UK Government

The United Kingdom's Tenth National Report on Compliance with the Convention on Nuclear Safety

Department for Energy Security and Net Zero (2026)

Contributors to the United Kingdom's National Report

The Office for Nuclear Regulation prepared this report on behalf of the Department for Energy Security and Net Zero (DESNZ) and in consultation with, and incorporating contributions, from:

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Executive Summary

The United Kingdom (UK) remains firmly committed to meeting its obligations under the Convention on Nuclear Safety and we welcome this peer review of our activities.

This, our tenth National Report, provides a comprehensive update on how the UK has maintained a high level of safety through the establishment and application of fundamental safety principles to safely manage our land-based civil nuclear power plants.

The UK has nine operating reactors, consisting of twin advanced gas-cooled reactors (AGRs) at four sites, and a separate single pressurised water reactor (PWR). Three twin-reactor AGR sites have ceased generation. Defuelling is complete at one of the sites, and the site has been declared fuel free. Defuelling activities are ongoing at the other two sites.

There are three companies that hold nuclear site licences for the UK's nuclear installations, which are granted by the Office for Nuclear Regulation (ONR), as well as permits and authorisations issued by the relevant environment agency. These licensees have primary responsibility for safety and environmental protection under UK law and they must demonstrate that they are meeting relevant good practice to minimise risks to people and the environment.

The principal statutory regulators for the purposes of the Convention are ONR (covering Great Britain), the Environment Agency in England and the Scottish Environment Protection Agency (SEPA) in Scotland. There are no nuclear installations in Northern Ireland, and none in Wales that are applicable under the Convention.

The UK nuclear industry continues to evolve, with a mixture of operational and end-of-generation nuclear power plants entering defuelling in preparation for decommissioning. The UK also has plans to develop a new generation of nuclear power plants in England and Wales as part of the Government's Net Zero ambitions.

The UK continues to make progress towards bringing the UK's first new nuclear power plant (twin European Pressurised Reactors (EPR™)) in more than 30 years into operation at Hinkley Point, in Somerset. A further site licence has been granted to develop a twin EPR™ site at Sizewell, in Suffolk.

Several Generic Design Assessments are ongoing in the UK at present. Additionally, UK regulatory agencies continue to provide early regulatory engagement for parties seeking to deploy reactor technology in Great Britain.

The UK works closely with its counterparts in other countries to ensure its approaches reflect international good practice and capture relevant lessons learnt from experience elsewhere. The UK continually seeks to benchmark its arrangements against others and since the UK's ninth National Report has hosted a follow-up Integrated Regulatory Review Service mission.

Throughout this reporting period, the UK has continued to comply with the requirements of the Convention. The UK addressed the Challenge identified in response to the National Report

submitted for the joint eighth and ninth Review Meeting. The UK report continues to provide responses to the Major Common Issues and the Vienna Declaration on Nuclear Safety.

This report demonstrates that the UK's approach to safety and environmental protection relevant to the management of civil land-based nuclear power plants is well-established, effective, and drives sustained improvements, thereby meeting the requirements of the Convention on Nuclear Safety. The report also identifies a number of notable achievements and proposes several good practices on the topics of regulatory sandbox for artificial intelligence, defuelling of shutdown reactors and preparations for transfer of licence, ownership and regulation, development of nuclear skills, resources and training.

The UK is committed to sharing its experience with other Contracting Parties.

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Section A – Introduction

Introductory remarks

A1 This, the United Kingdom's (UK's) tenth National Report (NR), is provided to demonstrate the UK's compliance with its obligations under the Articles of the Convention on Nuclear Safety [1] – hereinafter referred to as 'the Convention'.

A2 The UK is a Category 1 (Large) Contracting Party (CP) to the Convention. As such, it has reported under Articles 6 through to 19.

A3 This report provides a comprehensive update of progress since the UK's ninth NR, published in August 2022 [2] and now covers the period 01 June 2022 to 31 May 2025. Significant developments after this date will be included in the UK presentation to the tenth review meeting scheduled for April 2026 and recorded as appropriate within the UK's 11th NR in 2028.

A4 In accordance with the objectives of the Convention, the scope of this report is limited to matters pertaining to achieving and maintaining a high level of nuclear safety at nuclear installations, preventing accidents with radiological consequences and mitigating such consequences should they occur.

A5 This NR presents the application of modern safety standards and processes to the land-based civil nuclear power plants (NPP) reportable under the Convention and against the UK's new build projects.

A6 The UK nuclear industry continues to evolve, with a mixture of operational NPPs and end-of-generation (EoG) NPPs entering defuelling in preparation for decommissioning. The UK also has plans to develop a new generation of NPPs as part of the Government's Net Zero Ambitions .

A7 The UK maintains high standards of operational nuclear and radiological safety and environmental protection through a robust regulatory framework. The UK's approach reflects its strong safety culture characterised by learning and continuous improvement.

A8 Facilities used for defence purposes are excluded from this NR, as are the facilities and activities reportable under the Joint Convention on the Safety of Spent Fuel and on the Safety of Radioactive Waste Management [3] – hereinafter referred to as 'the Joint Convention'.

A9 The Office for Nuclear Regulation (ONR) is the UK's national statutory regulator for nuclear safety, nuclear site health and safety, civil nuclear security, nuclear safeguards, and the transport of civil nuclear and radioactive materials. Aspects of environmental protection and radioactive waste management covered by the articles of the Convention are regulated by the relevant environmental regulators. ONR is the author of this report on behalf of the UK Government's Department for Energy Security and Net Zero (DESNZ).

A10 Since the Convention came into force in 1996, the UK has participated in all reporting cycles, meeting its obligations under the Convention. This, the UK's tenth NR, continues to demonstrate full compliance with the obligations of the Convention.

Overview of the UK's nuclear programme

A11 The UK civil nuclear industry consists of a diverse range of nuclear facilities, which includes reactors under construction, operational and decommissioning NPPs; research

facilities; fuel manufacturing; spent fuel storage and reprocessing; and radioactive waste processing, and storage and disposal facilities. They are geographically spread across England, Scotland, and Wales, collectively known as Great Britain (GB). There are no nuclear facilities in Northern Ireland, and none in Wales that are applicable under the Convention. An overview of all the UK's nuclear facilities is available on the ONR website [4].

A12 This report uses the term UK, rather than GB, as it is the UK that is the Contracting Party, apart from to indicate when some laws have been passed by the UK Parliament that apply to GB only, or specifically to England, Scotland, and/or Wales.

A13 The NPPs reportable under the Convention are operated in the UK by three licensees; The operational NPPs for which Électricité de France Energy Nuclear Generation Ltd (EDF Energy NGL) is the licensee, and the reactors under construction licensed by Nuclear New Build Generation Company (Hinkley Point C) Ltd (NNB GenCo (HPC)) and Sizewell C Ltd. In all, the NPPs being reported upon consist of:

- Eight generating Advanced Gas-cooled Reactors (AGRs) spread across four sites (Hartlepool, Heysham 1, Heysham 2 and Torness), each with twin reactors
- Four AGRs across two sites (Hinkley Point B and Dungeness B) each with twin reactors that have ceased generation and are in the process of defuelling
- Two AGRs at Hunterston B site that have completed defuelling and have completed fuel free verification
- A single operational Pressurised Water Reactor (PWR) (Sizewell B)
- A twin European Pressurised Reactor (EPR™) (using PWR technology) under construction (Hinkley Point C) in Somerset, England
- A further twin EPR™ (Sizewell C) proposed for construction in Suffolk, England

A14 The safety of the UK's non-power generating facilities, including the first generation of NPPs in the UK, the Magnox reactors, are covered under the Joint Convention NR [5].

A15 Management of the radioactive wastes and irradiated fuels that are generated within the UK's operating fleet of NPPs are also covered under the Joint Convention.

Structure and basis of the UK's tenth national report

A16 This, the UK's tenth NR, is similar in both structure and content to the UK's ninth NR [2]. It continues to follow the guidelines issued by the Convention [6] as well as the template for National Reports [7] proposed at the third extraordinary meeting of the CPs to the Convention. As such, this is a stand-alone document that provides sufficient background information on UK policy and practices and the legislative and regulatory framework to enable the reader to gain adequate understanding of the safe management of the UK's operational land-based civil NPPs. In doing this, it demonstrates compliance with the obligations in the Articles of the Convention.

A17 Given the maturity of the UK's arrangements, the UK's means of demonstrating compliance with the Convention has not changed significantly in many areas since the UK's ninth NR, and in some cases since the first NR.

A18 Where the means of demonstrating compliance has changed including the introduction of new regulations, it is highlighted in the same way as this paragraph.

A19 Where the text has not been highlighted in this way, it may have been revised to improve presentation, but the means of demonstrating compliance has not significantly changed. The important changes are also summarised at the end of the relevant Articles.

A20 A range of examples are included to illustrate the practical application of the UK's nuclear safety arrangements during the reporting period. These cover the design, build and operation of the UK's NPPs, presenting tangible evidence of UK licensees' management of nuclear safety and the oversight of the UK's statutory regulators that hold them to account.

Example title

A21 Where examples are used, they are highlighted in the same way as this paragraph.

A22 This report covers those issues raised during the joint eighth and ninth review meeting, along with the issues identified within the Country Review Report for the UK [8] from the ninth review meeting. The issues consist of one **Challenge** and eight **Major Common Issues**, which are all addressed and highlighted within the text by referring to the type of issue in **bold.**

A23 All references take the form of [x], where 'x' contains a link to the reference located at the end of the report as an endnote.

A24 Cross-referencing has been used throughout the report, in the form of bookmarks to help the reader navigate the report. These are highlighted in blue as a link.

A25 Section B – Summary includes an overview of the UK operating nuclear fleet, an overview of the UK new build programme and relevant UK international activities. Section B also lists significant changes in demonstrating compliance with each article, proposed good practices, notable achievements, future focus, and how major common issues are addressed. The Articles are then addressed in turn from Article 6 – Existing Nuclear Facilities to Article 19 – Operation.

A26 In preparing this report, the UK has used information available up to 31 May 2025. The UK presentation to the tenth review meeting will be based on this report and will also be supplemented with information on any relevant developments since this report's authorship, up to the date of the review meeting itself; scheduled for April 2026.

Section B – Summary

B1 In accordance with the guidelines for National Reports (NR) [6], this section highlights the main developments in the UK during the reporting period. It provides only brief descriptions and mainly relies on cross-referencing to other parts of this report where more detail is held.

B2 In line with the template for National Reports [7], this section also summarises significant changes in demonstrating compliance with each Article, notable achievements, proposed good practices, and future focus. It also provides an overview of where the report addresses the UK challenge and major common issues from the joint eighth and ninth review meeting.

B3 A summary of the international work (including peer review missions) and compliance with Vienna Declaration on Nuclear Safety is also provided in this section.

UK operating nuclear fleet

B4 The UK has nine operating reactors, consisting of twin Advanced Gas cooled Reactors (AGRs) at four sites (Hartlepool, Heysham 1, Heysham 2, Torness) and a single Pressurised Water Reactor (PWR) (Sizewell B). (See Article 6 – Existing Nuclear Installations for more details).

B5 Three stations (Hunterston B, Hinkley Point B and Dungeness B) have ceased generation and transitioned into the decommissioning phase. Hunterston B station has completed defuelling its twin-reactors and has been declared fuel free. Defuelling activities are ongoing at Hinkley Point B and Dungeness B.

B6 The 13 reactors at Hartlepool, Heysham 1, Heysham 2, Torness, Sizewell B, Hinkley Point B and Dungeness B currently meet the definition of 'operating' in Article 2 of the Convention [1], which includes those reactors that have ceased generation, but have not completed fuel free verification. The report also discusses the twin-reactors at Hunterston B, (which are now fuel free) as these reactors were within the scope of the Convention for the majority of the reporting period.

Important safety challenges, ageing and obsolescence

B7 The existing fleet of UK nuclear power plants (NPPs) has been in operation for several decades. The operating period for AGRs have been extended multiple times and these NPPs are approaching the end of their lives with final shutdown for the remaining stations scheduled between 2027 and 2030. Both the licensee and regulator continue to work closely to ensure that the reactors can operate safely and address a broadening range of issues related to ageing management.

B8 Throughout the reporting period there were several nuclear safety issues reported by the fleet, key of which are summarised below. (More information is given in Article 6 – Existing Nuclear Installations)

- Heysham 1: Main steam supply route isolating valve failure
- Torness: Failure of gas coolant circulators
- Heysham 2 and Torness: Graphite degradation leading to debris in reactor core seal ring groove walls

- Hartlepool: ONR moved Hartlepool power station to enhanced regulatory attention in March 2025. The enhanced regulatory attention level reflects the effort ONR is using to influence improvements in areas including conventional health and safety, the number of site incidents and the production of nuclear safety cases at Hartlepool station.

Incidents, operational experience and lessons learned

B9 A summary of UK incidents and associated INES ratings can be found in Table 3 – Summary of Incidents and associated INES Ratings. The most notable incident (INES-2 rated) is summarised below.

- In November 2023, Torness Reactor 2 was shut down for a planned refuelling outage. Minimum post-trip cooling was established, and reactor cooldown occurred at the normal rate. However, four of the eight gas circulators initially failed to run on Variable Speed Drives (VSDs). This placed the reactor in an immediate Technical Specification action condition. Adequate post trip cooling of the reactor was maintained by the remaining gas circulators running. Failure of the 4 VSD units did not challenge the applicable safety case or operational limits but represented an unexpected reduction in defence in depth. This was rated as an INES Level 2 Incident.
- Subsequent investigations found that corrective actions from a similar event earlier in the year (rated INES-1) had not been carried out in a timely manner, and the bridging strategy was not effective in preventing a repeat. The actions taken by the dutyholder and ONR for this event are discussed in Annex 4 – Safety Related Issues and Safety Upgrade Programmes

B10 More information on the above event (as well as other UK and international incidents) is available through the International Atomic Energy Agency (IAEA) [9].

B11 Examples of learning from operational experience during the reporting period are discussed in Table 4 – Examples of Learning from Operating Experience.

NPP life extensions, planned improvements and safety upgrades

B12 During the reporting period, EDF Energy NGL announced the intent to operate four UK AGR NPPs (Hartlepool, Heysham 1, Heysham 2 and Torness) beyond their previous end-of generation date. The regulatory approach to NPP life extensions is discussed in Article 7 – Legislative and Regulatory Framework.

B13 Planned improvements and safety upgrades on the UK operating reactor fleet are driven by response to safety related incidents, ageing management, outcome of safety assessments and response to national and international Operational Experience (OPEX). Examples of ongoing and completed safety upgrades to support the safe operation of the UK's NPPs are discussed in Article 6 – Existing Nuclear Installations.

Transition to defuelling

B14 During the reporting period, three UK NPPs have ceased generation and commenced defuelling activities, and one NPP has completed the defuelling of both reactors and fuel free verification. The safety assessment aspects of defuelling are discussed in Article 14 – Assessment and Verification of Safety. The operational aspects of defuelling are discussed in Article 19 – Operation.

UK's preparations for new nuclear

B15 The UK Government's energy policy aims to have a diverse mix of low carbon generating technologies and is committed to investing in new technologies to address climate change by achieving net zero and improving UK energy security. The Clean Power 2030 Action Plan [10] highlights the important role nuclear will play in our future energy system, providing low-carbon, baseload power at scale, generating alongside intermittent renewable generation. The UK Government will continue to seek to streamline regulatory processes, and foster innovation in nuclear technology.

B16 The UK Government also enacted the Nuclear Energy (Financing) Act 2022 [11] to establish a new Regulated Asset Based funding model for large and small nuclear projects. This is intended to cut the cost of financing compared to the existing Contracts for Difference model, thereby reducing the cost to consumers and unlocking private investment.

B17 The UK Government recognises that nuclear power generated in the UK limits exposure to volatile energy prices and ensures the UK's energy security and independence.

B18 In early 2025, the Prime Minister commissioned an independent taskforce to look at the regulatory framework and regulations affecting nuclear across both civil and defence sectors. The taskforce will examine how to deliver nuclear faster and cost-effectively in support of growth and innovation, while maintaining the UK's high standards of nuclear safety, security and non-proliferation. It is led by an independent expert and reports to the Prime Minister and will present options to the Energy Secretary, the Defence Secretary, and Chief Secretary to the Treasury to consider in Autumn 2025 [12].

New build and licensing

Update on Hinkley Point C

B19 During the reporting period, the construction at Hinkley Point C, (a twin European Pressurised Reactor (EPR™) site, capable of providing 3.2GW) has continued to progress.

B20 Under its arrangements for compliance with licence condition (LC) 19 (construction or installation of new plant) [13] the licensee, NNB GenCo (HPC) Ltd, divided the Hinkley Point C project into stages separated by hold points. These represent key project milestones where there is a step change in the latent risk if they are poorly conceived or executed, or where shortcomings in construction or commissioning could have a significant impact upon nuclear safety.

B21 Hinkley Point C construction is now well-progressed, with equipment installation and early commissioning activities now taking place. Notable project milestones include:

- Installation of Unit 1 Dome in December 2023
- Installation of the Unit 1 Reactor Pressure Vessel (RPV) in December 2024

B22 During the reporting period, ONR has permissioned a number of project hold points such as the receipt of RPV, Unit 1 dome lift, start of low voltage commissioning, RPV Unit 1 installation, shipment of first steam generator etc.

B23 As Hinkley Point C progresses through these project phases, ONR's strategy remains to ensure that it can deal effectively with the changing nature of the project, with appropriate regulatory oversight of the construction, installation and commissioning activities as well as the protection of the health and safety of the large workforce on what is still one of Europe's biggest construction projects.

B24 Aspects of Hinkley Point C design and construction, financial and human resources, priority to safety, human factors, quality assurance, safety assessment and verification are discussed in the relevant articles of this report.

Update on Sizewell C

B25 Sizewell C, the 3.2GW nuclear power station under construction in Suffolk, has continued to progress during the reporting period. The project, which is majority-owned by the UK government, is designed to feature two EPR™ units. The Sizewell C project intends to realise substantial cost, schedule and safety benefits from design replication of the Hinkley Point C design.

B26 In the 2025 Spending Review Statement, the Chancellor announced a £14.2bn investment over the Spending Review period in Sizewell C.

B27 Another significant milestone in the reporting period was the granting of a nuclear site licence to Sizewell C Ltd in May 2024, marking a crucial step in the regulatory approval process and enabling the project to proceed with nuclear-related construction. This is further discussed in Article 7 – Legislative and Regulatory Framework.

B28 The grant of a nuclear site licence followed other key enabling milestones, including the issuing of Radioactive Substances environmental permit in March 2023 and the triggering of Sizewell C Ltd's Development Consent Order in January 2024, signalling the beginning of early construction works at the Suffolk site.

B29 Sizewell C Ltd continues to cultivate strong relationships with ONR as the regulator establishes a proportionate footprint in the early construction period, looking ahead to the key permissioning point of first nuclear safety concrete pour.

B30 Aspects of Sizewell C design and construction, financial and human resources, priority to safety, human factors, quality assurance, safety assessment and verification are discussed in the relevant articles of this report.

Advanced Nuclear Technologies

B31 The UK Government is actively progressing its advanced nuclear strategy, setting a clear policy framework to support the deployment of Advanced Nuclear Technologies (ANTs), like Small Modular Reactors (SMRs) and Advanced Modular Reactors (AMRs). The new framework will be published in late 2025 and will lay out pathways for privately led ANT projects to be brought forward in the UK.

B32 Through the Spending Review, the government is providing significant investment in the nuclear sector, including over £2.5 billion to enable one of Europe's first Small Modular Reactor programmes, with Rolls Royce SMR selected as preferred bidder to partner with Great British Energy – Nuclear, subject to all relevant approvals. The government is also providing a pathway for privately-led advanced nuclear projects to be deployed onto the grid and to supply industrial users. Great British Energy – Nuclear has been tasked with a new role in assessing proposals within a new framework, to be published shortly, with National Wealth Fund exploring potential investment opportunities and the Department for Energy Security and Net Zero (DESNZ) exploring revenue support for viable projects.

