correctly represents the processes included and can be thought of as a check of the mathematical correctness of the calculation. Our assessment calculations are carried out in GoldSim [116]. GoldSim is commercial software developed using appropriate protocols and rigorous testing. When developing our GoldSim assessment models, we have followed a rigorous process of specification of the assessment model, implementation and testing. Final model implementations are subjected to comprehensive verification checks to systematically verify the implementation of the specified mathematical models.

Validation

Validation is the wider assurance that the numerical model is an appropriate representation of the system, for example, through comparison of model results with real-world

observations. Validation of assessment models against real-world data is problematic due to their complexity, stylisation (they may incorporate cautious assumptions) and prospective nature. Where model validation is not possible, a degree of confidence can be gained by expert review of models, drawing on the conceptual understanding of the system and the evidence supporting it.

Changes to models and calculations are recorded via version control and associated review records; where changes may affect outputs, their potential implications are identified and addressed as part of checking and review.

The safety assessment for the 2026 ESC has been undertaken on a proportionate basis, consistent with the GRA [19], taking account of the hazards presented by the facility, the characteristics of the waste inventory, the potential consequences assessed and the current stage in the facility lifecycle.

Consideration has been given within the ESC to the identification of relevant safety functions, pathways, features and processes. Where appropriate, screening arguments and conservative assumptions have been used to demonstrate that certain contributors make an insignificant contribution to radiological risk or impact and do not require further detailed assessment. These arguments are set out within the relevant sections of the ESC, enabling assessment effort to be focused on those aspects most significant to system performance and uncertainty.

The selection of models and the level of model complexity adopted within the safety assessment have been determined on a fit for purpose basis. Modelling approaches have been chosen to provide sufficient information to support the safety arguments and regulatory decisions being made, without unnecessary complexity. Where simplified or higher-level models are used, their applicability and limitations are described and justified. This approach supports transparency and traceability while maintaining a proportionate assessment framework.

8 Provision of Information to the Environment Agency

This section describes the arrangements for providing information to the Environment Agency in support of both the 2026 ESC and ongoing regulatory requirements. It addresses the 2026 ESC submission and the manner in which supporting information and underpinning data are compiled, controlled and presented and the formal submissions and notification obligations arising from the Permit and the GRA [19].

Our ESC is structured around the presentation of our safety arguments and the evidence that supports them. The Preface to the ESC sets out the documentation structure for the 2026 ESC. Information within the ESC includes conceptual understanding, engineering design information, monitoring records and documented technical analyses. The ESC comprises a Level 1 report that sets out the safety arguments, supported by a suite of Level 2 reports that provide the underpinning evidence. The ESC is supported by a suite of technical and scientific reports and references, collectively referred to as Level 3 documents. Level 3 reports contain the detailed technical work underpinning the ESC, from which information and parameter values are derived, including model development and monitoring outputs. This hierarchical structure is consistent with that presented in the 2011 ESC.

As described in Subsection 4.6, following formal acceptance by the Site and Waste Operations Director, the 2026 ESC will become the baseline for safety arguments and operational decision-making. Development of the ESC will continue beyond submission of the 2026 ESC to incorporate new information and to reflect changes on the LLWR site, such as capping activities.

The provision of periodic updates of the ESC to the Environment Agency forms a key element of our formal provision of information arrangements. These reviews provide assurance that the LLWR continues to operate within the safety envelope defined by the ESC and that the ESC baseline remains current and complete. The governance, objectives and content of the Annual, Periodic and Major ESC Reviews, including their role in demonstrating ongoing compliance with Permit requirements and maintaining the ESC as a live safety case, are described in Subsection 5.2.

The Environment Agency may request copies of any reports referenced in the Annual, Periodic or Major ESC Reviews.

Our Permit requires us to inform the Environment Agency if we propose any change to the management system or to site resources that could affect how compliance with the Permit is achieved. We are also required to inform the Environment Agency if we propose to make a change to the ESC or to the WAC that may have an impact on the quantity or nature of the wastes to be disposed. Notification requirements relating to the ESC are implemented through NWSSOP 40.07.01 [21] (see Subsection 2.3.1).

Other submissions made under the permit include responses to ICs (see Subsection 2.2.3). Additional reports produced by the wider business, such as environmental monitoring results (see Subsection 5.1) and information on capping activities, are provided in accordance with relevant requirements and agreed schedules.