Small Modular Reactors and Generic Design Assessments

B33 The objective of the Generic Design Assessment (GDA) process is to provide confidence that the proposed design is capable of being constructed, operated and decommissioned in accordance with GB standards of safety, security and environmental protection. It is a voluntary process, that provides an opportunity for early design engagement with the regulators which can reduce programme and technical risks ahead of statutory nuclear

site licensing later in a project. It also allows developers/vendors to begin engagement with the regulator while they are progressing with site acquisition and planning consents.

B34 The process has three steps, with the assessment becoming increasingly detailed with each step. Step 1 is the initiation step, at which matters such as the scope and timescales are agreed, and the regulators' knowledge of the design and the RP's technology and documentation develops. Step 2 is the fundamental assessment of the generic safety, security and environmental cases, to identify any potential 'showstoppers' that may preclude deployment of the design. Step 3 is the detailed assessment of the generic design and the supporting documentation.

B35 A 'full' GDA, which provides a Design Acceptance Confirmation (DAC) from ONR and Statement of Design Acceptability (SoDA) from the environment regulators, requires all three steps to be successfully completed. There is an option to conclude GDA engagements at the end of Step 2 with a GDA Statement, if this lower level of assurance is judged by the vendor or RP, and their stakeholders to be sufficient for their business needs. Both ONR and the Environment Agency publish reports at the end of each step, which provide an update on the assessment and highlight any concerns or technical issues that have been raised. Further details of the individual steps can be found at reference [14].

B36 During the last reporting period, ONR, the Environment Agency and Natural Resources Wales (NRW) have progressed GDAs for three SMR reactor designs at the request of the UK Government. A summary of these are given in figure B.1 below. Additionally, in August 2024, DESNZ requested ONR and the Environment Agency to undertake a two-step GDA on the Westinghouse AP300 SMR. Westinghouse wrote to the regulators in December 2024 requesting to defer the start of GDA for the AP300. At the time of writing, the RP's anticipated timescales for commencing the GDA are not known.

Figure B.1 Summary of Generic Design Assessments

Requesting Party	Reactor Design	Current Status
Rolls-Royce SMR Ltd	Rolls-Royce SMR	Assessment Step 1 was completed in April 2022. Step 2 was completed and Step 3 started in July 2024.
GE-Hitachi Nuclear Energy International	BWRX-300	Assessment Step 1 was completed and Step 2 started in December 2024. There are currently no plans to start Step 3.
Holtec International	SMR-300	Assessment Step 1 was completed and Step 2 started in August 2024. There are currently no plans to start Step 3.

International collaboration on SMR reviews and other advanced nuclear technologies

B37 The information in this section relates directly to the major common issue on **fostering international collaboration** from the joint eighth and ninth review meeting.

B38 In March 2024, ONR signed a trilateral Memorandum of Cooperation (MoC) with the US Nuclear Regulatory Commission (NRC) and the Canadian Nuclear Safety Commission (CNSC) to collaborate on the assessment of SMR and AMR designs. With many of the same SMR and AMR designs being proposed for all three countries and engagements with the relevant regulators underway, this agreement provides a valuable opportunity for schedule savings and

efficiencies for the regulators, and standardisation of designs to the benefit of safety and supply chains.

B39 On the GE-Hitachi and Holtec GDAs, ONR has sought to actively explore opportunities to maximise the value of international regulatory collaboration and identify efficiencies in processes. As part of this work, ONR has obtained access to regulatory submissions already completed by US NRC and CNSC, observed ongoing interactions between the regulators and 'applicants' in the other countries, and initiated new areas for collaborative work informed by our engagements on the two reactor designs.

B40 In addition to this collaboration with North American regulators, the UK regulators have opened up the Rolls-Royce SMR GDA process to European regulators, with observers from Poland, the Netherlands, Sweden, Finland and Czechia attending meetings on a range of topics.

B41 The ONR report [15] on its international regulatory collaboration for SMRs and AMRs provides further details on the activities discussed above.

B42 ONR has contributed to the IAEA's Nuclear Harmonization and Standardization Initiative (NHSI), actively engaged in the IAEA's SMR Regulators Forum (of which the UK is currently vice chair) and Nuclear Energy Agency (NEA) working groups to accelerate mutual understandings of the similarities and differences in regulatory requirements, and to look for equivalence of approaches across design assessment and licensing processes. The UK has provided multidisciplinary input and commentary to IAEA reviews of its safety standards and ONR has increased its bilateral engagements with other regulatory bodies to identify areas of commonality and potential harmonisation. Further information about bilateral and multilateral collaboration between ONR and other regulators is given in reference [16].

B43 The UK's other collaborative work on new/advanced reactor design assessments include:

- In June 2022, ONR hosted a joint NEA and IAEA symposium on 'Probabilistic safety analysis of reactors of singular designs'.
- The UK (via the Environment Agency) is a founding member of the Generation IV International Forum (GIF) [17], created as a cooperative international endeavour seeking to coordinate research and development on fourth generation nuclear systems.
- The UK is also a member of the Clean Energy Ministerial (CEM) [18], a global forum focused on the transition to global clean energy, and co-leads on the CEM Flexible Nuclear campaign, which looks to understand and communicate the benefits of advanced nuclear reactors with highly-flexible power outputs.
- In 2021, the UK Government stated its ambition to build a High Temperature Gas Reactor (HGTR) demonstrator by the mid-2030s. DESNZ is actively engaging with industry bodies and potential vendors to determine the design and siting options for this endeavour. ONR and the Environment Agency are using learning from internal and international activities on ANTs to provide advice to DESNZ on how to effectively regulate this undertaking in accordance with UK legislation and international safety standards. UKNNL have been working with the Japan Atomic Energy Agency on both AMR (HTGR) and Coated Particle fuel projects since the commencement of Phase A in 2022. The current phase of work for both programmes, which commenced in 2023 has been extended to December 2025 in order to facilitated good quality outputs to inform future policy work (e.g. it will include costings and deployment timelines for a well developed ANT).
- In August 2023, ONR hosted an international workshop to share insight into the UK regulatory processes for the assessment and licensing of SMRs and the wider new reactor field. The session was led by ONR alongside the Environment Agency and

DESNZ, and offered guidance on the GDA process for new reactor designs and ways to promote opportunities for better collaboration between fellow international regulators.

Early regulatory engagement on new nuclear projects

B44 ONR, the Environment Agency and NRW have developed a process for early regulatory engagement for parties seeking to deploy reactor technology in Great Britain. This process is available to any party requesting early engagement on a proposed deployment in GB, including reactor technology vendors, developers or aspirant licence/permit holders (or consortia of these). Early engagement is a voluntary process that is designed to be flexible, and the approaches are neither mandatory, prescriptive, or fixed in scope. The regulators have published guidance material on the early engagement process [19].

B45 In February 2025, Last Energy entered the nuclear site licensing process to build a 20 MWe micro modular nuclear power plant in South Wales. Last Energy has been participating in the early regulatory engagement framework since May 2024. In the early stages of the process, regulators will provide pre-application advice to Last Energy as it prepares its application for a nuclear site licence. This advice will inform Last Energy of the regulatory expectations and legal responsibilities of a nuclear site licensee in GB.

Summary of responses to applicable challenges and suggestions from the joint 8th and 9th review meeting

B46 One challenge was identified for the UK from the joint 8th and 9th review meeting [8]: *'**Recognizing the military conflict in Ukraine arising as a result of the invasion by Russia, the UK is to further consider potential radiological consequences arising from postulated military actions which endanger nuclear installations and the potential for trans-border effects on Emergency Preparedness and Response and the health and well-being of UK citizens**'.*

B47 This challenge has been addressed through the application of Joint Agency Modelling (JAM) to the war in Ukraine through modelled predictions of radionuclide dispersion. JAM is a national capability to estimate, forecast and provide expert advice on the scale and uncertainties associated with a radiological release arising from a nuclear emergency. Additionally, the UK acted as the Chair for the Heads of European Radiological Protection Competent Authorities – Working Group for Emergencies (HERCA-WGE) taskforce and enabled urgent protective action methodology sharing, so that an agreed and aligned public protection strategy could be reached for cross-border situations (see Article 16 – Emergency Preparedness for more details). Based on the activities outlined in Article 16, the UK considers that this challenge can be closed.

B48 No suggestions were identified for the UK from the joint 8th and 9th review meeting.

B49 The Country Review Report for the UK [8] from the 8th and 9th review meeting confirmed that all the challenges and suggestions from the 7th review meeting have been closed.

Summary of significant changes during the reporting period

B50 In addition to work summarised above to address the challenge from the joint eighth and ninth review meeting, the UK has undergone the following significant changes during the reporting period:

Figure B.2: Summary of significant changes during the reporting period

Article	Significant changes during the reporting period
Article 6	• One station (Hunterston B) completed defuelling and fuel free verification. • Two further stations (Dungeness B and Hinkley Point B, which ceased generation in 2021 and 2022 respectively) continue to defuel. • EDF Energy NGL announced the intent to operate the four remaining AGR sites beyond their previous end-of-generation (EoG) date.
Article 7	• ONR has published several risk-informed policies and frameworks (e.g. Risk Informed Targeted Engagements policy) to optimise its regulatory practices.
Article 8	• ONR has undertaken a review of its organisational structure and made changes to enhance efficiency and implement clear lines of accountability. • A new ONR Chair was appointed in early 2025. • ONR announced a new Chief Executive/Chief Nuclear Inspector (who will take up the post in mid-2025). • ONR has introduced a new 12-month training programme for newly-recruited inspectors. • ONR has undertaken work on enhancing regulatory capability in the area of innovation with a particular focus on artificial intelligence. • ONR has published a new openness and transparency policy.
Article 9	• Sizewell C Ltd has been granted a nuclear site licence and is now the licensee for the Sizewell C site.
Article 10	• An IAEA OSART mission took place at EDF Energy NGL's Heysham 2 NPP in October 2023. • Establishment of Sizewell C NPP's arrangements to give priority to nuclear safety (start of construction) and further development of the arrangements at Hinkley Point C. • The development and implementation by ONR of two new regulatory guidance documents on corporate governance for nuclear safety and organisational culture 'warning flags'.
Article 11	• Nuclear Services, an EDF business unit set up to build and maintain key nuclear skills, became a separate legal company with equal ownership by the three licensees: NNB GenCo (HPC) Ltd, Sizewell C Ltd, and EDF Energy NGL. • Publication of the National Nuclear Strategic Plan for Skills. • Sizewell C Ltd developed its organisational capability sufficiently for ONR to grant a Nuclear Site Licence in 2024.
Article 12	• The development of the Nuclear Learning Pathway by ONR and the Chartered Institute of Ergonomics and Human Factors (CIEHF) to develop technical competence in human factors and effective communication of human factors principles.

Article 13	The UK has no significant changes to highlight under Article 13 during the reporting period.
Article 14	• Sizewell B has completed its third periodic safety review (PSR). • For those NPPs that have transitioned to defuelling, EDF Energy NGL has submitted relevant defuelling/post-defuelling safety cases that have been assessed by ONR. EDF Energy NGL has developed essential defuelling safety cases for the remaining AGRs, which have been assessed (or are in the process of being assessed) by ONR. • Dutyholders and ONR have commenced a number of workstreams to consider the impact of global climate change on the safe operation of nuclear installations.
Article 15	• In 2022, the UK completed a 5-yearly statutory post-implementation review (PIR) of the Ionising Radiation Regulations (IRR) 2017 legislation. The main conclusion from the review was that IRR17 fulfilled its primary objectives, remains fit for purpose, improved radiological protection and effectively minimises exposures to ionising radiation.
Article 16	• In 2024, the UK completed a 5-yearly statutory PIR of the Radiation Emergency Preparedness and Public Information Regulations (REPPIR) 2019 legislation. The main conclusion from the review was that the current legislation fulfilled its primary purpose, that REPPIR19 remains fit for purpose and has identified some improvements that may be considered in the future.
Article 17	• In 2022, the UK completed a 5-yearly statutory PIR of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. The PIR resulted in a recommendation to consider replacing the regulations with new regulations and a streamlined system of environmental assessment.
Article 18	The UK has no significant changes to highlight under Article 18 during the reporting period.
Article 19	The UK has no significant changes to highlight under Article 19 during the reporting period.

Notable achievements and proposed good practices

B51 This report discusses a number of notable achievements in the UK nuclear sector during the reporting period. Each of these notable achievements are discussed in detail in the relevant article. This section summarises the notable achievements, some of which are judged by the UK to represent Good Practice.

- Article 6: Defuelling of shutdown AGRs, preparations for transfer of licence and ownership of the sites to Nuclear Decommissioning Authority (NDA)/Nuclear Restoration Services (NRS) and the transfer of regulation of the sites to ONR's decommissioning, fuel and waste sub-directorate
- Article 7: ONR Risk Informed Targeted Engagements (RITE) policy
- Article 8: Trialling of a regulatory sandbox for artificial intelligence **(Proposed Good Practice)**

- Article 8: ONR policy on openness and transparency
- Article 10: Development of a model of safety culture and associated survey tool
- Article 10: Independent culture assessment of the UK nuclear regulatory body
- Article 11: Establishment of Nuclear Services by UK licensees **(Proposed Good Practice)**
- Article 11: Publication of the National Nuclear Strategic Plan for Skills **(Proposed Good Practice)**
- Article 12: Development of Human Factors 'Nuclear Learning Pathways' by ONR and UK Chartered Institute of Ergonomics and Human Factors **(Proposed Good Practice)**
- Article 14: Chief Nuclear Inspector's themed inspection on climate change **(Proposed Good Practice)**
- Article 14: EDF Nuclear Services' climate ADAPT programme
- Article 16: UK emergency preparedness (Joint Agency Modelling) capability development
- International regulatory collaboration on SMR GDAs (see paragraphs B37 to B41)
- UK IRRS follow-up mission in 2024, including closure of 19 of the 24 recommendations (see paragraphs B56 to B62).

Future focus

B52 The UK has identified the following issues as areas that demand future effort to resolve:

- Article 6: Ongoing management (by the licensee and regulator) of issues at AGRs that challenge reactor lifetimes
- Article 8: ONR's review of its Organisational Learning (OL) and Knowledge Management (KM) arrangements against best practice to identify future improvements

Major common issues

B53 Eight major common issues were identified during the joint eighth and ninth review meeting. Figure B.3 outlines how they have been addressed in this report.

Figure B.3: Major Common Issues Arising from Country Group Discussions from the Joint Eighth and Ninth Review Meeting

Common Issues	Response
Managing extraordinary circumstances impacting the safe operation of nuclear installations (regulatory resilience)	Regulatory resilience is addressed in Article 8 – Regulatory Body.
Strengthening national regulatory capabilities taking into account new and innovative technologies	Regulation of innovative technologies is addressed in Article 8 – Regulatory Body.

Fostering international collaboration (for the review of SMR design)	Fostering international collaboration for the review of SMR design is addressed in paragraphs B37 to B41.
Fostering international peer review missions and timely addressing of findings	International peer reviews that have taken place in the reporting period, and planned international peer reviews, are discussed under the international update under paragraphs B56 to B65 and Article 10 – Priority to Safety.
Possible impact of global climate changes on the safe operation of nuclear installations	The work done by UK regulatory bodies and licensees to address possible impact of global climate change is discussed in Article 14 – Assessment and Verification of Safety.
Securing reliable supply chains	Securing reliable supply chains and quality assurance is addressed in Article 13 – Quality Assurance.
Strategies for ageing management in support of the long-term operation of nuclear installations	Strategies for ageing management are addressed in Article 14 – Assessment and Verification of Safety.
Strengthening emergency preparedness and response arrangements and fostering cross border collaboration	Emergency preparedness and international collaboration is discussed in detail under Article 16 – Emergency Preparedness and further information is available under Article 19 (19.32 to 19.40).

International update

B54 The UK has been a member of the Convention since its establishment and has been through the review process nine times. In addition, the UK regulatory system continues to be regularly peer reviewed through the IAEA's Integrated Regulatory Review Service (IRRS). As such, elements of the regulatory system have been subject to extensive international peer review on multiple occasions.

B55 The following paragraphs, are directly related to the major common issue on **fostering international peer reviews and timely addressing of findings** from the eighth and ninth review meeting.

Integrated regulatory review service

B56 In October 2019, the UK hosted a full-scope IRRS mission covering all facilities, activities and exposure situations present in the UK. For the first time, this mission included all UK bodies regulating facilities and activities concerning ionising radiation (excluding defence) and involved relevant government departments with responsibilities for policy and sponsorship of the relevant regulatory bodies. The IRRS mission made 24 recommendations to bring the UK system into further compliance with IAEA safety standards. The final report from the mission [20] and the UK Government's response [21] is available on the GOV.UK website.

B57 In January 2024, IRRS carried out a follow-up mission to the UK to assess the UK's progress in addressing the recommendations and suggestions from the 2019 mission. The

follow-up mission concluded that 19 of these recommendations are now closed. The follow-up mission report and the UK Government's response can be found on the GOV.UK website [22].

B58 During the follow-up mission, the IRRS team noted achievements in the following areas:

- The establishment of the Radiological Safety Group (RSG), an overarching coordination group that consists of senior officials from all government departments and regulatory bodies having responsibilities for radiological safety, and the Radiological Safety Working Group (RSWG) that sits beneath it.
- The Health and Safety Executive (HSE)'s development and implementation of the requirement for submission of a safety assessment before issuing consent for operating a facility or commencing work with high-risk radiation sources. This requirement has also been adopted by the Health and Safety Executive for Northern Ireland (HSENI).
- The Environment Agency introducing a new nuclear Radioactive Substances Regulation (RSR) business planning process to ensure a graded approach to inspections.
- The UK developing a new framework for facilitating national-level contribution and communication of IAEA standards updates.
- ONR's revision of its Technical Assessment Guide (TAG) 026 on decommissioning, and TAG-050 on periodic safety review.
- The Northern Ireland Environment Agency (NIEA) issuing 'Guidance on Decommissioning of Non-Nuclear Facilities for Radioactive Substances Activities', together with the Department of Agriculture, Environment and Rural Affairs (DAERA).

B59 The IRRS team also identified four good performances in relation to:

- The UK regulatory framework Draft Standards and Guidance Status Spreadsheet, which facilitates national coordination in relation to IAEA safety standards updates
- ONR's openness and transparency policy
- The decision to commission an independent and transparent assessment of ONR's culture
- The Environment Agency's establishment of a nuclear site resource prioritisation tool

B60 The IRRS team made four new recommendations and two new suggestions in relation to the topics covered during the IRRS initial mission.

B61 During the reporting period, representatives from ONR and the Scottish Environment Protection Agency (SEPA) have participated in several IRRS missions to other countries. ONR's Chief Executive/Chief Nuclear Inspector (CE/CNI) led the IRRS mission to Bangladesh and in mid-2025, ONR's CE/CNI will lead the IRRS mission to China. ONR and the UK Environmental Regulators are committed to supporting future IRRS missions.

B62 In October 2023, ONR's CE/CNI attended the IAEA international workshop for IRRS leaders to consider improvements to peer review missions. The outcome is to enhance the effectiveness of Member State's regulatory infrastructure for nuclear, radiation, radioactive waste and transport safety.

OSART and WANO missions

B63 As operator and licence holder for the UK's operational NPPs, EDF Energy NGL subscribes to a planned programme of peer reviews by the World Association of Nuclear Operators (WANO). EDF Energy NGL has also been the subject of one IAEA Operational Safety Review Team (OSART) mission at Heysham 2 during the reporting period. A follow-up

OSART mission is planned for early 2026 and a WANO mission is planned for December 2026. Many of the criteria under review by WANO and OSART include aspects of plant operations that directly relate to safety. More information on past and planned missions can be found in Article 10 – Priority to Safety.

B64 For the nuclear new build project at Hinkley Point C a pre-operational OSART is under consideration and will likely be conducted around 2028/29.

B65 Sizewell C Ltd joined WANO as a Category 5 member in 2024. This marks a significant step in the journey towards the operation of Sizewell C and reflects Sizewell C Ltd's commitment to embedding nuclear professionalism into the organisation at this early stage of the project.

European Nuclear Safety Regulatory Group Topical Peer Review on fire protection

B66 The European Union's (EU) 2014 Nuclear Safety Directive [23] includes the requirement for Member States to undertake a Topical Peer Review (TPR) every six years from 2017.

B67 Following the UK's exit from the EU, the UK now participates in European Nuclear Safety Regulators Group (ENSREG) as a third country (observer status) and voluntarily committed to participate in the second TPR exercise on fire protection at nuclear installations. ONR coordinated the UK's self-assessment and the development of the UK National Assessment Report (NAR).

B68 The UK NAR [24] was published in October 2023 and has been peer-reviewed by technical and regulatory experts from across Europe, with UK experts reviewing other countries' reports in turn. Members of the public also fed back through the ENSREG consultation process. The UK report concluded that the nuclear installations analysed have appropriate fire safety analysis and fire protection arrangements in place. ONR raised recommendations for industry to take forward including more systematic analysis of hazard combinations and improved integration of fire safety management across different purposes.

B69 Following the peer review of the NARs, international workshops were held in October 2024 to foster dialogue between regulators and industry. This enabled participants to benchmark their own performance, improve consistency across countries, and learn from each other.

B70 The peer review [25] of the UK NAR identified four areas of good performance, three of which are related to nuclear installations within the scope of this report:

- Sizewell B: There is an independent verification of hot work in addition to the assessment by the 'Hot Work Selected Person' and review by the 'Hot Work Controller' for enhanced control of work areas.
- All Nuclear Installations: The nuclear sector-wide review of combustible cladding risks instigated by the nuclear regulator, to identify and implement any transferable learning from the Grenfell Tower fire.
- Hinkley Point C, Sizewell B and second generation AGRs: Fire doors and hatches that form part of the nuclear fire compartment boundaries have position monitoring that initiate an alarm in the main control room if the door is left open.

B71 The peer review identified three areas for improvement, which had also been identified by ONR in the UK NAR and were subject to on-going regulatory oversight. None of the improvements identified apply to the nuclear installations within the scope of this report.

B72 The UK's TPR 2 action plan, including next steps, will be published later in 2025.

Other international engagements

B73 In addition to the Convention and the review missions, the UK has an extensive international footprint and leads and participates across a wide range of international activities at senior strategic and working levels. This enables the UK to influence globally, collaborate with, and learn from others to inform relevant international experience and good practice and maintain alignment with international obligations, standards and conventions.

B74 The UK has formal bilateral arrangements and agreements in place between the UK and other international bodies in the form of government-to-government agreements (GTGA) and legally binding Nuclear Cooperation Agreements (NCAs). These provide an effective mechanism to facilitate the exchange of information and technical cooperation in areas of mutual interest. ONR's bilateral cooperation is also governed and supported by strong international partnerships through bilateral engagements, and where appropriate, through arrangements formalised in Information Exchange Arrangements (IEAs). These agreements are not legally-binding and do not preclude formal arrangements that may be needed, such as export control licences but rather they establish the parameters for cooperation and information exchange.

B75 The UK, through its own engagement as a member of the IAEA and as a member of the Group of Seven (G7) inter-governmental forum, encourages all states to take part in international cooperation and the peer review process of the Convention – the UK is supportive of the continuing efforts of the Convention President and Secretariat to achieve greater engagement by all Contracting Parties.

B76 Representatives of the UK have acted as the Chair of the Heads of European Radiological Protection Competent Authorities – Working Group for Emergencies (HERCA-WGE) Task Force Ukraine. The UK's international engagement on emergency preparedness and response is discussed in more detail in Article 16 – Emergency Preparedness

B77 ONR participation in the World Government Summit, a global event focusing on innovation and technology to address universal challenges and setting the agenda for next-generation governments, highlighted ONR's piloting the world's first application of a nuclear regulatory sandbox, applied to Artificial Intelligence (AI) [26]. Regulatory Sandboxing approach to AI and ONR's international work on this topic is discussed in Article 8 – Regulatory Body.

B78 Further examples of ONR's international work include participation in IAEA standards setting, missions and conventions it sponsors, Organisation for Economic Co-operation and Development (OECD) and NEA committees and working groups, and other standards setting bodies such as the Western European Nuclear Regulators Association (WENRA). In 2023, ONR's CE/CNI was appointed as the Chair of WENRA. ONR also participates in joint inspections with other international regulators as well as international conferences and workshops aimed at improving nuclear safety.

B79 ONR's work on international collaboration for the review of SMR designs is discussed in paragraphs B37 to B41.

Vienna Declaration on Nuclear Safety

B80 The UK addressed all aspects of the Vienna Declaration on Nuclear Safety (VDNS) within the UK's seventh NR [27]. It was agreed at the seventh review meeting of the CNS that the UK was in compliance with the VDNS. Key aspects of the compliance are as follows:

B81 **Principle 1** (new power plant design, siting, and construction)

- The UK applies the internationally-endorsed principle of defence-in-depth to the design and operation of its nuclear installations and to reducing risks where reasonably

practicable; these principles are firmly embedded in ONR's Safety Assessment Principles (SAPs) [28], which have been benchmarked against IAEA Safety Standards (see Article 14 – Assessment and Verification of Safety and Article 18 – Design and Construction).

- The UK adopts a clear policy on siting of new reactors and applies procedures for evaluating site-related factors likely to affect the safety of nuclear installations for the projected lifetime (see Article 17 – Siting).
- The final layer of defence-in-depth is emergency preparedness and response and the UK continues to develop and test local, regional and national plans to ensure emergency preparedness is maintained and improved (see Article 16 – Emergency Preparedness).

B82 **Principle 2** (safety assessments and implementation of safety improvements)

- The PSR requirements of UK nuclear site licences have meant that for many years the UK has been regularly reviewing and re-assessing the safety of its nuclear installations, and making improvements where necessary. ONR maintains oversight of safety significant issues and ensures a proportionate response is taken by licensees to implementing improvements. The process of routine integrated interventions (assessment and inspection), the comprehensiveness of the PSRs and improvements made are discussed in Article 6 – Existing Nuclear Installations and Article 14 – Assessment and Verification of Safety.
- Reappraisals are undertaken at intervals to confirm continued safe operation and also to examine plant safety in the foreseeable future, reflecting changes in safety standards.

B83 **Principle 3** (considering IAEA Safety Standards and other good practices identified in the Review Meetings)

- The UK applies IAEA Safety Standards and ensures that its own regulations, regulatory requirements and guidance (SAPs) for existing and new nuclear facilities are consistent with them (See Article 18 – Design and Construction).
- The UK actively contributes to the development and revision of the IAEA Safety Standards. The SAPs were benchmarked against IAEA Safety Standards and revised in 2014 to reflect changes, including work by the IAEA in its revision to the Design Standard on the safety of nuclear power plants (SSR-2/1) [29] and insights post-Fukushima.
- The principles contained in ONR's SAPs are supported by more detailed ONR Technical Assessment Guides (TAGs), which together reflect the relevant guidance in the IAEA Safety Standards as well as other relevant good practices. (See Annex 5 – Safety Analysis of UK Nuclear Power Plants for more details).

Section C – Reporting Article-by-Article

Article 6 – Existing Nuclear Installations

Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary, in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shutdown may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

Summary statement for article

6.1 The UK fulfils the obligations of Article 6. The UK addressed the obligations of Article 6 for its existing nuclear installations when the Convention came into force for the UK in 1996. Since then, the UK has continuously taken measures to maintain and improve the safety of its nuclear installations. A summary of the operating nuclear installations in the UK and an overview of the safety issues and safety upgrades that occurred during the reporting period are presented below.

Nuclear installations in the UK

6.2 There are 13 land-based civil nuclear power plants (NPPs) within the UK that meet the definition of 'operating' in Article 2 of the Convention, consisting of 12 Advanced Gas-cooled Reactors (AGR) and a single Pressurised Water Reactor (PWR). There are twin AGRs per site. Each site has its own nuclear site licence, except for Heysham 1 and Heysham 2, which are on the same licensed site. In total, there are six AGR licensed sites and one PWR licensed site within England and Scotland, for which EDF Energy NGL is the sole licensee.

6.3 Two of the AGR sites, Hinkley Point B and Dungeness B, have ceased generation and are in the process of defuelling; they remain under the definition of 'operating'. Hunterston B has ceased generation and completed defuelling both its reactors and was confirmed as fuel-free in April 2025. Although Hunterston B no longer falls under the definition of 'operating' in Article 2 of the Convention, it is included in this report as it was within the scope of the Convention for the majority of the reporting period.

6.4 The locations of the reactors and their supporting engineering centres are indicated on the map shown in figure 6.1. Also shown are the locations of the twin reactor NPP under construction at Hinkley Point C and the site at Sizewell C where a further twin reactor NPP is planned. As Hinkley Point C and Sizewell C are not yet operating, neither are considered under Article 6.

6.5 The operating parameters for the NPP fleet are summarised in Table 1 – UK Civil Power Reactors' Key Parameters.

Reactors outside the scope of the convention

6.6 The UK's first NPPs, the Magnox reactor fleet, started generation between 1956 and 1971 and shutdown between 1989 and 2015. There were 26 Magnox reactors on 11 sites, all

of which have all now been defueled, and are out of the scope of the Convention of Nuclear Safety (and are covered under the Joint Convention).

Figure 6.1: Location of UK Operating Reactors, their Supporting Engineering Centres and Planned Sites for EPR™ Construction

Number of reactor per type	AGR	PWR	EPR	Engineering
Construction or Project			4	
Operation	14	1		
Engineering Centre				2

Note: Of the AGRs identified, six (twin AGRs at Hinkley Point B, Hunterston B and Dungeness B) have ceased generation, and are in the process of defuelling. Hunterston B completed defuelling both its reactors and was declared fuel-free in April 2025. Hunterston B is included in the figure above as it was within the scope of the Convention for the majority of the reporting period.

Life extensions and End-of-Generation of nuclear reactors

6.7 In the UK, neither nuclear site licences nor environmental permits have a time limit. Consequently, they continue in force even after a licensee has decided to shut down an NPP permanently. The onus is on the licensee to demonstrate the plant continues to be safe to operate based on its assessment of the plant condition. The licensee must decide to shut down the NPP permanently and declare the end of the NPP's operational life when it is no longer able to justify safe operations to ONR's satisfaction. Of course, an NPP may be shut down for a range of other commercial reasons.

6.8 During the reporting period, one AGR station has completed defuelling and fuel free verification, and two further AGR stations have continued to defuel. EDF Energy NGL has announced the intent to operate the four remaining AGR sites beyond their previous end-of-generation (EoG) date (see paragraphs 7.78 to 7.81 for more details), which will be supported by appropriate safety cases, Figure 6.2 shows the UK's fleet of NPPs and the current closure dates.

Figure 6.2: AGR current EoG dates

NPP Site	Commenced operations	EoG date
Hinkley Point B	1976	2022 (Shutdown)
Hunterston B	1976	2022 (Shutdown)
Dungeness B	1983	2021 (Shutdown)
Heysham 1	1983	2027 (est.)
Hartlepool	1983	2027 (est.)
Heysham 2	1988	2030 (est.)
Torness	1988	2030 (est.)
Sizewell B (PWR)	1995	2035 (est.)

Note: Sizewell B has a planned EoG date of 2035 but EDF Energy NGL are seeking to justify an extension to 2055.

Transition to decommissioning

6.9 Hunterston B commenced defuelling activities in May 2022, beginning with Reactor 3, which was safely defueled over a 16 month period. Following a fuel route outage and reset period, Reactor 4 defuelling commenced in November 2023 and completed in December 2024. Defuelling of both reactors took just over 2.5 years, and was completed with no significant safety events. Following assessment by ONR, the site was declared fuel free in April 2025.

6.10 Site focus is now on transfer of ownership and management of the site to Nuclear Decommissioning Authority (NDA) and Nuclear Restoration Services (NRS). In March 2025, ONR received an application from NRS seeking approval to become the new dutyholder for

the Hunterston B nuclear power station. The point of transfer from EDF Energy NGL to NRS is expected to be in spring 2026.

6.11 Following the completion of defuelling and fuel free verification of the Hunterston B site, the regulation of the site has been transferred to ONR's Decommissioning, Fuel and Waste sub-directorate.

6.12 Hinkley Point B and Dungeness B are continuing defuelling activities, with Hinkley Point B having completed defuelling of one of its reactors in September 2024.

6.13 Safety assessment of defuelling reactors is discussed in Article 14 – Assessment and Verification of Safety.

6.14 Operation of NPPs during the defuelling phase is discussed in Article 19 – Operation.

Overview of safety related issues

6.15 During the reporting period, there have been several safety issues across the UK's operating fleet. Each of these issues are discussed in further detail in Annex 4 – Safety Related Issues and Safety Upgrade Programmes:

- Heysham 1: Main steam supply route isolating valve failure.
- Torness: Failure of Gas Coolant Circulators (Leading to an INES-1 event and an INES-2 event (see Table 3 – Summary of Incidents and associated INES Ratings).
- Heysham 2 and Torness: Graphite degradation leading to debris in reactor core seal ring groove walls.

6.16 Hartlepool: ONR moved Hartlepool power station to enhanced regulatory attention for safety in March 2025. This decision was based on evidence gained from ongoing targeted engagements at the site which have identified areas where improvements are required. Regulatory attention levels are set by ONR and are assigned based on the regulator's assessment of overall performance, considering a broad range of safety and operational issues that a site is addressing. The Hartlepool enhanced regulatory attention level reflects the effort ONR is using to influence improvements in areas including conventional health and safety, the number of site incidents and the production of nuclear safety cases. EDF has provided an improvement plan that identifies key deliverables to address the areas of enhanced regulatory attention and welcomes the additional support and attention from the regulator to manage an ageing asset in line with accepted safety standards. Table 3 – Summary of Incidents and associated INES Ratings provides a summary of INES-1 rated events at the Hartlepool power station during the reporting period.

Overview of safety upgrade programmes

6.17 EDF Energy NGL's safety upgrade programmes are driven by a number of different reasons, such as response to safety related incidents, ageing management, outcome of safety assessments, and response to national and international OPEX. Some examples of completed and ongoing safety upgrades to support safe operation of the UK's NPPs are listed below. Each of these are discussed in detail in Annex 4 – Safety Related Issues and Safety Upgrade Programmes.

Figure 6.3: Overview of Safety Upgrade Programmes

NPP Site	Safety Upgrade Programme	Driver(s) for Upgrade
Hartlepool & Heysham 1	Development of tooling for control rod channel trepanning	Graphite ageing management
Hartlepool & Heysham 1	Improvements to the diversity of boiler feedwater routes	Outcome from safety assessment, response to INES-1 incident (Hartlepool), ageing management
Heysham 1 & Hartlepool	Managing safety risk from hydraulic shock (water hammer) events	Response to incident, ageing management
Hartlepool	Replacement of bulk fuel oil tanks	Ageing management
Heysham 1	Corrosion inspection and management	Ageing management
Heysham 1	Improvements in pressure vessel cooling provision for an extended loss of grid scenario	Safety assessment
Heysham 2 & Torness	Installation of a Leak Termination System to mitigate water ingress and reactor overpressure faults	Safety assessment (periodic safety review)
Heysham 2 & Torness	Move to off-load depressurised refuelling	Graphite ageing management
Heysham 2 & Torness	Graphite core seal ring groove wall risk mitigation	Graphite ageing management
Sizewell B	Fault studies on core barrel cracking	Response to international OPEX
Sizewell B	Stress corrosion cracking inspections	Response to international OPEX
Sizewell B	Installation of a filtered containment venting system to mitigate severe accidents	Response to international OPEX
All	Grid stability work	Improvements to the UK national grid to support a low-carbon energy system

6.18 In addition to the site-specific programmes listed above, EDF Energy NGL also has several fleetwide ageing and obsolescence management programmes. These are also discussed in Annex 4 – Safety Related Issues and Safety Upgrade Programmes.

Summary of significant changes since previous report

6.19 During the reporting period, developments under this Article are as follows:

- One station (Hunterston B) completed defuelling and fuel free verification.
- Two further stations (Dungeness B and Hinkley Point B, which ceased generation in 2021 and 2022 respectively) continue to defuel.
- EDF Energy NGL announced the intent to operate the four remaining AGR stations beyond their previous end-of-generation (EoG) date.

Notable achievements

6.20 **Defuelling of shutdown AGRs and preparations for transfer of ownership and regulation:** Three AGR sites (Hunterston B, Hinkley Point B, and Dungeness B), ceased generation and began defuelling activities during the reporting period. Both reactors at Hunterston B completed defuelling in December 2024, with no top tier safety events. Fuel free verification was completed and Hunterston B was declared fuel free in April 2025. Hinkley Point B and Dungeness B are continuing defuelling activities.

6.21 Following fuel free verification, ownership of the sites will be transferred to Nuclear Decommissioning Authority (and NRS management). In March 2025, ONR received an application from NRS seeking approval to become the new dutyholder for the Hunterston B nuclear power station. The point of transfer from EDF Energy NGL to NRS is expected to be in spring 2026. Transfer of site ownership to NDA is expected to provide synergy opportunities, especially where there are adjacent Magnox sites. These sites are Hunterston A and B, Hinkley Point A and B, and Dungeness A and B, with all A sites currently under NRS management and B sites currently under EDF Energy NGL ownership. In time and subject to stakeholder engagement, opportunities may exist for joint working and sharing of facilities and resources between A and B sites.

6.22 When each site is free from all fuel, regulation of the site will transfer to ONR's Decommissioning, Fuel and Waste (DFW) sub-directorate, as has happened with Hunterston B. This transfer enables ONR to benefit from staff's considerable knowledgebase and experience of regulating decommissioning sites, to effectively and efficiently regulate the defueled AGRs until they are delicensed.

Future focus

6.23 The AGR NPPs are approaching the end of their lives with final shutdown for the remaining stations scheduled between 2027 and 2030. There are a number of issues that challenge reactor lifetimes, including boiler corrosion, ageing management of plant and graphite brick cracking. These issues require the licensee to provide enhanced safety cases to justify continued operation, which must be acceptable to ONR. Both licensee and regulator continue to work closely to ensure that the reactors can operate safely in the face of these challenges.

Article 7 – Legislative and Regulatory Framework

Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

The legislative and regulatory framework shall provide for:

I. the establishment of applicable national safety requirements and regulations;
II. a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;
III. a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;
IV. the enforcement of applicable regulations and of the terms of licences, including suspension, modification, or revocation.

Summary statement for article

7.1 The UK fulfils the obligations of Article 7. It has a comprehensive regulatory framework with national safety requirements and regulations, a system of licensing and a system of regulatory inspection and assessment for nuclear installations. It also has comprehensive arrangements for the enforcement of applicable regulations and the terms of licences.

Enactment of the legislative framework of the United Kingdom

7.2 The Parliament of the United Kingdom of Great Britain and Northern Ireland, centred in Westminster, London, is the supreme legislative body in the UK. Parliament alone possesses legislative supremacy over all devolved political bodies in the UK and its territories.

7.3 Laws can be made by Acts of Parliament, which are primary legislation. Acts can apply to the whole of the UK or to parts of it.

7.4 There are several Acts of Parliament that apply to the nuclear installations in the UK. Under the UK system of legislation all Acts of Parliament have equal status and must be complied with. Due to the continuing separation of Scottish law, however, many Acts do not apply to Scotland. Where this is the case, they are either matched by equivalent Acts that apply to Scotland alone or, since 1999, by legislation made by the Scottish Parliament relating to devolved matters. Nuclear safety is not a devolved matter; it is 'reserved' to the UK Parliament in Westminster so any nuclear safety legislation must be passed by the UK Parliament. However, certain topics, including protection of the environment and radioactive waste management, are devolved matters and hence the Scottish Government has responsibility for these areas. The same is true for Wales and Northern Ireland. Some laws passed by the UK Parliament only apply to Great Britain (GB) – consisting of England, Scotland, and Wales.

7.5 Secondary legislation, for example in the form of regulations, is a type of statutory provision in the UK legislative system. Regulations can be made by a Secretary of State or minister where primary legislation (an Act of Parliament) gives the power to do so. The scope of the secondary legislation that can be made by the Secretary of State or minister is specified in the primary legislation containing the relevant power. The primary legislation may also include requirements about who must be consulted during the drafting of the secondary legislation; for example, a requirement to consult the relevant regulatory bodies.

Establishing and maintaining a legislative and regulatory framework

7.6 A wide range of legislation must be described to demonstrate compliance with the Convention. This section describes the key legislative and regulatory measures that apply directly to nuclear installations.