As described in Subsection 2.1.1 we have had regular dialogue with the Environment Agency during development of the 2026 ESC. In support of that we have followed a process by agreement, as discussed in Subsection 2.2.4, where we submitted documents to the Environment Agency to gain regulatory assessment of the acceptability of approaches, methods and options as they are developed. We also held meetings to discuss technical topics with the Environment Agency to brief them on our developing arguments and gain their feedback.

9 Documentation and Record Keeping

The purpose of maintaining records extends beyond immediate operational needs. The facility is expected to be operational for several decades. It is essential therefore that accurate and complete information about the site and the wastes it contains is preserved for future generations. Records provide the evidence base required to demonstrate compliance with regulatory requirements and ensure that decisions taken during the lifetime of the facility can be understood and justified. They also support transparency, enable continuity of knowledge and provide confidence in the safety case over the long term. Our arrangements for record management are summarised below.

Our approach is underpinned by an accredited management system (described further in Subsection 4.7), compliance with permit requirements for record keeping and adherence to a retention schedule agreed with the Environment Agency. Management of documents and records of specific relevance to the ESC is described in Subsection 9.1.1.

We also maintain awareness of international developments in information and knowledge management for radioactive waste programmes. For example, we monitor initiatives such as the OECD-NEA's Information, Data and Knowledge Management programme [117, 118] to remain aligned with emerging good practice. This engagement provides early visibility of methods and innovations that may enhance the robustness and accessibility of safety case records, enabling us to adopt and share improvements where appropriate.

9.1 Nuclear Waste Services Records Management

Within NWS, records are documents or other items containing information created, received, and maintained to support business activities or statutory obligations. We have identified records that are required to be retained for legislation, regulation, contractual and business reasons. These are listed on the NWS Record Retention Schedule [119]¹¹. The retention schedule lists all the metadata associated with the records, including the record description, the retention time, the reason for retention and the owner of the record.

Management of records is supported by the identification of Information Asset Owner (IAO) and Information Asset Manager (IAM) roles. IAOs are responsible for identifying, classifying and managing records within their domains, IAMs support day-to-day management of information assets. Once the records have reached the end of their local retention time, the IAO reviews the records and decides if:

- the retention period should be extended;
- the record is no longer needed and can be destroyed;

¹¹ The schedule can be accessed via the NWS Integrated Management System (IMS) under EHSSQ Directorate – Quality – 08.08 Records Management, or through the Records Management communications page on the NWS Vault.

- the record can be sent for long-term preservation.

Records that need to be retained for longer than seven years are sent to the NDA archive at the Nucleus facility in Wick [120].

9.1.1 Management of ESC Information

All information generated by the ESC team is managed using a specific document control system. Access to the ESC information area is restricted to authorised personnel to maintain the integrity and security of records, prevent unauthorised modification and ensure that only controlled versions of documents are available for use. All ESC-related information is logged and tracked within the designated ESC document management system.

When a task is initiated a Task Manager is assigned (see Subsection 5.2.2) and the task is given a 'work pack' reference number and a folder is created in the document control system. This folder is where all the working files related to the task are stored during the task. Memoranda, technical notes, reports and correspondence that are generated by the ESC team are given an ESC reference number, logged and controlled. Work that is produced externally is also logged in the system using the unique reference number assigned by the author. As the task progresses all of the relevant information generated is stored in the work pack folder, including correspondence that records decision making, draft documents and review comments.

As set out in NWSSOP 40.07.01 [21], it is the responsibility of each Task Manager to ensure that all information relevant to their task is accurately recorded, logged and stored within the ESC system. This requirement includes the completion and submission of the Task Completion Sheet [99] to confirm adequate records are kept. As part of closing out the task, the Task Manager ensures that all checking records and significant references relating to the task are stored in the system.

All reports and memoranda are reviewed by the appointed Task Manager, the ESC Technical Integrator and ESC Manager. Once approved, each report and memorandum is issued with an ESC front sheet. Approved and issued reports and memoranda are formal records, covered by the retention schedule as described above. The ESC records are included in the NWS Records Retention Schedule and the record list is also documented in NWSSOP 40.07.01 [21].