7.7 For these items it describes, where applicable, the primary and secondary legislation and licensing regimes.

7.8 The legislation governing nuclear safety at nuclear installations applies to GB only, as there are no nuclear installations in Northern Ireland, nor any planned.

7.9 The principal primary legislation for ensuring the safety of nuclear installations consists of the following Acts of Parliament:

- The Health and Safety at Work etc. Act 1974 (HSWA74) [30]
- The Nuclear Installations Act 1965 (NIA65) [31]
- The Energy Act 2013 (TEA13) [32]

7.10 The key features of each of the statutes above are summarised below, followed by other Acts considered relevant to the Convention.

The Health and Safety at Work etc. Act 1974

7.11 HSWA74 applies to all work activities within the UK and hence is broader than nuclear safety. HSWA74 allows regulations to be made and there are many of these relating to industrial safety, radiation protection and radiation emergency preparedness.

7.12 Under HSWA74 a general duty is placed on every employer and the self-employed to conduct their undertaking in such a way as to ensure, so far as is reasonably practicable (SFAIRP), the health and safety at work of their employees and those affected by their work activities. The principle of SFAIRP is goal setting. ONR uses, and has set out in guidance, the concept of relevant good practice (RGP). RGP is the generic term used for those standards or approaches to managing risk that have been judged and recognised by ONR and the industry as satisfying the law when applied to a particular relevant case in an appropriate manner. (See Annex 3 – SFAIRP, ALARP and ALARA for more details).

7.13 Legislation made ONR the enforcing body for the HSWA74 on GB nuclear sites, including nuclear new build construction work and any associated articles designed, manufactured, imported, or supplied for use on the site.

7.14 HSWA74 also allows ONR to appoint inspectors and to provide them with similar enforcement powers to those under TEA13.

The Nuclear Installations Act 1965

7.15 Under the NIA65 no site can be used for the purpose of installing or operating a nuclear installation unless a nuclear site licence is currently in force, granted by ONR. Only a corporate body, such as a registered company or a public body, can hold a licence and the licence is not transferable. Those parts of the NIA65 relevant to safety and licensing are 'relevant statutory provisions' of TEA13, which means they are enforced by ONR under that legislation.

7.16 NIA65 requires and permits ONR to attach such conditions to a site licence as it sees appropriate in the interests of safety or radioactive waste management. It is an offence under the law not to comply with LCs [13].

7.17 NIA65 also allows ONR to recover its costs associated with licensing and enforcement of the LCs from licensees.

The Energy Act 2013

7.18 TEA13 sets out the provisions that created the ONR as a statutory body, establishing its purposes, powers, and functions. ONR's purposes are those relating to regulating nuclear safety, nuclear site health and safety (NSHS), civil nuclear security, nuclear safeguards, and the transport of radioactive material by rail, road and inland waterway.

7.19 TEA13 also allows for 'nuclear regulations' to be made to provide additional statutory requirements with respect to nuclear safety, security, safeguards and the transport of radioactive material.

7.20 TEA13 establishes ONR's ability to appoint inspectors and provides those inspectors with legal powers, which are necessary for ONR to meet its enforcement responsibilities under S.82 TEA13, described later in this Article.

7.21 ONR was formally established as a statutory public corporation on 1 April 2014. Its regulatory functions were formerly carried out by other bodies. Within this report, the term ONR is used to denote not only the current regulatory body, but also any of its predecessor bodies.

The Environment Act 1995

7.22 Discharges and disposals of radioactive wastes from nuclear sites are regulated by environmental law. The key legislation for this is the Environment Act 1995 (EA95) [33] and associated secondary legislation (for example the Environmental Permitting (England and Wales) Regulations 2016 (EPR16) [34], and the Environmental Authorisations (Scotland) Regulations 2018 (EASR18) [35]. EA95 provides the regulatory framework for environmental protection. There have been some subsequent revisions to the framework. There is additional legislation in Wales, the Environment (Wales) Act 2016 [36], which promotes sustainable management of natural resources in decision making. The Climate Change (Scotland) Act 2009 [37] places duties on SEPA (and all Scottish public bodies) to 'act sustainably' and consider climate change mitigation and adaptation in all decision-making. The environmental regulators for the countries of the UK with nuclear sites are:

- Environment Agency in England
- Scottish Environment Protection Agency (SEPA) in Scotland
- Natural Resources Wales (NRW) in Wales (although currently there are no nuclear installations in Wales that fall within the scope of the Convention)

7.23 EA95 also provides for the transfer of functions to the environmental regulators, including powers and duties in relation to radioactive substances regulation.

7.24 Generally, the Environment Agency, SEPA and NRW have regulatory responsibilities for a range of other activities on, or from, nuclear sites, including the regulation of the following, which are relevant to the Convention:

- Mobile high activity sealed sources (HASS) on nuclear sites, and all HASS owned by tenants on nuclear licensed sites
- Abstraction from and discharges to controlled waters, including rivers, estuaries, the sea and groundwaters
- Requirements under the Control of Major Accident Hazards Regulations 2015 (COMAH) [38] at nuclear sites, where ONR and the relevant environmental regulator are the Joint Competent Authority

7.25 Annex 2 – The Environmental Regulatory Bodies provides more information on the mandates of the environmental regulatory bodies.

The Energy Act 2008

7.26 The Energy Act 2008 [39] made provision for the management and disposal of waste produced during the operation of nuclear installations, including introducing a requirement for prospective operators of new nuclear power projects to prepare and submit a funded decommissioning programme (FDP) when they apply for a nuclear site licence.

7.27 A FDP makes provision for the treatment, storage, transportation and disposal of waste and for the decommissioning of the power station and the clean-up of the site. It also sets out estimates of the costs likely to be incurred in relation to the decommissioning and clean-up of the site, and the construction and maintenance of an interim store built during the operation of the plant, as well as how those aspects of the programme are to be funded.

Obligations under international treaties, conventions, or agreements

7.28 The UK is committed to maintaining high levels of safety and contributes its expertise to the development of relevant international safety standards. Safety standards developed by international bodies such as the IAEA and International Commission on Radiological Protection (ICRP) are widely regarded as international good practice. The UK actively contributes to these and adopts them into its laws, regulations, and guidance. In so doing, the UK continues to demonstrate full compliance with the obligations in the relevant Conventions. The UK recognises the IAEA's safety standards as the primary standards that its safety framework is measured against and routinely welcomes IAEA peer review missions (see B56 to B72). This independent benchmarking ensures the UK benefits from sharing good practice and learning across IAEA member states, demonstrating the UK's commitment to high safety standards.

7.29 The EU Nuclear Safety Directive 2014/87/Euratom [40] and the EU Basic Safety Standard Directive 2013/59/Euratom [41] were historically implemented in the UK. Following the exit from the EU, the UK amended its domestic legislation to ensure a workable regime. The UK then entered into a Nuclear Cooperation Agreement (NCA) with Euratom which notes the international conventions that apply to both parties (including the CNS) and under which, the UK has agreed not to weaken or reduce the levels of protection in relation to nuclear safety as they stood at the point at which it left the EU.

National safety requirements and regulations

Secondary legislation

7.30 In common with all UK industries, nuclear installations must comply with non-nuclear safety specific regulations made under the HSWA74 in addition to nuclear regulations made under TEA13. The key regulations applicable to nuclear installations are set out below.

Ionising Radiations Regulations 2017

7.31 The Ionising Radiations Regulations 2017 (IRR17) [42] are relevant statutory provisions of HSWA74. They provide for the protection of all workers and members of the public, whether on licensed sites or elsewhere, from ionising radiation. IRR17 came into force on 1 January 2018 and replaced Ionising Radiations Regulations 1999 (IRR99) [43]. IRR17 implemented the worker safety aspects of the European Council (EC) Directive establishing Basic Safety Standards (2013/59/Euratom) (known as the Basic Safety Standards Directive) which the UK was required to implement when it was an EU member state and includes the setting of radiation dose limits for employees and members of the public for all activities involving ionising radiation. IRR17 also implemented EC Directive 90/641/Euratom. IRR17 is further discussed in Article 15 – Radiation Protection.

Radiation (Emergency Preparedness and Public Information) Regulations (REPPIR) 2019

7.32 REPPIR 2019 [44], came into force on 22nd May 2019 in GB and implemented the radiation emergency requirements set out in EC Directive 2013/59/Euratom, which the UK was required to implement when it was an EU member state and repealed and replaced REPPIR 2001.

7.33 Implementation of REPPIR 2019 ensured that arrangements were sufficiently flexible to respond to very low probability events and commensurate with the range of hazards for each facility in addition to other enhancements. REPPIR is further discussed in Article 16 – Emergency Preparedness.

7.34 REPPIR is supported by a statutory Approved Code of Practice (ACoP) and non-statutory guidance. Where REPPIR 2019 set out legal duties, the ACoP and guidance give practical advice on how to comply with those requirements. The REPPIR ACoP is intended for use by dutyholders; that is, persons having legal responsibilities under the REPPIR regulations.

The Management of Health and Safety at Work Regulations 1999

7.35 The Management of Health and Safety at Work Regulations 1999 (MHSWR99) [45] are relevant as they place requirements on employers, and hence nuclear site licensees.

7.36 MHSWR99 are very wide-ranging. Where their requirements overlap with other health and safety regulations, compliance with the more specific regulations is normally sufficient for compliance with MHSWR99.

7.37 As part of the suite of supporting regulations to the HSWA74, the MHSWR99 sets the expectations on dutyholders in Regulation 5 to make appropriate arrangements for health and safety management. It also states that these should be prioritised and set in the appropriate context for the size and complexity of the organisation, and the hazards and risks present. This is consistent with Regulation 4, which requires the principle of prevention to be applied, and then supported by Schedule 1, which defines the principles of control.

The Carriage of Dangerous Goods (CDG) and Use of Transportable Pressure Equipment Regulations 2009

7.38 The UN Model Regulations define classes of dangerous goods, with nuclear materials being Class 7. Dutyholders transporting Class 7 goods by road, rail, or inland waterway in GB must comply with the requirements of CDG 2009 as amended on 21st April 2019 by Carriage of Dangerous Goods (Amendment) Regulations 2019 to implement the Basic Safety Standards Directive.

Overview of regulations and guides issued by ONR

7.39 To ensure that the regulatory interpretation of LCs is consistent, ONR has published a set of Technical Inspection Guides (TIGs) [46]. TIGs provide guidance to ONR's inspectors on the purpose of LCs and inspection to monitor the adequacy of nuclear site licensees' arrangements against legal requirements.

7.40 ONR inspectors use Safety Assessment Principles (SAPs) [28], together with the supporting Technical Assessment Guides (TAGs) [47], to guide regulatory decision making in the nuclear permissioning process. Underpinning such decisions is the legal requirement on nuclear site licensees to reduce risks SFAIRP. The use of these SAPs should be seen in that context. The SAPs incorporate IAEA safety standards and other relevant international and

national standards (See Annex 5 – Safety Analysis of UK Nuclear Power Plants for more details).

7.41 The SAPs and supporting TAGs and TIGs are all available to the public and provide nuclear site dutyholders with information on the regulatory principles against which the adequacy of their safety provisions will be judged by ONR inspectors. However, the SAPs and supporting guidance are not intended or sufficient to be used as design or operational standards as they reflect the non-prescriptive nature of the UK's nuclear regulatory system.

7.42 Following the Fukushima accident, the SAPs were reviewed and revised to include the lessons identified relevant to the UK nuclear industry and were re-issued in 2014. The document was further revised in January 2020 to capture minor typographical corrections and to reflect changes to the UK's nuclear regulatory framework since 2014, principally changes to statutory instruments.

7.43 ONR introduced the Security Assessment Principles (SyAPs) [48] in 2017, which it uses in the same way as it uses SAPs, together with supporting TAGs, to guide regulatory judgements and recommendations when undertaking assessments of dutyholders' security submissions. Underpinning the requirement for these submissions, and ONR's role in their approval, are the legal duties placed on organisations subject to the Nuclear Industries Security Regulations (NISR) 2003 [49] and as amended [50]. In 2020/2021, ONR also implemented the UK State System of Accounting for and Control of Nuclear Material (Safeguards) [51], necessitated by the UK's decision to leave the EU and hence Euratom. Nuclear security and safeguards aspects are out of the scope of the Convention, and as such are not discussed further in this report.

System of licensing

Nuclear site licensing

7.44 The safety of nuclear installations in GB is assured by a system of regulatory controls based on a licensing process. A nuclear site licence may only be issued to a corporate body and must be in force before a site may be used to install or operate a nuclear reactor or other specified installations or facilities.

7.45 ONR's publication 'Licensing Nuclear Installations' [52] provides guidance on how ONR regulates the design, construction, and operation of any nuclear installation in GB for which a nuclear site licence is required under the NIA65. Such installations include:

- nuclear power stations
- nuclear fuel manufacturing facilities
- nuclear defence facilities for weapons manufacturing and fuelling/maintenance of nuclear submarines
- nuclear reprocessing facilities
- facilities for the storage of bulk quantities of radioactive matter which has been produced or irradiated during the production or use of nuclear fuel.

7.46 The sections of NIA65 relating to the licensing (Section 1) and attaching of conditions (Section 4) to the licence are 'relevant statutory provisions' of TEA13 and subject to TEA13 arrangements for regulation and enforcement.

7.47 A nuclear site licence is granted for an indefinite period and, providing there are no material changes to the basis on which the licence was granted, it can cover the entire lifecycle of a site from installation and commissioning through operation and decommissioning to site clearance and remediation. The granting of a site licence brings an operating organisation, or

potential operating organisation, into a more rigorous regulatory regime than would be achieved using more general health and safety legislation. The granting of a site licence does not automatically give permission for a proposed plant to be built and operated; further permissions are required for these activities. Routine regulatory inspection and assessment, and the periodic safety review (PSR) process ensure that the licensing basis is maintained.

7.48 A nuclear site licence is issued to a corporate body based on a satisfactory outcome of regulatory assessment of an applicant's case including:

- the capability, organisation and resources of the applicant corporate body
- the nature of the prescribed activities and the relevant safety case
- the nature and location of the site

7.49 NIA65 requires ONR to consult the appropriate environment regulator before granting a new nuclear site licence. This is to ensure that granting a new licence will not conflict with the environment regulator's environmental protection responsibilities or prejudice any legal process under environmental legislation. ONR has a discretionary power under Section 3(4) of NIA65 to direct a licence applicant to serve notice on the public bodies ONR specifies. These bodies will normally be local to the site in question and may include, for example, local authorities and emergency services. The intention of public body notification is to ensure that relevant public bodies who have statutory duties in relation to the site have an opportunity to be informed of the licence application and to advise ONR whether their duties may be affected by the licensable activities.

7.50 NIA65 requires ONR to attach to each nuclear site licence such conditions as it considers necessary or desirable in the interests of safety, referred to as licence conditions (LCs). Regulatory control of activities on a licensed site is exercised using these site LCs, and ONR has promulgated 36 standard LCs that together form a legal basis for requiring high standards of nuclear safety [13]. The conditions are generally non-prescriptive but set goals for all aspects of managing and assuring nuclear and radiological safety. ONR requires that a prospective licensee provides evidence that it can comply with the LCs. Once a site licence has been issued, the licensee must comply with the LCs. Each licensee develops LC compliance arrangements that best suit its activities, while demonstrating that safety is being managed properly. While the system gives flexibility to licensees, it secures high standards in a wide spectrum of nuclear facilities without being prescriptive or requiring detailed rule making by the regulatory body.

7.51 A licence is not transferable, but a replacement licence may be granted to another corporate body if that body demonstrates it is fit to hold a licence. Other circumstances that may lead to the need to relicense a site include changes to the site boundary, changes to the types of prescribed installation or facility for which the site is licensed, or transfer of ownership to a different corporate body. In considering an application for a replacement licence, ONR would take a proportionate approach and focus particularly on those aspects of the licensing basis that are the subject of the change.

7.52 A licence may be revoked by ONR or surrendered by the licensee. However, depending upon the circumstances, the licensee may be required to retain certain responsibilities for the site. This 'period of responsibility' is ended only when a new licence has been granted for the site, the site is used by the UK Government for defence purposes and does not require a licence, or has ceased to be any danger from ionising radiation from anything remaining on the site.

Sizewell C Site Licence Application

7.53 On 30 June 2020, ONR received an application from NNB Generation Company (SZC) Ltd (now Sizewell C Ltd) for a nuclear site licence to construct and operate a twin EPR™ power station at Sizewell in Suffolk, adjacent to the existing Sizewell B station.

7.54 Following the nuclear site licence application, ONR developed a programme of regulatory activities and an assessment strategy covering the expectations for a prospective licensee. During this phase, ONR's focus was the assessment of the adequacy of the prospective licensee's proposed arrangements, site suitability, safety submissions and organisational capability.

7.55 In its initial assessment, ONR identified two outstanding matters related to the shareholders' agreement and ownership of land at the site that required resolution before a licence could be granted. Following the resolution of the outstanding matters by the applicant, ONR inspectors conducted a proportionate reassessment of the Sizewell C nuclear site licence application and a nuclear site licence was granted, coming into effect from 7 May 2024.

7.56 ONR's formal regulatory responsibility starts at the point of granting of a nuclear site licence. ONR can use the powers available under the site licence to require the licensee to request permission for starting nuclear safety related construction at Sizewell C. Similarly, Sizewell C Ltd will be required to seek ONR's permission to proceed to subsequent, key construction and commissioning stages up to the start of commercial operation.

System of regulatory inspection and assessment

7.57 ONR has responsibility for the day-to-day exercise of the nuclear licensing function. The regulatory functions are vested in the Chief Nuclear Inspector (CNI), as the authoritative regulatory head, who delegates specific functions as appropriate to nominated inspectors.

Inspections carried out to verify compliance with the licence and relevant regulations

7.58 Inspection is mainly undertaken on licensees' premises. It entails inspection of licensees' compliance with LCs and their corresponding arrangements and to ensure that operation remains within the boundaries of the safety case (which defines the safe limits and conditions). Most routine site inspection is carried out by ONR's site inspectors. ONR inspectors are not resident on site, however in general they will spend a part of their working time on site. Additionally, ONR undertakes team inspections on specific topics (see Article 14 – Assessment and Verification of Safety for more information).

Assessments carried out in support of permissioning activities

7.59 Before ONR can permission key activities, ONR assesses licensees' safety cases, based on potential consequences, to ensure that the hazards have been understood and will be properly controlled (See Article 14 – Assessment and Verification of Safety for more information).

Periodic safety reviews

7.60 LC15 (Periodic Review) requires the licensee to conduct PSRs at installations. ONR assesses the outcomes of licensees' reviews. It maintains oversight of safety significant issues and ensures a proportionate response is taken by licensees to implementing improvements (see Article 14 – Assessment and Verification of Safety for more information).

Enforcement of applicable regulations and terms of licences

7.61 A wide range of enforcement powers are available to ONR. These powers arise from both TEA13 and HSWA74 and are broadly the same across both Acts.

7.62 Inspectors are appointed through a legal instrument in writing, referred to as a warrant. The warrant can confer a wide range of powers to the inspector, such as the power of entry to premises at any time, power to take evidence into possession and power to have an incident scene left undisturbed.

7.63 ONR has an Enforcement Policy Statement (EPS) [53] that defines enforcement as all interactions with those on which the law places duties. The EPS also sets out the purpose of enforcement, and the principles that should be applied across all enforcement activity.

Enforcement management model

7.64 To ensure inspectors take consistent, proportionate, and transparent enforcement action, ONR is guided by its Enforcement Management Model (EMM) [54]. The model follows a formal internal review process and ONR may also engage with other stakeholders including other regulatory bodies. The enforcement recommendation is recorded in a decision record, which is used to support and justify the associated enforcement action taken.

7.65 The purpose of the EMM is to:

- Provide a framework for making enforcement decisions
- Ensure proportionate, consistent, and transparent enforcement decision making
- Ensure the regulator is accountable for enforcement decision making
- Adopt a risk-based criteria to target enforcement action
- Better equip inspectors to make decisions in complex cases and allow peer review of enforcement action

7.66 The EMM enables ONR to coordinate enforcement management information more easily. Key enforcement powers that are available to ONR inspectors, as set out in HSWA74 and TEA13 are:

- Improvement Notice (IN) – if an inspector is of the opinion that one or more relevant statutory provisions (or applicable provisions for TEA13) is being contravened or has been contravened in circumstances that will continue or be repeated, they can serve an IN. The Notice requires that the stated improvements be made within a specified timescale.
- Prohibition Notice (PN) – if an inspector is of the opinion that an activity is being, or is likely to be, carried out that risks causing serious personal injury, they can serve a PN to immediately halt an activity.
- Prosecution – ONR inspectors have the power, in England and Wales, to institute proceedings in a court of law for an offence under any of the relevant statutory provisions, including failure to comply with an IN or PN. In Scotland, an inspector can recommend that a prosecution be initiated to the Crown Office and Procurator Fiscal Service. ONR's administrative arrangements require senior level approval to exercise this power.

7.67 ONR has other regulatory powers through the standard LCs, which are referred to as primary powers and are legally binding. There are six primary powers, and they provide for regulatory control of certain activities. When used, they are done so through issuing Licence Instruments (LI) to the licensee. The primary powers are described below:

- Direction – a direction is issued by ONR when it requires the licensee to take a particular action, such as shutting down specified operations.
- Specification – this power gives ONR discretionary controls with regard to a licensee's arrangements.
- Notification – this power gives ONR the ability to request the submission of information by notifying the licensee of the requirement.
- Consent – this power is used to ensure permission is granted before the licensee can carry out any activity that has been specified or directed to require Consent from ONR. Before being given Consent, the licensee must satisfy ONR that the proposed action is safe and that procedures necessary for control are in place.
- Approval – this power can be used to control a licensee's arrangements. Once formally approved by ONR, such arrangements or procedures cannot be changed without the licensee seeking approval from ONR.
- Agreement – this power allows the licensee to proceed with a particular activity or course of action when ONR's agreement is given.

7.68 The powers through the licence and the primary legislation above are deemed sufficient to regulate nuclear safety. However, to ensure efficient regulation, the licensee's arrangements often incorporate further provisions, referred to as derived powers (NB: these are not derived from legislation). For example, through derived powers given in the licensee's arrangements, the most significant category of modification proposals may be required to be submitted to ONR for agreement before they can be implemented. Similar controls could be achieved through primary powers, and the use of derived powers does not preclude use of primary powers. The use of these derived powers has the benefit of introducing more flexibility to develop and implement hold point control plans, efficient use of resource and reduction of bureaucracy. It also encourages enhanced self-assurance and internal regulatory control on the part of the licensee. ONR will only use derived powers when they are confident that the licensee's arrangements are robust and regularly sample checks the adequacy of the arrangements.

ONR Risk-Informed Policies and Frameworks

7.69 The scale of the UK nuclear sector requires ONR to deploy its regulatory resource in a targeted manner, to ensure that it can regulate the nuclear industry efficiently and effectively. ONR does this by focusing on those activities giving rise to the most serious risks, or where the related hazards or vulnerabilities are least well controlled, or where it decides that ongoing compliance with relevant legislation needs to be established. In 2024, ONR published the Risk Informed Targeted Engagements (RITE) Policy [55], which sets out how ONR expects inspectors to target regulatory engagements in a risk-informed manner.

7.70 It supports inspectors in deciding what to engage dutyholders on, based on their judgement of risk prior to and during regulatory engagements, according to the following six principles:

- Inspectors should have a broad awareness of the types and **balance of risks** across all relevant purposes, to ensure regulatory effort is targeted and proportionate.
- **Regulatory strategies** should set out clearly how outcomes are risk-informed and intelligence-led and provide a baseline for schedule and resource planning.

- **Regulatory plans** defining the schedule and resource demand for engagements should adopt a graded and intelligence-led approach to target and sample matters of ongoing regulatory priority.
- **Regulatory engagement scopes** should capture the purpose of specific engagements and use a graded approach to risk-informed targeting and sampling.
- **Responsibilities and accountabilities for targeting** regulatory effort should be clear and inspectors should collaborate to secure balanced outcomes.
- Inspectors should work in a way that **supports those they regulate to comply and grow**.

7.71 The RITE policy will continue be progressively embedded into ONR's arrangements and culture during 2025/2026.

7.72 During the reporting period, ONR also republished its Risk-Informed Regulatory Decision-Making (RIRDM) document [56], which sets out ONR's risk-based framework for making regulatory decisions. This document sets out the framework and criteria by which ONR, in implementing its regulatory purposes, makes decisions. It describes how ONR considers scientific evidence and uncertainties, and strikes the balance between the benefits and disadvantages of a dutyholder adopting a measure, to avoid or control the risks. The document is aimed at helping ONR's stakeholders understand how ONR makes regulatory decisions.

7.73 ONR recently created the Strategic Prioritisation Regulatory Intelligence Tool (SPRINT) [57] to inform ONR's regulatory resource decisions. SPRINT is a multifactor framework that presents comparative ranking for ONR's regulatory activities and the policy states how ONR will use SPRINT to prioritise regulatory activities and resources.

ONR appeals process

7.74 A licensee or licence applicant that is dissatisfied with a particular regulatory decision may raise concerns with the relevant ONR inspector and ONR senior management. If the matter is not resolved, there is the opportunity to appeal to ONR to reconsider the regulatory decision. The ONR website details complaints procedures, including the appeal procedure [58]. Should issues not be resolved after consideration by the Senior Director of Regulation, the appellant may request a 'decision review' to be undertaken by the CNI.

7.75 Nuclear site licensees or other relevant dutyholders have the right of appeal to an employment tribunal in respect of Improvement and Prohibition Notices issued to them under TEA13 or HSWA74. More generally, within UK law, a judicial review can challenge the lawfulness of any decision or action by a regulatory body or any other public body. The court can clarify or confirm the powers of public bodies through this procedure.

Enabling Regulation

7.76 ONR's compliance with the principles of the UK Government's Regulators' Code [59] is demonstrated through a regulatory philosophy that is to work in an enabling way with dutyholders [60], whilst enforcing compliance with the law and regulatory requirements.

7.77 ONR adopts an 'enabling' approach with compliant dutyholders and other relevant stakeholders that seeks effective delivery against clear and prioritised safety outcomes. This approach has and continues to prove very successful, influencing significant progress and improvements on longstanding safety issues.

Enabling Regulation – EDF Energy NGL lifetime extensions for Advanced Gas-cooled Reactors (AGRs)

7.78 During the reporting period, EDF Energy NGL announced the intent to extend the operational life of four AGR stations beyond their previous end of generation dates, with Heysham 2 and Torness now due to generate until March 2030 and Hartlepool and Heysham 1 due to generate until March 2027.

7.79 In accordance with the UK regulatory regime, nuclear power plant life extension decisions do not need formal regulatory assessment or permissioning by ONR. However, it is a requirement of the site licence that operations on a licensed nuclear site be carried out under a valid safety case.

7.80 In accordance with its enabling regulatory approach, ONR worked constructively with EDF Energy NGL on its lifetime extension ambitions, while ensuring it achieves the required standards of safety in the most practical way.

7.81 ONR advised EDF Energy NGL that several safety cases at each station are likely to require updating to achieve EDF's stated ambitions, together with investment in plant to sustain equipment reliability, whilst ensuring that the necessary people and skills are available.

Environmental regulation

7.82 There are a range of enforcement powers available to the environmental regulators, which include those arising from EPR16 (in England and Wales) and EASR18 ((together with the Regulatory Reform (Scotland) Act 2014 [61] and the Environmental Regulation (Enforcement Measures) (Scotland) Order 2015) [62]) and are broadly similar across the devolved nations of the UK.

7.83 Individual inspectors are appointed through a legal instrument called a warrant and this document can confer a wide range of powers on the inspector under Section 108 of EA95, such as the power of entry to premises at any time, power to take evidence into possession; and power to have an incident scene left undisturbed.

7.84 The Environment Agency has published the Enforcement and Sanctions Policy [63], which explains how it makes enforcement decisions, the types of tools available and associated processes. These range, for example, from providing advice and guidance through to prosecution. Similarly, NRW has published regulatory guidance on its regulatory principles [64] and NRW enforcement powers [65], and SEPA has published both enforcement policy and enforcement guidance (References [66] and [67]). Key enforcement measures that are available to the environmental regulators include:

- Providing advice and guidance
- Issuing warnings
- Arranging court injunctions and court orders
- Agreeing Enforcement Undertakings (voluntary agreements)
- Serving Fixed and Variable Monetary Penalties (FMPs, VMPs)
- Serving Notices, which include Stop, Suspension, Enforcement, Prohibition, Compliance Restoration, and Anti-Pollution Works
- Revoking an environmental permit
- Issuing a variation of an environmental permit

- Issuing a formal caution
- Prosecution

7.85 During the reporting period, Environment Agency introduced a new nuclear Radioactive Substances Regulation (RSR) business planning process to ensure a graded approach to inspections. This was recognised as a good performance during the IRRS follow-up mission in January 2024 (See paragraphs B56 to B60).

Environmental regulators appeals process

7.86 Enforcement action (specifically the imposition of a sanction) can normally be appealed either through the court process or through specific appeal provisions. The environmental regulators' notices set out the rights of appeal that apply in the specific circumstances of each sanction or provision.

Summary of significant changes since previous report

7.87 During the reporting period, ONR has published a number of Risk-informed policies and frameworks to optimise its regulatory practices. These are as follows:

- Risk Informed Targeted Engagements (RITE) Policy [55]
- Risk Informed Decision Making (RIDM) Framework (Republished) [56]
- Strategic Prioritisation Regulatory Intelligence Tool (SPRINT) [57]

Notable achievements

7.88 **ONR Risk Informed Targeted Engagements Policy:** This policy sets out how ONR expects inspectors to target regulatory engagements in a risk-informed manner. It supports inspectors in deciding what to engage dutyholders on, based on their judgement of risk prior to and during regulatory engagements, according to a number of principles based on the balance of risks and targeting, regulatory strategies, plans and engagement scopes (See paragraphs 7.69 to 7.71 for more details).

Article 8 – Regulatory Body

Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy.

Summary statement for article

8.1 The UK fulfils the obligations of Article 8. The information in this Article is directly related to the major common issues on **managing extraordinary circumstances impacting the safe operation of nuclear installations** and **strengthening national regulatory capabilities, taking into account new and innovative technologies** from the joint eighth and ninth review meeting.

Establishment of the regulatory body

Legal foundation and statute of the regulatory body

8.2 These aspects are covered under Article 7 – Legislative and Regulatory Framework.

ONR's mandate, mission, and tasks

8.3 The ONR's function is to regulate the safety and security of nuclear facilities, and the safeguarding of nuclear materials within its legal remit. ONR regulates safety at 36 licensed nuclear sites in the UK. These include the existing fleet of operating reactors and decommissioning power stations. In addition, ONR regulates the design and construction of new nuclear facilities and the transport of nuclear and radioactive materials. ONR also has a safeguards regulatory function that works with the IAEA to ensure that safeguards obligations for the UK are met. ONR co-operates with international bodies on safety and security issues of common concern, including associated research.

8.4 ONR's role, captured in its mission statement, is to 'Protect society by securing safe nuclear operations'. ONR has published its strategy [68, 69] and plans [70] for the delivery of this on its website. The vision for ONR over the lifetime of the current strategy is 'To be a modern, transparent regulator delivering trusted outcomes and value'.

8.5 ONR delivers its strategy through core functions of licensing and permissioning of sites/ prescribed activities (i.e. authorisation), inspection and enforcement, review and assessment and ensuring the required standards of safety, security and safeguards are achieved. It deploys its inspectors to deliver these functions across the UK licensed sites for all its purposes. ONR is the legal enforcing authority for nuclear safety on GB licensed sites and acts in conformance with its Enforcement Policy Statement (EPS) [53] – implemented in accordance with the UK Regulators' Code [59] and the regulatory principles required under the Legislative and Regulatory Reform Act 2006 [71]. It is the EPS that explains how ONR will act with respect to regulating dutyholders.

8.6 ONR delivers its statutory obligations, in a manner consistent with international obligations, through its core regulatory functions that focus on the verification and assessment

of safety, security and safeguards, in compliance with regulatory requirements. The core regulatory functions are:

- Development and/or provision of regulations and guides
- Notification and authorisation (including registration and licensing)
- Regulatory review and assessment of safety of facilities/safety cases and activities
- Regulatory inspection of facilities and activities
- Enforcement
- Emergency preparedness and response
- Communication and consultation with interested parties

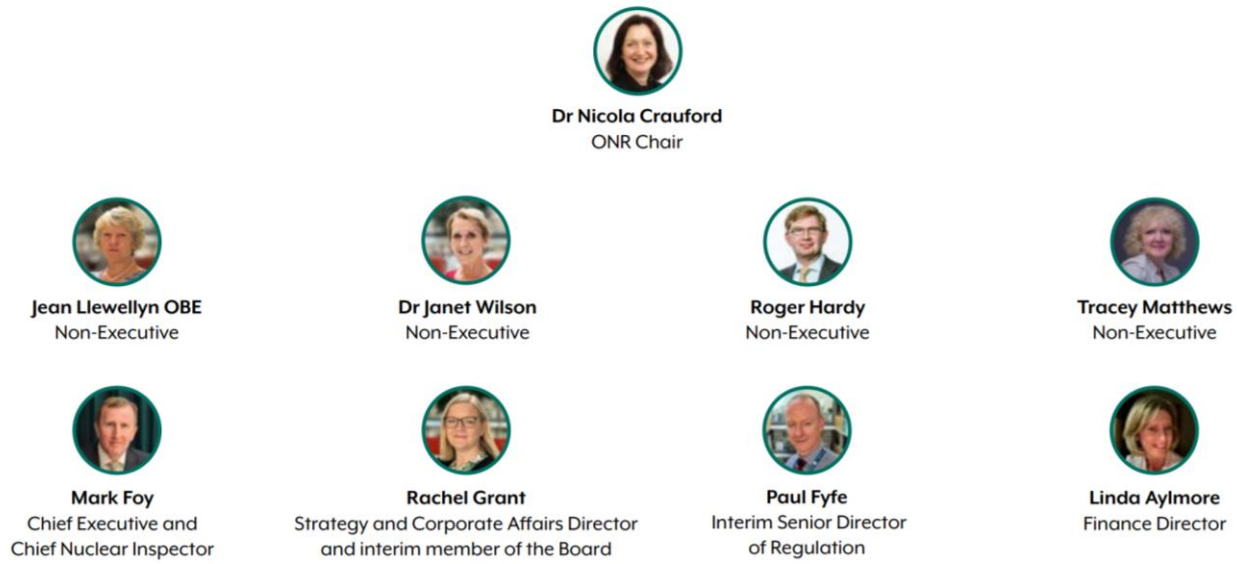
8.7 The core regulatory functions interact with one another; for example, regulations and guidance set out the regulatory requirements and expectations to be used in review and assessment of safety justifications, in the authorisation process, in carrying out inspections, and when determining enforcement actions. Similarly, the findings of regulatory review and assessment guide the approach to regulatory inspection, and regulatory inspection may identify areas for review and assessment. Both regulatory review and assessment, and regulatory inspection may influence the development of regulations and guidance.

8.8 ONR develops annual business plans for its regulatory activities that are intelligence-led, and reflect its core regulatory functions and strategic priorities.

Organisational structure of ONR

8.9 ONR was established under TEA13 [32]. The ONR Board is made up of non-executive and executive members. The ONR Board's role is to provide leadership, set strategy, agree the overarching policy framework within which ONR operates as a regulator, agree and monitor resources and performance, and ensure good governance. (See figure 8.1).

Figure 8.1: ONR Board Structure (as at 31 May 2025)



8.10 During the reporting period, ONR has undertaken a review of its organisational structure. The aims of the review were to:

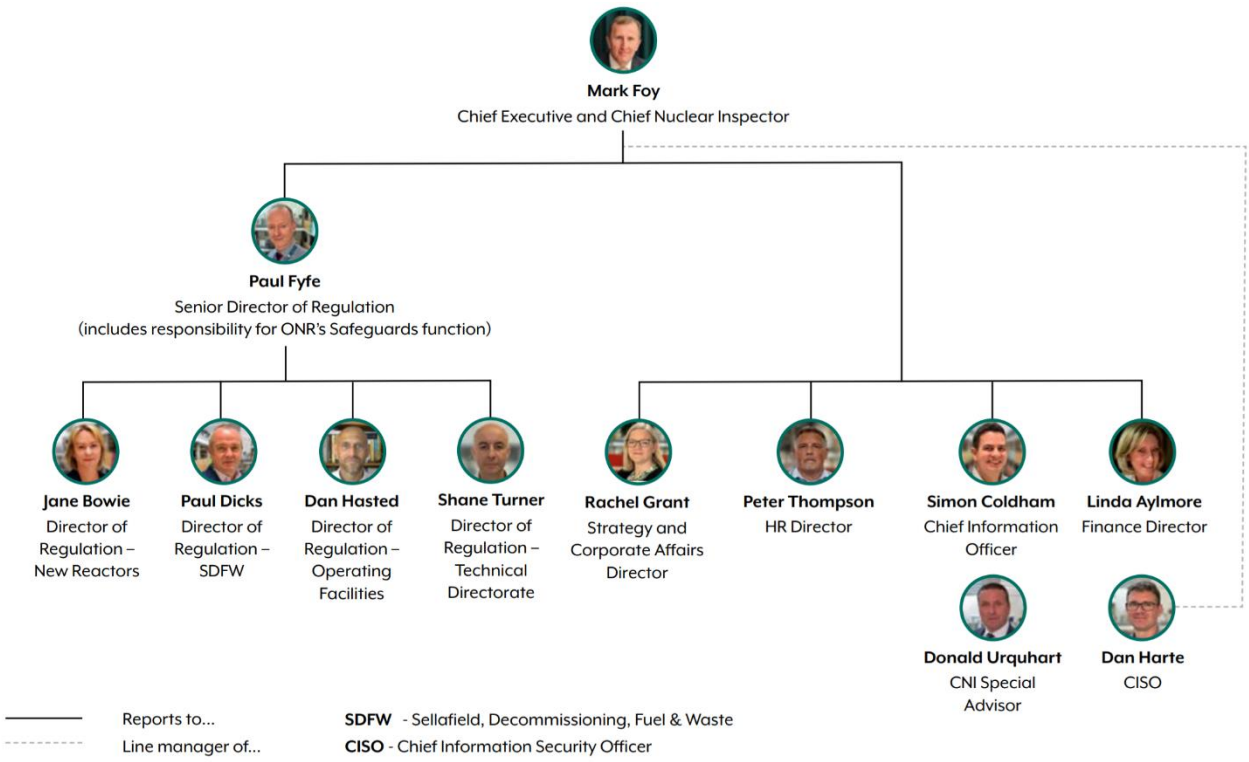
- Create a delivery structure that is simpler, more efficient and effective, by removing complexity, ambiguity, and burdensome reporting lines.
- Design a structure that is easier to operate in, enabling better support for staff and ensuring delivery line accountability is clear.
- Enable Heads of Profession to apply greater focus on capability, competence and the quality of regulation.

8.11 The result of the review was to create a simpler structure focussed on delivery whilst retaining the benefits of the maintenance and deployment of competent staff provided by Heads of Professions (See figures 8.2 and 8.3).

8.12 A new ONR Chair, Dr Nicola Crauford, was appointed in early 2025.

8.13 ONR announced a new Chief Executive/Chief Nuclear inspector (CNI), Mike Finnerty, (who will take up the post in mid-2025).

Figure 8.2: ONR Senior Leadership Structure (as at 31 May 2025)



8.14 ONR delivers its core regulatory functions and other activities through its directorates supported by deployment of specialist inspectors allocated by Heads of Profession. ONR's arrangements provide for a flexible approach to nuclear regulation, ready to respond to the demands of an evolving nuclear industry, and an integrated ONR that does this efficiently and effectively.

8.15 ONR's inspectors/staff are assigned to specialisms, from which they are allocated to ONR's industry-facing regulatory directorates. The current ONR regulatory structure is shown in figure 8.3. In addition, there are enabling programmes for corporate services and other assurance and support functions.