All information relating to the ESC will continue to be managed using the ESC information management system and considered to be 'live' information until the end of its local retention period. Following the expiry of the local retention period, the long-term management and archival requirements for these records, as described in Subsection 9.1, will be followed.

In addition to the information generated by the ESC team, we also rely on information owned and produced by other teams within NWS. We have reviewed the requirements and defined a set of information that we need to retain throughout the operation of the LLWR and beyond the Period of Authorisation [121]. Alongside the ESC documentation, this information set includes monitoring information, inventory data and engineering drawings.

10 Summary and Conclusions

This report describes how we have maintained and implemented the management arrangements, governance structures and engagement processes necessary to support the development, implementation and ongoing maintenance of the 2026 ESC for the LLWR. The 2026 ESC has been developed against a defined process, NWSSOP 40.07.01 [21] (formerly RSP 2.25 [21]) and supported by clear management expectations, a structured regulatory dialogue and a traceable and auditable decision-making framework.

Regulatory interaction

We have had regular interaction throughout the development of the ESC with the Environment Agency and the ONR following the tiered meeting structure described in Subsection 2.1 [29]. We have formal processes for providing information to the Environment Agency regarding changes that could impact the ESC or WAC. Feedback from the previous ESC, including FIs, IRFs and recommendations, has been addressed in this ESC. The process by agreement has enabled early regulatory scrutiny of key methods and assumptions (Section 2).

Stakeholder dialogue

Dialogue with planning authorities, local communities, waste consignors, national bodies and international organisations has been maintained throughout ESC development. We engage with our regulators through the structured regulatory meeting framework described in Subsection 2.1.1. We have a dedicated Waste Services team, which manages the NWS relationship with its customers and a Community Engagement team that supports local stakeholder engagement. One of the main ways we do this is through the WCSSG and its associated working group. We also meet with the local parish council and hold drop-in events and site tours for local residents. This provides the opportunity for open communication on issues such as monitoring results, operational activities and future site development. Stakeholder contributions have informed the ESC where appropriate and have reinforced confidence in the processes that support long-term site management (Section 3).

Environmental safety culture and management system

Our EHSSQ Policy states that *'above all, nothing is more important to us than protecting people and the environment'*. We have established a set of values, standards and expectations that are communicated to all employees. The organisation continues to operate with a mature environmental safety culture supported by a certified and evolving management system. The transition from LLW Repository Ltd's management system to the NWS IMS has retained continuity of controls and governance while integrating corporate arrangements applicable across NWS. The management system provides the necessary structure for oversight of environmental, health, safety, security and quality activities, and

supports the competencies, responsibilities and behaviours required to sustain a positive safety culture throughout the period of ESC development. Regular audits and management review processes confirm that the arrangements remain suitable, adequate and effective (see Section 4).

Planning and control of work

We have management arrangements in place to plan and control the work involved in complying with our Permit and supporting and developing the ESC. These processes include change control, plant modification proposals, waste acceptance governance and the ECC. These arrangements ensure that operational activities remain consistent with ESC assumptions and that new information, emerging risks or organisational changes are assessed in a proportionate and timely manner. NWSSOP 40.07.01 [21] sets out the governance and management requirements for the control of work in support of the development and application of the ESC.

Application of sound science and good engineering practice

Our activities are delivered by SQEP across scientific, engineering, operational, and assurance disciplines and reflects established good practice.

One of the key aspects is the process by which we check, verify, challenge and undertake our technical work. We also place strong value on international learning and best practice, drawing on recognised standards, global research programmes, international waste management experience and cross-industry engagement. Quality assurance, internal peer review, independent review and structured learning are all components of this approach. Conceptual models and assessment approaches have been updated where necessary to reflect improved understanding, operational experience and international practice.

Engineering design and assessment activities are undertaken by suitably qualified and experienced personnel, supported by structured requirements management, design verification, construction assurance and independent checking.

Quality management, documentation and records

Quality management arrangements underpin the development, review and application of the ESC. Information supporting the ESC is subject to controlled processes for data provenance, review, checking and verification, ensuring traceability and reproducibility of all key assessments. Documentation and records are maintained in accordance with the management system, retention schedule and regulatory expectations, with clear arrangements in place to preserve relevant information for the long term. These processes provide confidence that the evidence supporting the ESC is complete, controlled and accessible.

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