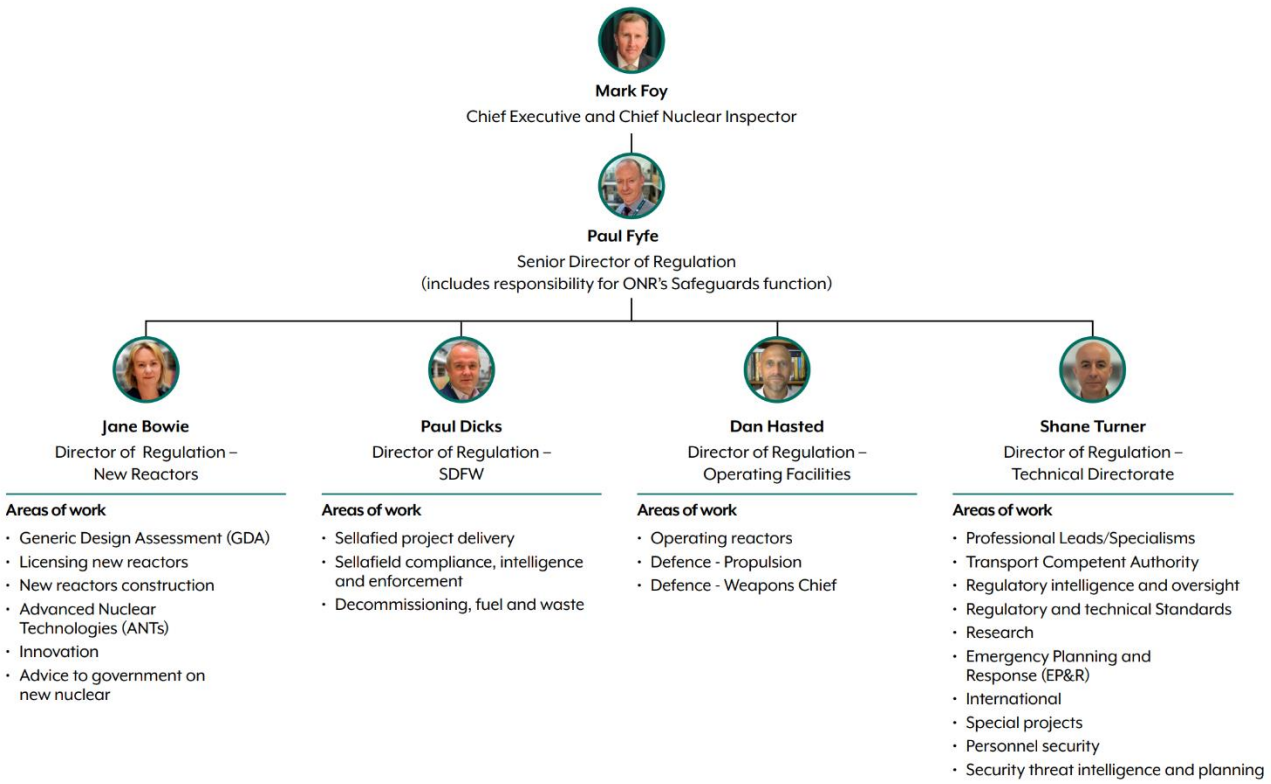
8.16 As part of the organisational review, accountability for the regulation of civil nuclear security has been embedded into the industry facing regulatory directorates. Specialist Security Inspectors are now allocated to regulatory directorates in the same manner as other specialist inspectors.

8.17 Effective delivery of ONR's core regulatory functions is managed across the regulatory directorates, which are led by the Senior Director of Regulation (SDoR). However, ultimate regulatory accountability still rests with the CNI. Consequently, the CNI and SDoR work closely together.

8.18 There are four regulatory directorates, each of which is led by a Director of Regulation who report to the SDoR . The Directors of Regulation are responsible to the SDoR for the delivery of their business plans. The three Directorates that are relevant to the convention are outlined below.

- The Operating Facilities Directorate – regulates the safety and security of operating NPPs (including those that are shutdown and in the process of defuelling) and safety on the nuclear sites that form an integral part to the delivery of the UK's nuclear deterrent and other maritime defences.
- The New Reactors Directorate – regulates the development of Hinkley Point C and Sizewell C NPPs, and undertakes the design assessment of potential new reactor designs planned for operation in the UK, as well as new reactor licensing. The Directorate is also developing the capability and capacity to regulate developing Advanced Nuclear Technologies (ANTs).
- The Technical Directorate – ensures that ONR is competently resourced to effectively regulate the UK nuclear industry against modern standards, in an enabling manner. The Directorate also governs ONR's wider cross-cutting regulatory functions including Emergency Preparedness and Response, Research, ONR's Transport Competent Authority, Regulatory Intelligence, and a range of major projects.

Figure 8.3: ONR Regulatory Structure (as at 31 May 2025)



Provision of adequate human resources

8.19 ONR employs suitably qualified and experienced technical specialists as inspectors, as well as corporate support staff to deliver the core regulatory work and other obligations. As of 31 December 2024, ONR consists of 430 regulatory specialists (inspectors) and 279 support staff.

8.20 During the reporting period, ONR has successfully recruited staff based on capacity requirements whilst continuing to address ageing demographics. ONR continues to adapt its recruitment methods where possible by launching more inclusive job adverts, modifying campaigns using different techniques and continuing to recruit at the lower levels and invest in graduates and degree apprentice programmes to keep up with an increasingly competitive market. ONR has also partnered with external organisations to raise its profile and increase the ability to attract a diverse range of applicants. Additionally, the potential for insufficient organisational capability is identified as a strategic risk, with work underway to mitigate and treat the causes and effects, and is used to inform, the ONR 2025/2026 Corporate Plan [70].

8.21 ONR continues to use its strategic workforce planning tool, which estimates resource requirements over the coming years to inform its understanding of recruitment and training needs. In addition to permanent resource, ONR also supports secondments into and out of ONR and across the nuclear industry, including international secondments. This provides opportunities to share best practice and provides insights into alternative regulatory regimes and cultures.

8.22 ONR's full year total expenditure figures over previous financial years are as follows:

- 2021/22 – £87.1M
- 2022/23 – £93.3M
- 2023/24 – £103.8M

Training of inspectors

8.23 The main purpose of the training given to ONR inspectors is to equip them with the detailed legal knowledge, skills and competency required to deliver core regulatory work. To achieve this, inspectors receive training in two main areas:

- Mandatory core regulatory training, including refresher training
- Training to expand technical expertise and to gain a working knowledge of other essential technical disciplines

8.24 Development of a new 'cohort' approach to training: A collective group of new ONR recruits undergo a 12-month programme of formal and operational training ('on-the-job training') together. As a cohort or close-knit team, they carry out specific regulatory assignments under coaching and close supervision by members of the training team who have extensive regulatory experience. Each recruit is allocated a technical mentor from their specialist area who provides further support and development. The effectiveness of all training activities is evaluated throughout the 12-month programme. The programme has been designed to give opportunities for trainees to utilise knowledge in the context of the practicalities of their job and provides better feedback to those developing the training courses. The change to this approach has enabled ONR to develop inspectors to a known level of competence faster than previous training programmes were able to achieve.

8.25 The ONR Academy, launched in 2018, provides a single source for all learning and development within the organisation. Since this time, ONR has increased the range of formal development on offer to include comprehensive management and leadership learning alongside the regulatory development programme. In addition to this, the ONR Academy offers learning in a variety of formats including online, blended and coaching, enabling flexibility for

individuals to attend at a time and location that is convenient to them. Over 3500 training places have been filled from July 2023 to December 2024 with 204 face-to-face and 156 virtual courses run during the same period.

8.26 Topics cover both regulatory and non-regulatory subjects, and all modules are available to all staff. Based on IAEA good practice, the Academy project has developed a Regulatory Competence Framework (RCF) identifying what competences an inspector needs. This is used in ONR's inspector training programme and a development plan created once individuals have graduated from the training.

Warrants for new inspectors

8.27 All inspectors are formally appointed by ONR through the issue of a warrant, which entitles them to exercise specified legal powers. Newly-recruited inspectors are issued with a 'limited warrant', which does not confer the full scope of powers available through TEA13 and HSWA74 for example. This is in recognition that it takes time to train new recruits and for them to develop sufficient experience and competency to use all the available powers appropriately.

8.28 The powers excluded from the limited warrant are those broadly associated with investigation and enforcement action, for which ONR mandates specific legal training. Following a period of training and sufficient and suitable on-the-job experience, which typically lasts 12 months, inspectors undergo an interview to demonstrate their competence and present further evidence of experience before being issued with a full warrant.

Other recruitment pipelines

8.29 At the joint eighth and ninth review meeting, ONR's introduction of innovative new recruitment pipelines was recognised as a good practice. ONR continues to focus on building and retaining of resources at different levels of experience and capability using various recruitment pipelines including:

- ONR sponsors and ultimately employs 'Graduates' (with 56 graduates being sponsored by ONR to date) who undertake a 2-year nuclear industry-wide graduate scheme including secondments across industry.
- 'Associates' (those developing their nuclear/high hazard experience (6 currently at this level) while working for ONR, who follow a formal development programme to become an inspector.
- 'Equivalence' recruits with unique skills from other industry sectors who undertake an 'equivalence development role' that leads to them becoming nuclear inspectors (12 currently working towards inspector with 54 achieving full nuclear inspector status from 2021 to date).
- Degree level apprentices, who undertake a five-year programme comprising of a degree in nuclear engineering and science whilst working with ONR and going out on secondments to other parts of the industry (5 individuals recruited via this route), two are currently completing their foundation degree, and three have successfully completed their degree and two are now in their 6th year studying for their masters, before becoming nuclear associates.

Continued professional development

8.30 Whilst considerable effort is spent on the training of new recruits, ONR also has a refresher training programme to ensure that all staff maintain professional competencies.

8.31 ONR's current policy is that further training requirements should be discussed between individual inspectors and their managers in consultation with their Head of Profession. Such

training covers topics such as communication, influencing skills, change management and interpersonal skills, as well as the development of technical competencies.

8.32 In addition to regulatory and technical training, ONR has agreements in place for staff exchange schemes with other regulatory bodies. These schemes facilitate sharing and capture of best regulatory practices.

Re-warranting of inspectors

8.33 All inspectors' warrants are issued for a fixed period of five years. As the expiry date approaches, inspectors are required to complete a formal legal refresher training course and competence assessment process, which demonstrates continued and up to date knowledge and understanding of their powers and ONR's legal authorities.

Knowledge management

8.34 Key to improving organisational learning (OL) and knowledge management (KM) and the delivery of ONR's vision, mission and strategy, is recognising the importance of its people and the need to ensure knowledge is transferred throughout a person's career, rather than captured as they leave. Each specialism within ONR has a knowledge and skills matrix that defines core knowledge areas and the specialism technical competencies required for the specialism to operate effectively and support the work of ONR, the level of knowledge of specialism members is regularly assessed against these. ONR uses these assessment matrices to identify organisational vulnerabilities and knowledge gaps, to inform the way ONR develops and trains its people and better defines recruitment needs.

8.35 Since the UK's ninth National Report (NR) [2], progress continues to be made on implementing the Well-Informed Regulatory Decisions (WIReD) Project. The purpose of WIReD is to modernise ONR's processes and IT based systems to support the efficient undertaking of ONR's regulatory activities (e.g. improve visibility of and management of regulatory issues, inspection reports and findings, incident report etc.). This is an enabler to improving effectiveness and in making better-informed regulatory decisions.

8.36 In addition to the WIReD project, ONR is undertaking a comprehensive review of its knowledge management and organisational learning with the aim of agreeing a future framework, that supports the whole organisation.

Regulation of innovative technologies

8.37 The discussions in the following sections below relate directly to the major common issue of **strengthening national regulatory capabilities taking into account new and innovative technologies** from the joint eighth and ninth review meeting.

8.38 ONR has focussed on strengthening its regulatory capabilities in the area of the regulation of innovation and in particular the impact of Artificial Intelligence (AI). In April 2024 ONR published its policy on a pro-innovation approach to AI Regulation [72].

Trialling of a Regulatory Sandbox for Artificial Intelligence
8.39 This was a ground-breaking project developed by ONR and the Environment Agency, which explored the regulation of AI within the nuclear industry. 8.40 Both ONR and the Environment Agency are developing approaches to the regulation of innovation in the nuclear sector, aiming to support the adoption of innovative solutions where it is in the interest of society and consistent with safety, security, safeguards and environmental protection expectations. 8.41 AI could be used in the nuclear industry to simulate reactor behaviour and inform reactor design, performance, safety and operation. This technology could present significant

opportunities and challenges for the sector, but there is limited relevant good practice currently available to inform regulators.

8.42 The sandbox pilot found that the benefits of AI should be clearly articulated, particularly in comparison to traditional technologies, and any risks understood and managed through robust arrangements. Understanding the reliability of AI systems is also important.

8.43 The final report on the project [73] discusses how the sandbox, the first applied to nuclear regulation anywhere in the world, provided regulators and industry stakeholders with a safe space to consider how AI technologies could be regulated.

8.44 Other key recommendations summarised in the report included:

- Phasing the deployment of AI systems to build confidence and experience;
- Evaluating whether a principles-based approach to regulation is preferred, to take into account differing considerations for each potential application of AI;
- Assuming any existing training data is no longer adequate when an AI system is transferred to a new operation or phase, and providing a hazard analysis for each potential deployment mode;
- Understanding the complexity of the human/system interaction; and
  Developing skills and guidance through accessing AI expertise, reflecting operational experience, and promoting behaviours that support a challenging safety, security and environmental culture.

8.45 During the reporting period, ONR, in collaboration with the United States Nuclear Regulatory Commission (US NRC) and the Canadian Nuclear Safety Commission (CNSC) published a tri-lateral paper on principles for deploying AI in the nuclear sector while maintaining adequate safety and security [74]. The paper reports how effective integration of AI into nuclear systems would need to explore the balance of trust between the human and machine, establishing an optimal level that realises the benefits of AI while maintaining appropriate oversight.

8.46 ONR's international collaboration on Sandboxing has expanded further, with collaboration with CNSC and US NRC progressing positively, along with involvement from the United Arab Emirates' nuclear regulator, Federal Authority for Nuclear Regulation (FANR) and the Korea Atomic Energy Research Institute. This approach has now evolved into international Regulatory Laboratories (RegLabs), a new initiative to enable the safe and efficient application of AI to enhance regulatory readiness and facilitate the development and deployment of small modular reactors [75].

Provision of financial resources

Adequacy of financial resources

8.47 Section 24A of Nuclear Installations Act 1965 [31] enables ONR to recover costs from licensees and licence applicants for expenses associated with its nuclear site licensing, permissioning and inspection work. Licensees and licence applicants are charged according to the amount of ONR staff time applied to their sites or applications. Charges may also cover the costs of research and of nuclear safety studies commissioned to assist ONR and ensure that it has access to independent technical advice and information. Such costs are allocated to licensees according to the nature of the work commissioned.

8.48 ONR uses a work recording system to identify the effort and expenses of its staff attributable to each licensee. Where ONR cannot reclaim costs from the industry, it receives funding from the UK Government (currently approximately 5% of ONR's costs).

8.49 On an annual basis ONR publishes its annual report and accounts. This document provides information on its financial performance [76]. ONR's income could be significantly

reduced should a major dutyholder experience financial difficulties. In this situation, the Government has committed to ensure that ONR has sufficient resources to discharge its functions, thus underpinning the Government's international duties to ensure that the regulator is adequately resourced. In such circumstances, ONR will provide the Government details of the funding requirement, including the impacted dutyholder, the action taken and the outcome of that action.

8.50 Section 41 of EA95 [33] provides the Environment Agency, Natural Resources Wales (NRW) and the Scottish Environmental Protection Agency (SEPA) with the power to impose financial charges for regulatory activities to recover the expenses incurred through regulation. Such expenses also include those incurred in respect of a programme of waste and environmental monitoring carried out by the environment agencies. All agencies use a work recording system to identify the effort and expenses of its staff attributable to each licensee.

Quality management system of regulatory body

8.51 ONR uses SharePoint as its web-based collaboration and document management system, which includes its management system. The ONR management system is designed to comply with IAEA requirements in General Safety Requirements (GSR) Part 2 [77] and as such, includes documentation setting out ONR's core regulatory processes, as well as management and support processes. Documentation of the management system is structured in accordance with a four-tier hierarchy, comprising of strategic, tactical and operational-level arrangements (i.e., policies, procedures, instructions, and guidance). The management system is reviewed regularly to ensure that content is up-to-date and is readily available to staff. During the reporting period, ONR has embarked on a 'SharePoint Transformation Project' that aims to transfer all its knowledge estate from existing systems to SharePoint by mid 2026.

8.52 Technical guidance for inspectors is contained in ONR's SAPs [28], TAGs [47] and TIGs [46], which are regularly reviewed and updated and are also publicly available through the ONR website.

Monitoring ONR's effectiveness

8.53 ONR uses an Organisational Effectiveness Indicator (OEI) framework, which is based on the OECD's NEA Ten Characteristics of an Effective Nuclear Regulator. This shows how ONR operates and regulates in a manner that delivers effective outcomes for safety, security, and safeguards.

8.54 The OEIs are aligned to ONR's four strategic themes and provide a broad evidence base to assure the ONR Board, Government and the public of the efficiency and effectiveness of ONR's regulation and wider organisational impact. The ten OEIs are underpinned by sub-indicators, each with outputs and outcome-based measures attached. The consolidation of the outputs and outcomes indicate the extent that ONR's Strategy 2020–25 has been achieved, evidenced through the management information.

8.55 The current 10 OEIs are aligned with the priorities in the Strategy 2020–25 and present clear outcomes against each.

Integrated audit and assurance

8.56 ONR's Integrated Audit and Assurance Framework was introduced in 2017 and has proven very effective in delivering independent oversight and assurance throughout the organisation. ONR's assurance function provides assurance to the ONR Board and committees, CNI and the ONR Senior Leadership Team that it is appropriately delivering its regulatory purposes and functions. The three integrated tiers of assurance align with good practice and are set out below:

- Tier 1 – Within the operational areas of the business, there are a range of indicators of how objectives are being met, such as management information, performance data and risk registers.
- Tier 2 – ONR has established a Regulatory Assurance function (independent of the front-line operating units) that conducts risk-informed strategic assurance reviews across ONR's purposes, regulatory processes, and decisions.
- Tier 3 – The UK Government's Internal Audit Agency provides ONR (under contract) with risk-informed external audit coverage across its corporate functions.

8.57 A Post Implementation Review (PIR) of Part 3 of the Energy Act 2013 (TEA13), which established ONR in 2014 as the UK's independent nuclear regulator, was undertaken in 2022. The government review, which was independently led, noted that ONR is seen domestically and internationally as a strong example of an organisation that follows a modern, enabling regulatory approach, respected for its technical ability and regulatory performance. The PIR concluded that the objectives of Part 3 of TEA13 are being met and ONR is effectively delivering its regulatory purposes. The PIR raised 19 recommendations aimed at assisting ONR as it develops and to underpin its future capability and capacity [78]. Consequently, substantial work was undertaken by ONR to action the recommendations. A follow-up review in 2024 concluded that ONR has made significant progress against the recommendations in the PIR and all recommendations can now be closed [79].

Openness and transparency of regulatory activities

8.58 During the reporting period, ONR published its new Policy for Openness and Transparency [80]. The policy covers ONR's current approach and intentions for future excellence, in line with relevant legislation and guidance. ONR seeks to build and maintain public trust by being an exemplar of transparency, through greater proactive publication of information and strengthened two-way engagement. By working more openly, transparently and communicating in accessible ways, ONR strives to inspire public confidence, which is essential to being an effective and trusted regulator.

8.59 For this purpose, ONR's Openness and Transparency Policy sets out three guiding principles that ONR will apply in its communications and engagement with interested stakeholders and the public; accessibility, confidence, and accountability. The policy includes a three-tier framework for how and when ONR informs, engages and consults interested stakeholders and the public on its work and regulatory decisions, and when and how it takes account of feedback. Where ONR is unable to disclose specific information, generally under a legal exemption, it provides a clear and specific explanation why this is the case. Further details on ONR's framework for informing, engaging and consulting interested stakeholders and the public can be found in the policy document [80].

8.60 Prior to issue, the policy was sent out for public consultation to ensure it would meet interested stakeholders expectations. The responses were generally supportive of the approach taken, but highlighted the need to increase openness and transparency to further enhance public trust and confidence. The policy was further refined to take on board the consultation feedback.

8.61 The impact, transparency, and accessibility of stakeholder engagement is being monitored through the Organisational Effectiveness Indicators, which are published in ONR's Corporate Plan. In addition, reports will be published detailing international benchmarking, targeted surveys, and independent review and evaluation of the policy and its implementation.

8.62 The environmental regulators also have well-established and broadly equivalent mechanisms for communicating and engaging with the public and interested groups including attendance at quarterly Site Stakeholder Groups and Local Liaison Committees. Non-routine site matters (such as enforcement letters, incidents) are reported at these meetings. The Environment Agency also has an extensive programme of engagement meetings with NGOs and communities around high public interest nuclear sites. These are both face-to-face and online. Public and stakeholder enquiries are also responded to through their Customer Contact Centre and via email. Regular eBulletins about nuclear regulation are issued to stakeholder lists – both national and local to sites and via social media. Further details of the environmental regulators' activities promoting openness and transparency can be found in Annex 2 – The Environmental Regulatory Bodies.

External technical support

8.63 Most of the expertise to regulate nuclear safety is available to ONR through its own staff. There are occasions, however, when specialist advice and/or additional resources are needed to provide flexibility to variations in workload, or where the specialism is not available in ONR. To accommodate this, ONR has framework agreements with outside bodies in specific technical areas, which enable support contracts to be placed quickly. Details of technical support contracts are published on the ONR website [81].

8.64 ONR recognises that with the scarcity of nuclear expertise, many of the companies contracted to deliver work on its behalf will also be bidding for and delivering work on behalf of licensees, prospective licensees, and/or GDA requesting parties. ONR has robust processes in place to avoid any conflicts of interest including the following:

- Consulting with and informing dutyholders on the use of a contractor for a particular piece of work, thus ensuring matters, such as conflicts of interest, are identified and addressed.
- Using contracted staff not engaged on licensee work, establishing a degree of separation within the contract organisation.
- Ensuring detailed work specifications are agreed at the outset.
- Implementing strong contract management procedures.
- Following ONR's openness and transparency agenda and ensuring relevant information about the use of contractors is put promptly into the public domain.
- Having detailed non-disclosure agreements in place.
- All parties knowing that ONR owns the intellectual property rights resulting from external work undertaken on its behalf and will, where appropriate share reports and make findings available.

Advisory committees

8.65 In 2016, ONR introduced the CNI's Independent Advisory Panel (IAP) to provide independent advice to ONR on nuclear matters. The IAP is now well-established and meets twice a year, bringing together experts from across the nuclear industry, academic community, UK Government Departments, other regulators, and NGOs who contribute to informed debate and provide advice on relevant topics. The discussions range from regulatory strategies and policy to implications of developments in new nuclear technologies and the regulation of innovation.

8.66 ONR has also set up an Expert Panel on Natural Hazards and a Graphite Technical Advisory Committee.

8.67 ONR's Expert Panel on Natural Hazards is a group of independent academics and specialist consultants covering a range of skill areas relevant to seismic hazards, meteorological and coastal flooding hazards, and climate change. The Panel provides ONR's External Hazards inspectors with a valuable source of authoritative technical and independent expertise.

8.68 The Graphite Technical Advisory Committee (GTAC) is a group of independent academic experts and specialist consultants who provide technical assistance to support ONR in carrying out its regulatory duties regarding the UK fleet of graphite moderated nuclear power stations.

8.69 More information on advisory committees can be found on the ONR website [82].

Interface with other agencies and regulators

Environmental regulatory bodies

8.70 The environmental regulatory bodies (the Environment Agency, SEPA, and NRW) also have duties under the Convention. Annex 2 – The Environmental Regulatory Bodies provides more information on the authority, competence, and financial and human resources of the environmental regulatory bodies. The following section sets out the arrangements between ONR and the environmental regulatory bodies to ensure effective and efficient regulation of the GB nuclear industry.

8.71 ONR and the environment agencies work closely together to ensure the effective co-ordination of their respective regulatory activities. ONR has Memoranda of Understanding (MoU) with the Environment Agency, SEPA and NRW [83]. The common objectives of the MoU are to:

- Deliver effective and efficient regulation of the nuclear industry in the UK, and ensure international safeguards obligations for the UK are met.
- Maintain and improve standards of protection of people and the environment from the potential hazards from ionising radiations.
- Ensure that radioactive wastes are appropriately managed in both the short and long term.

8.72 Under NIA65, ONR is required to consult the Environment Agency, NRW or SEPA before:

- Granting a nuclear site licence.
- Varying a nuclear site licence if the variation relates to or affects the creation, accumulation, or disposal of radioactive waste.

8.73 Similarly, the environment agencies must consult ONR (or HSE as appropriate) under EPR16 [34] or EASR18 [35] on proposed (new or varied) authorisations for disposals of radioactive waste including discharges to the environment from nuclear licensed sites.

8.74 The environment agencies, together with ONR, have published joint guidance on the management of higher activity radioactive waste on nuclear sites [84], which provides advice to nuclear licensees on the management of the safety and disposability of such wastes. The environment agencies and ONR have also published updated guidance that sets out high-level regulatory expectations for the prevention and management of radioactive and non-radioactive contamination of the ground and water on nuclear licensed sites [85]. Department for Energy Security and Net Zero (DESNZ) also provides strategic level coordination between UK government, devolved administrations and regulators on the development and delivery of policy, and legislation.

8.75 In addition to their own routine inspection activities on nuclear licensed sites, the environment agencies carry out planned joint inspections with ONR on areas of shared regulatory interest and co-operate in the investigation of incidents where appropriate. (e.g. joint climate change inspections between ONR and Environment Agency (See Article 14 – Assessment and Verification of Safety for more information).

8.76 The Environment Agency and ONR have also established a joint programme office to provide a single point of contact for the GDA of nuclear power plant designs and the early engagement of reactor designers.

Responsibilities of other agencies and bodies

8.77 The UK Health Security Agency (UKHSA), formally Public Health England, is a non-departmental public body, whose statutory functions include the following:

- The advancement of the acquisition of knowledge about protection from radiation risks.
- The provision of information and advice in relation to the protection of the community (or any part of the community) from radiation risks.

8.78 UKHSA has a UK-wide responsibility to provide advice and technical services to persons with responsibilities in relation to radiation hazards.

Independence of the regulatory body

8.79 ONR's independence as a regulator is ensured under TEA13, where ONR is given direct responsibility for the enforcement of nuclear safety, security, safeguards, site conventional health and safety, and nuclear material transport; collectively known as ONR's 'purposes'. Similarly, the environment agencies are responsible for the environmental protection regulatory system under EPR16 [34] in England and Wales and EASR18 [35] in Scotland and are sponsored by government departments and devolved governments separate from DESNZ to ensure independence.

8.80 ONR is sponsored by the Department for Work and Pensions (DWP), ensuring independence from DESNZ, which is the department responsible for ensuring energy supply including nuclear energy.

8.81 ONR provides information and advice to Ministers and the Government on matters related to ONR purposes, but its regulatory functions operate separately from Government and Ministers. Furthermore, Government cannot direct ONR with respect to regulatory functions in a particular case – ensuring that regulatory decisions are independent.

Reporting obligations

8.82 ONR must publish a report of its activities together with its audited accounts after the end of each financial year. The annual report must meet the requirements set out in TEA13. The accounts are prepared in accordance with the relevant statutes and direction issued by DWP, and in accordance with the Treasury's Financial Reporting Manual. The annual report and accounts are laid in UK Parliament and published on ONR's website.

8.83 In accordance with TEA13, ONR submits a strategy for carrying out its functions to the responsible Government Minister for approval. The strategy must be reviewed, and if necessary updated, at least every five years. Any revisions to the strategy must be approved by the responsible Minister.

8.84 In accordance with TEA13, ONR must submit to the responsible Minister for approval an annual plan. The annual plan must include key targets for the year and budgeting information so that resources allocated to achieve specific objectives can be readily identified.

Resilience of the regulatory body

8.85 The discussions in this section relate directly to the major common issue of **managing extraordinary circumstances impacting the safe operation of nuclear installations** from the joint eighth and ninth review meeting.

8.86 ONR has an Incident Response and Recovery Framework, which outlines ONR's incident response and recovery arrangements. The framework outlines ONR's end-to-end response and recovery process for serious incidents including: team structure, post-incident activities, key actions and responsibilities for all members of the Incident Management Team (IMT), Tactical Management Team (TMT) and Recovery Working Group (RWG) during all the phases of an incident.

8.87 ONR's incident management guiding principles are:

- Protect: Protect life and health of people and public.
- Preserve: Secure and preserve integrity of information and physical assets to prevent or minimise unacceptable loss or harm due to issues arising from or during an incident.
- Communicate: Maintain effective stakeholder communication to ensure that information provided is timely, complete, relevant and accurate to help deliver against ONR's priorities.
- Recovery: Facilitate recovery and continuity of most critical activities to ensure those that rely on ONR's services are not significantly impacted by adverse conditions.

8.88 The framework provides an overview of how ONR categorises the severity of incidents and outlines the appropriate level of escalation (i.e. how they are to be managed). The incident severity levels are as follows:

- Emerging event: Enhanced attention because it threatens minor to moderate disruption with little to no disruption to essential organisational activities (e.g. building break in).
- Minor: An incident that is contained to one or two functions and poses minor reputational, financial, and/or operational threats (e.g. minor data breach).
- Significant: An incident that cannot be managed by an individual function or directorate that has, or threatens to, significantly disrupt critical activities (e.g. failure of key supplier).
- Major: An incident that poses a severe operational, financial, and reputational threat to ONR, and/or threatens the wellbeing of ONR staff (e.g. widespread and prolonged loss of IT resources).
- Catastrophic: An incident beyond the scope of business as usual operations that is likely to involve serious harm, damage, disruption or risk to welfare, essential functions, or critical national infrastructure. (e.g. total national power outage, or a global pandemic).

8.89 The UK's ninth NR [2] presented ONR's response to the global Covid-19 pandemic. Relevant recommendations identified as a result of ONR's organisational response to, and recovery from, the COVID-19 pandemic have been incorporated into ONR's incident response and recovery framework.

Summary of significant changes since previous report

8.90 During the reporting period, developments under this Article are as follows:

- ONR has undertaken a review of its organisational arrangements and made changes to enhance efficiency and implement clear lines of accountability.
- New ONR Chair was appointed in early 2025 by the DWP.

- ONR announced a new Chief Executive/Chief Nuclear inspector (who will take up the post in mid-2025).
- ONR has introduced a new 12 month cohort approach to its induction and training programme for newly recruited inspectors.
- ONR has undertaken work on enhancing regulatory capability in the area of innovation with a particular focus on artificial intelligence.
- ONR has published a new openness and transparency policy.

Notable achievements

8.91 **Trialling of a regulatory sandbox for artificial intelligence:** This project provided regulators and industry stakeholders with a safe space to consider how AI technologies could be regulated. AI could be used in the nuclear industry to simulate reactor behaviour and inform reactor design, performance, safety and operation. This technology could have significant opportunities and also challenges for the sector, but there is limited relevant good practice currently available to inform regulators. The sandbox pilot, thought to be the first of its kind in the nuclear sector, found that the benefits of AI should be clearly articulated, particularly in comparison to traditional technologies, and any risks understood and managed through robust arrangements (See paragraphs 8.39 to 8.44 for more details)

8.92 **ONR's new policy on openness and transparency:** The policy covers ONR's current approach and intentions for future excellence in openness and transparency, in line with relevant legislation and guidance, and is thought to be the first publication of its kind by a national nuclear regulator. By working more openly, transparently and communicating in accessible ways, ONR strives to inspire public confidence, which is essential to being an effective and trusted regulator. The policy is based on 3 guiding principles of accessibility (of information), confidence (empower staff to communicate more openly) and accountability. The policy document provides examples of how ONR adheres to these principles and how ONR intends to improve its practices in the future (See paragraphs 8.58 to 8.61 for more details).

Future focus

8.93 Organisational Learning (OL) and Knowledge Management (KM) are key enablers for ONR to build and maintain resilient capability. Although work has previously been undertaken to enhance ONR's OL and KM capability, ONR recognises the need to keep pace with industry trends and technical advancements. In 2025 ONR will review its current OL and KM arrangements against best practice and identify future improvements, including making best use of emerging information technology (See paragraphs 8.34 to 8.36 for more details).

Article 9 – Responsibility of the Licence Holder

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

Summary statement for article

9.1 The UK fulfils the obligations of Article 9. It has comprehensive arrangements to assign prime responsibility for nuclear safety to the licence holder and to take steps to ensure that each such licence holder meets its responsibility.

Legislation assigning prime responsibility for nuclear safety to the licence holder

9.2 In the UK, the holder of a nuclear site licence is responsible for the safety of its nuclear installations and for the health and safety of both its workers and members of the public that may be affected by its operations.

9.3 The legislation assigning primary responsibility for safety to the licence holder is covered in detail in Annex 1 – Extracts from Legislation relevant to the Convention:

- Nuclear Installations Act 1965 (NIA65) Section 7 [31]
- Health and Safety at Work Act 1974 (HSWA74) Section 2 [30]

9.4 To meet legal obligations for managing nuclear safety adequately, the licensees (EDF Energy NGL, NNB GenCo (HPC) Ltd and Sizewell C Ltd) have established policies and detailed arrangements that discharge their prime responsibilities. ONR requires that the licensees' safety policies and organisational structures are documented as part of the licensing process. All licensees operate with their own Integrated Management System framework. These frameworks accommodate nuclear, industrial, and environmental requirements. This allows them to manage all aspects of the operation of their sites within their respective frameworks. In respect of environmental arrangements, the licensees have specialists who own and manage the environmental processes within the respective frameworks.

9.5 Further information on how licensees organise and manage their construction and operations to ensure safety can be found throughout this report but particularly under Article 6 – Existing Nuclear Installations, Article 10 – Priority to Safety, Article 14 – Assessment and Verification of Safety and Article 19 – Operation.

Ensuring that the licensees have appropriate resources

9.6 The nuclear site LCs require the licensee to have adequate human and financial resources in place to ensure safe operation of the licensed sites. The financial and human resources required to ensure the safety of the reactor sites throughout the lifetime of the plant and the regulatory arrangements to assess these are described in more detail under Article 11 – Financial and Human Resources.

9.7 Article 16 – Emergency Preparedness and Article 19 – Operation discuss the licensee arrangements for emergency preparedness and incident notification and associated regulatory requirements.

Licensee structure – EDF Energy NGL

9.8 In addition to site-based staff, EDF Energy NGL has a significant number of personnel located at offices near Gloucester (England), and Glasgow (Scotland), who set safety and

operational standards, carry out reviews of safety and provide specialist support to EDF Energy NGL nuclear licensed sites. The central capability is responsible for setting standards and governance and oversight (e.g., undertaking audit and assurance of the sites). The centre also undertakes audit and assurance activities of the supply chain - contract staff and procurement of systems / components / plant.

9.9 The Director of Nuclear Operations is responsible for selecting station directors for nuclear power stations, monitoring their performance, and ensuring that they have adequate corporate support. The Director of Nuclear Operations reports to the Managing Director.

9.10 All UK nuclear power plant sites have a designated Station Director, who has delegated authority for all day-to-day activities and operations. This includes responsibility for compliance with the nuclear site licence and environmental permits.

9.11 There are several key positions supporting the role of Station Director. These roles are responsible for leading teams to deliver plant operations, maintenance, work-management, engineering, defuelling preparation and technical and safety support. Each station has approximately 530 staff with an additional 200 persons employed by contracting companies involved in day-to-day operations. During outage periods this figure increases by up to 1000 additional contractors, which are necessary to deliver specific engineering and maintenance activities.

9.12 The Technical and Safety Support Manager at each site leads a team with broad responsibilities covering nuclear safety, site security, industrial safety, radiation protection and environmental safety.

9.13 Independent oversight is provided by Independent Nuclear Assurance (INA) teams, located at each site. They have separate reporting lines through the Safety and Assurance director to the Managing Director (via the head of INA at the corporate centre).

Licensee structure – Nuclear New Build Generation Company (HPC) Ltd

9.14 NNB GenCo is a limited company, and as the licensee, has sole responsibility for the conduct of all activities affecting nuclear and radiological safety at Hinkley Point C. The NNB GenCo Board is responsible for effective governance of the project, including implementing EDF group policies so that nuclear safety risks are adequately managed and controlled. The executive arm of the licensee is headed by the Hinkley Point C Managing Director who is a member of the NNB GenCo Board. The Managing Director is accountable to the Board for the safe and secure delivery of the project, to time and cost, in accordance with specified quality and engineering standards. The project structure is designed to have clarity of objectives, across three aspects of the organisation:

- Direction – comprising core functions of engineering, technical and delivery
- Delivery – areas and programmes responsible for implementing the verified design
- Functions – supporting the delivery of Hinkley Point C and the schedule

9.15 The Safety and Schedule Assurance Director is independent from the construction/delivery reporting line within Hinkley Point C and provides appropriate review and challenge in relation to nuclear safety. The Safety and Schedule Assurance Directorate provides specialist expertise and guidance in areas such as regulatory, licensing, occupational health, and industrial safety, learning and environmental. The Directorate seeks to ensure that appropriate health and safety policies and standards are formulated and promulgated throughout the company.

9.16 NNB GenCo has an internal regulator, providing independent assurance and challenge to ensure nuclear safety and conformance with quality requirements. The Internal Nuclear

Regulation function comprises of: Independent Assessment; Supply Chain Inspection; Independent Security Assurance; Independent Technical Assessment; and Hinkley Point C Site Inspection teams. They have a separate reporting line through the Safety and Schedule Assurance director to the Managing Director.

Licensee Structure – Sizewell C Ltd

9.17 Sizewell C Ltd is an integrated organisation responsible for specifying requirements, governing, enabling, assuring, and managing the integration of its suppliers and alliances. Within the Sizewell C organisation, the Delivery team is responsible for the delivery of the project works against Sizewell C's defined requirements, from design to hand over to the operations team.

9.18 Sizewell C Ltd will be the integrator of the design, procurement, manufacturing, construction and commissioning of the plant. Interfaces between systems, structures, components and contracts will be managed by the delivery programmes and by the integration functions when required.

9.19 In order to do so, Sizewell C Ltd will implement an interface management process with particular focus on configuration management of the overall plant (including the link with the Hinkley Point C technical configuration), interface management between contracts and on the instrumentation and control interfaces.

9.20 The Technical Directorate is responsible for the design, design assurance and production of the safety case and the control of its development throughout the life cycle of the plant via the Design Authority. The Technical Directorate also includes Engineering Integration, which is responsible for managing the replication of the Hinkley Point C design at Sizewell C, the engineering interfaces between programmes and ensuring end to end configuration management of the Sizewell C project.

9.21 To ensure Sizewell C Ltd fully meets its legal duties and represents and considers the interests and the needs of shareholders and other stakeholders, the assurance of delivery will be performed by the business enabling functions, namely supply chain, finance, treasury, safety, security & assurance and human resources. Sizewell C Ltd has an independent nuclear assurance function, providing independent assurance and challenge to ensure nuclear safety and conformance with quality requirements.

How the regulatory body ensures the licence holders discharge their responsibility for safety

9.22 The most frequent interfaces between the licensee and ONR arise through oversight activities, the assessment of safety cases, technical engagements, and inspections at licensed nuclear sites. ONR conducts inspections to check the licensee's compliance with LCs and other health and safety legal requirements. ONR has a nominated site inspector for each of the licensed sites, to lead on this regulatory work. The nominated site inspector is the principal focal point for the licensee and any other dutyholders on site in relation to nuclear safety matters. The processes of assessment and inspection provide ONR with assurance that the licensee meets its responsibilities regarding the LCs and safety case.

9.23 ONR applies a risk-informed and intelligence-led strategy for the targeted and proportionate regulation of NPPs and related activities, which provides a framework for assessment and inspection of licensee's activities. This is implemented through a resourced regulatory plan, which is produced annually. Additionally, inspection plans are produced for each site, outlining the scope of the planned inspections. (See Article 14 – Assessment and Verification of Safety for more details).

9.24 In addition to planned inspections, reactive inspections, or inspections associated with permissioning projects may also be appropriate. ONR inspectors may also carry out unannounced inspections at any time. Reactive inspections often include responding to any events on the site following notification to ONR or otherwise recorded through the licensee's arrangements. ONR enforces the law through a graded approach, starting at verbal advice for minor non-compliances through to prosecutions in a court for serious breaches of the law.

9.25 The main interactions between operators and their environmental regulator arise through inspections of facilities and arrangements at nuclear licensed sites. Inspections are designed to assess compliance with permit conditions, which embody environmental safety requirements. Interventions also include; enforcement prompted by non-compliances, review of operators' demonstrations of optimisation and environmental safety of ongoing or planned activities, provision of advice and guidance, use of regulatory principles to ensure consistent regulatory judgements, themed inspections to ensure consistent application across the sector, joint inspections with ONR, and development of site environmental reviews to inform the annual plan of inspection or the use of strategic regulatory plans for longer term position on new build sites. The environmental regulators have nominated site inspectors for each of the operational NPP sites and for the Hinkley Point C construction site, to lead on this regulatory work. The nominated site inspector is the principal contact for the operator regarding environmental safety. Also see Annex 2 – The Environmental Regulatory Bodies for more information.

Open and transparent communications

Licensee transparency arrangements

9.26 UK licensees adopt a policy of openness and transparency and place importance on providing assurance to the public, that it can be trusted to operate to the highest safety and environmental standards. EDF Energy NGL Station Directors write to local stakeholder groups regularly, providing updates on safety and operational performance and details of specific events reported formally under organisational learning process. In addition, regular newsletters are circulated to the community and local media and published on the company's website. The Hinkley Point C site team holds public forums quarterly to engage people neighbouring the site, a forum for all local stakeholders and a forum focused on transport challenges.

9.27 EDF Energy NGL's website provides updates on the status of all its operating reactors, information on the power outputs, status of the reactor (at power/shutdown) and provides an indication of when the reactor is due to return to service [86]. The NNB GenCo website [87] provides an overview of the technology, the benefits to the local community, and high-level updates on the progress of the Hinkley Point C and Sizewell C construction projects.

9.28 EDF Energy NGL and NNB GenCo has five visitor centres across the UK (Torness, Sizewell B, Heysham, Hartlepool and Hinkley Point). The centres contain interactive exhibitions that provide information about nuclear power generation, helping visitors to understand how its power stations contribute to low carbon electricity generation, through interactive models and information panels. Hunterston B and Dungeness B, which have ceased generation, no longer have visitor centres.

Summary of significant changes since previous report

9.29 During the reporting period, developments under this Article are as follows:

- Sizewell C Ltd has been granted a nuclear site licence and is now the licensee for the Sizewell C site.

Article 10 – Priority to Safety

Each Contracting Party shall take the appropriate steps to ensure that all organizations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

Summary statement for article

10.1 The UK fulfils the obligations of Article 10. It has comprehensive arrangements in place to ensure that all organisations engaged in activities directly related to nuclear installations have established policies that give due priority to nuclear safety.

10.2 The information in this Article is directly related to the major common issue on **fostering international peer review missions and timely addressing of findings** from the joint eighth and ninth review meeting.

UK Government policy

10.3 The UK has a well-established radiological and civil nuclear safety regime that demonstrates a long-term commitment to safety as a top priority. Its fundamental objective is to ensure an efficient, proportionate and effective safety framework that protects the public, workers and the environment from the harmful risks of ionising radiation [88]. The UK legislative framework (See Article 7 – Legislative and Regulatory Framework) requires that those who create the radiation risk must ensure that risks are removed or limited so far as is reasonably practicable (SFAIRP) to ensure the safety of the public and those who work with the radiation. Those that fail to meet their legal obligations in any sector will be subject to proportionate enforcement action.

10.4 The Department for Energy Security and Net Zero (DESNZ) is responsible for establishing Government policy in relation to the use of nuclear power. It also has responsibility for the regulatory framework in place to ensure that high standards of nuclear safety are observed in the UK, and that any international obligations related to nuclear safety are met. The Secretary of State for DESNZ carries overall Government responsibility for nuclear safety policy and legislation, and reports to parliament on this matter. ONR is the UK's statutory independent regulatory body for nuclear safety and provides advice to DESNZ on nuclear safety matters when requested.

The regulatory body's priority to nuclear safety

10.5 As the principal regulatory body for nuclear safety, ONR has core functions to licence, inspect, and assess nuclear installations to make judgements, on behalf of the public, that they are being managed and operated safely and within the law.

10.6 In pursuit of its mission, ONR seeks to ensure that the operators of the nuclear sites have made, and are implementing, adequate arrangements for complying with all relevant legislation. (See Article 7 – Legislative and Regulatory Framework for more details).

10.7 The licensees must be adequately resourced to underpin safe operations and maintenance, understand the hazards and risks that they are dealing with, and be committed to the adoption of relevant good practice (RGP) where available and appropriate, and making reasonably practicable improvements to safety. RGP is the generic term used for the collection of controls that, if implemented, would usually lead to the risk being reduced SFAIRP based on the experience of similar circumstances. However, RGP is not enforceable whereas the requirement to reduce risks SFAIRP is.

10.8 ONR has established an enforcement policy [53] that provides guiding principles for enforcing the law. As recommended by IAEA safety guide GSG-13 [89], ONR adopts a graded approach to enforcement, with any regulatory action taken being commensurate with the seriousness of the identified safety deficiency or administrative gap. ONR has legal powers to prohibit or shutdown specified operations. The licensee for the UK's operating nuclear power plants, EDF Energy NGL, has a strong culture of making conservative decisions to shutdown reactors should a safety concern warrant such significant action.

10.9 ONR's main aim is to regulate the nuclear industry's safety performance in a way that commands public confidence and trust. Further information on how ONR prioritises and focuses its attention on safety of the nuclear installations can be found in Article 8 – Regulatory Body and Article 14 – Assessment and Verification of Safety. Further information is also available in ONR's Strategy 2020–25 [68] and Corporate Plan 2024–25 [70].

The operator's priority to nuclear safety

10.10 In the UK there is a single licensee, EDF Energy NGL, for all operating civil nuclear power plants. Additionally, two new nuclear reactors are currently under construction by NNB GenCo (HPC) Ltd and Sizewell C Ltd. The following sub-sections provide further information on how EDF Energy NGL, NNB GenCo (HPC) Ltd and Sizewell C Ltd demonstrate their commitment and priority to safety.

Organising and managing priority to safety in EDF Energy NGL

10.11 EDF Energy NGL is part of the wider EDF group and it shares group-wide common commitments that give priority to safety. These include:

- An overriding priority is placed on nuclear safety at every stage of the plant lifecycle. That priority is the responsibility of all and is demonstrated via the individual commitment of all staff.
- Recognising the importance of establishing a strong nuclear safety culture among its staff and contractors. This is characterised by: people having a questioning attitude and being free to raise safety concerns; using error prevention techniques; reporting safety incidents and adverse conditions in a timely and transparent way; being conscious of risks; and continually assessing them. The company values encourage strong, independent oversight and challenge, as set out in para 10.13.
- Recognising that excellence in everything it does is underpinned by equipment reliability, human performance, and efficient work management, as these are important drivers of nuclear safety and reliability.
- Promoting continuous improvement using the full range of knowledge and services within the company, and within international organisations. Operational experience is collected, analysed, reported, and acted upon. The company has committed both to receive international peer reviews and to provide peers for such reviews in other countries.

10.12 The commitment to give priority to nuclear safety is clearly established within EDF Energy NGL company policies. These policies are implemented through the organisation's integrated management system; the management system and detailed arrangements are structured to meet the IAEA requirements contained in GSR Part 2 [77]. Further information can be found on the EDF website [90].

10.13 The ultimate responsibility for setting policy and ensuring that the company operates safely and complies with legislative and regulatory requirements lies with the EDF Energy NGL Board, which monitors safety performance routinely. Specifically, safe management of

operations of the reactor fleet resides with the EDF Energy NGL executive team headed by the Managing Director, supported by the Director of Nuclear Operations, Technical Director and Safety and Assurance Director alongside directors in areas such as nuclear decommissioning, finance, human resources and legal affairs. The Safety and Assurance director is independent from the operational reporting line within EDF Energy NGL and provides appropriate review and challenge to operations in relation to nuclear safety. To reinforce their independence, the director has an additional direct reporting line to the EDF Inspector General for Nuclear Safety and Radiation Protection, who is part of the wider EDF group.

10.14 The Safety and Assurance directorate includes Independent Nuclear Assurance (INA) and Safety, Health, Environment and Quality, which supplies specialist expertise and guidance in emergency planning, radiological protection, environment, industrial safety, fire safety and occupational health. The directorate seeks to ensure that appropriate health and safety policies and standards are formulated and promulgated throughout the company. It provides advice and monitors the effectiveness of aspects of the management system, which are designed to implement the health and safety policy. The monitoring programme includes independent on-site inspections and reviews of the health of various systems and periodic review of SPIs.

10.15 In addition, each of the EDF Energy NGL NPPs has a station director who is responsible for effectively implementing the company's safety policy and standards on the licensed site.

10.16 On significant matters related to nuclear safety, the EDF Energy NGL power stations seek and take advice from the licensee's Nuclear Safety Committee (NSC), which usually meets monthly; this is a requirement of LC13 (nuclear safety committee) and is constituted to include independent members with extensive experience and knowledge in the field of nuclear safety. If the licensee rejects the advice of the NSC, there is a requirement to notify ONR and outline the reasons for the rejection.

10.17 NGL has established a nuclear baseline to ensure that it has sufficient resource and competence to discharge its responsibilities for the delivery and oversight of nuclear safety. This includes sufficient capability for 'intelligent customer' oversight of the supply chain, i.e. that the management of an NGL facility know what is required, fully understand the need for the contractor's services, specify requirements, supervise the work and technically review the output before, during and after implementation.

Review and challenge to EDF Energy NGL processes and procedures

10.18 EDF Energy NGL recognises the benefits from external peer review, internal challenge and self-assessment to existing arrangements and practices, and for enhancing its safety culture. EDF Energy NGL regularly invites scrutiny from its international peers and has established internal company arrangements and processes that provide challenges to the sites' management teams on the efficacy of its leadership and management for nuclear safety.

International peer reviews

10.19 The information herein is directly related to the **major common issue** to **foster international peer review missions and timely addressing of findings** from the joint eighth and ninth review meeting.

10.20 EDF Energy NGL subscribes to a planned programme of peer reviews (PR) by World Association of Nuclear Operators (WANO). The performance objectives and criteria under review by WANO include aspects of plant operations that affect nuclear safety and reliability. The PR programme identifies strengths and improvement areas. Ten weeks after the end of the PR, a formal exit meeting takes place where the relevant station director presents, to WANO and the EDF Energy NGL executive, the strategy for how the identified improvement areas will be remedied. In line with its WANO membership obligations and recognition of the

benefits of receiving these reviews, EDF Energy NGL has undertaken to have each generating nuclear installation reviewed every four-years with an interim mid-cycle visit to review improvement progress. EDF Energy NGL also undertakes to receive a review of its corporate support functions, with the next mission scheduled in December 2025.

10.21 In 2024, a Nuclear Safety Review Board (NSRB) was established, similar to that for EDF Energy NGL, to support the Hinkley Point C project as a critical friend through the commissioning phase and the journey to fuel to site in preparation for a review pre-startup.

10.22 In October 2023, an Operational Safety Review Team (OSART) mission to Heysham 2 took place and reviewed ten areas: Leadership and Management for Safety, Training and Qualification, Operations; Maintenance, Technical Support, Operating Experience Feedback, Radiation Protection, Chemistry, Emergency Preparedness & Response, and Accident Management. During the mission, the international experts observed that safety performance at Heysham 2 was good. The review highlighted nine examples of good practices at Heysham 2 including a system to detect electromagnetic and radio frequency interference, the use of military training expertise to develop high quality staff training, and the plant's contingency plans during routine maintenance or during emergent issues. In keeping with the approach taken in peer reviews, the mission team made recommendations and suggestions to EDF Energy for further improvements. In the months since the OSART review, EDF Energy NGL has made substantial progress on the recommendations and suggestions received. Action plans to address the findings have been developed, and are being worked through prior to the follow-up OSART review. A follow up review at Heysham 2 will take place in 2026 (26 January 2026 to 30 January 2026).

10.23 By these means, performance continues to be benchmarked against international standards and good practices are shared. The final reports of the OSART missions have been made publicly available through Government [91] and IAEA, ONR, and EDF Energy websites.

10.24 For the nuclear new build project at Hinkley Point C a pre-operational OSART is under consideration and will likely be conducted in around 2028/29.

10.25 Sizewell C Ltd joined WANO as a Category 5 member in 2024 marking a significant step in the journey towards the operation of Sizewell C and reflecting Sizewell C Ltd's commitment to embedding nuclear professionalism into the organisation at this early stage of the project.

Internal challenge and independent assessment

10.26 EDF Energy NGL has set up arrangements to provide for challenge within the company including the INA function, which is independent from those directly involved in plant operations. At each site there are permanent inspectors from the corporate internal regulatory function who are independent from the site. These independent inspectors carry out inspections and other reviews of plant operations, processes, and procedures. They provide regular reports to the station director and advise on safety and the safe conduct of activities. They also escalate advice to higher levels of management if the resulting action is deemed to be insufficient in scope or urgency.

10.27 As part of maintaining EDF Energy NGL's ISO 9001 quality management certification, there are third party compliance audits carried out by Lloyds Register each year. In addition, audits are carried out against ISO 14001, ISO 45001, and ISO 55001 to maintain certification. Furthermore, each site has a programme of planned and reactive audits, with the outputs from these and other assurance activities being considered regularly by a central scrutiny process to identify any company-wide generic issues. For more information, refer to Article 9 – Responsibility of the Licence Holder and Article 14 – Assessment and Verification of Safety NNB Genco (HPC) Ltd are certified against ISO 14001 and 9001, with full re-certification taking place in 2025.

Self-assessment within EDF Energy NGL

10.28 Self-assessment is regularly carried out at all levels within the company to evaluate and assess performance of the work, leading to identification of strengths and areas for improvement. This is supported by the benchmarking process that provides a standardised methodology for an efficient evaluation by an individual or team. This enables any good practices and improvements to be recorded and shared with other stations.

Taking actions to improve safety

10.29 All the review and challenge activities referenced above, and other processes, may identify a need to take corrective or remedial actions to improve the plant, processes or procedures to enhance safety. To manage these actions, EDF Energy NGL has a comprehensive corrective action programme and process that documents, reviews, evaluates and initiates remedial action to correct non-compliances or other anomalous findings. This process allows any member of staff to identify an issue or problem by raising a condition report. The report requires management review to determine its significance to safety and the extent to which further investigation into the matter is necessary. Once corrective actions are identified, the corrective action programme and process provides a company-wide method to track the actions to a satisfactory conclusion. For the most significant actions, additional effectiveness reviews are included following their implementation.

Enhancing safety culture in EDF Energy NGL

10.30 EDF Energy NGL has defined its nuclear safety culture using the IAEA safety series document INSAG-4, [92] and has developed a framework that characterises specific aspects of a healthy safety culture, based largely on WANO and Institute of Nuclear Power Operations (INPO) recommendations. The ten traits identified are as follows:

- Personal accountability: All individuals take personal responsibility for safety.
- Questioning attitude: Individuals avoid complacency and continuously challenge existing conditions and activities in order to identify discrepancies that might result in error or inappropriate action.
- Effective safety communications: Communications maintain a focus on safety;
- Leadership safety values and actions: Leaders demonstrate a commitment to safety in their decisions and behaviours.
- Decision making: Decisions that support or affect nuclear safety are systematic, rigorous, and thorough.
- Respectful work environment: Trust and respect permeate the organisation.
- Continuous learning: Opportunities to learn about ways to ensure safety are sought out and implemented.
- Problem identification and resolution: Issues potentially adversely impacting safety are promptly identified, fully evaluated, and promptly corrected.
- Environment for raising concerns: A safety conscious work environment is maintained where personnel feel free to raise safety concerns without fear of retaliation, intimidation, harassment, or discrimination.
- Work processes: The process of planning and controlling work activities is implemented so that safety is maintained.

10.31 The health of nuclear safety performance and culture is assessed typically biennially (every other year) by the licensee, initiated by a nuclear safety culture survey based on the traits above. This is an important opportunity for employees to provide views and recognise the progress made. It helps with the ongoing assessment and trending of nuclear safety culture and is a valuable tool in allowing EDF Energy NGL to listen to the views of their staff and drive forward improvements in nuclear safety.

10.32 NGL is implementing a 2022 Nuclear Safety Culture Assessment strategy that reinforces the expectation to adopt multiple methods to assess safety culture (in line with IAEA practice). Safety culture is reviewed and further assessed with the help of methods including Learning Teams or Focus Groups, a survey, through observations and events trending and the review of metrics. Improvement activities are identified and monitored within Directorates, stations and at a fleet level to further assess and address potential gaps. Actions are identified using the INPO GDAR model. The most recent Nuclear Safety Culture survey was completed in 2024 and NGL are reflecting on the findings of this survey.

10.33 During 2025, a review of the approach to assessment, enhancements to the governance and oversight arrangements and actions to further assess and improve three traits is being launched by the Nuclear Safety Culture Fleet Lead, sponsored by the Safety and Assurance Director.

Safety culture during outages on EDF Energy NGL sites

10.34 The success of outages and post-outage operation is dependent upon safety being an integral part of the working arrangements and safety management systems. Team leaders increase the safety awareness of individuals by looking to continuously improve safety performance in all areas.

10.35 During the planning stages of the outage process a defence-in-depth plan is drawn up to always maintain nuclear safety during the outage. This plan contains a schedule showing the significant work activities and the availability status of nuclear safety related plant during the execution phase of the outage. It is used to indicate periods of vulnerability to various types of event, such as loss-of-grid or individual system failures.

10.36 Pre-outage walk-downs or assessments have been promoted for risk significant activities to review, identify, and address factors that could undermine reliability such as procedure quality. Pre-outage training includes references to operational experience from the previous outage season and covers basic principles of nuclear professionalism (enhanced in 2024 by the Human Performance and Behavioural Safety Programme). The expectations for the defence-in-depth plan are communicated to all station personnel. Awareness training on the standards required for plant given protective status is also provided to all personnel having access to the plant during outage execution. Operations staff receive training on shutdown faults and the expected operator response, using the simulator for fault response training where appropriate.

10.37 At least weekly throughout the outage, a safety forum reviews the previous seven days safety performance. Findings from regular inspections are also presented at this forum. These inspections are focused on the observation of work, monitoring and reinforcement of the safety standards being applied and the identification and control of any hazards present in the area. Where necessary, actions are placed to address any safety concerns.

Decision-making processes at stations

10.38 Working in the nuclear industry means it is important to define processes that help personnel to make sound decisions, particularly those related to safety. The EDF Energy NGL processes are linked in an Operational Risk Management Model, which shows how the various elements of the decision-making process are connected along with the interactions with the various supporting tools. The main components are:

- Conservative decision-making: Predominately used by the operations department for making high quality, safe decisions when faced with uncertain and dynamic operating conditions. It is the process for ensuring a conservative view is taken of an unknown plant state such that safety overrides commercial issues. Actions are taken to place the plant in a safe known state, reviewing decisions on a regular basis.
- Operational decision-making: Used when degraded conditions exist that result in continued reductions in safety margins over a period of days, weeks, or even months, in order to return the plant to a known safe state and within action thresholds defined in safety procedures.
- Safety case anomalies process: Used when the plant differs from the condition or configuration assumed in the safety case.
- Troubleshooting and technical fault finding: A standard and systematic approach for use by all NPP station staff involved in troubleshooting and technical fault finding.
- Mitigation of operational risk: This process describes the response to periods of reduced plant availability or heightened operational risk both during 'at power' and shutdown operations and the necessity to apply additional risk mitigation measures.
- Event recovery: Outlines the framework and key roles required to facilitate a safe and effective recovery from significant degraded conditions.
- Operational Safety Review Committee: Provides oversight and review of operational risk and decision-making processes.

10.39 There is also special guidance on planning and performing tasks that if carried out incorrectly could have a significant impact on nuclear, radiological, environmental safety or incur generation losses and tasks that fall into the category of infrequently performed tests or evolutions.

10.40 The stations are operated within limits defined as Limiting Conditions of Operation within a suite of Technical Specifications, substantiated by a nuclear safety case. These are directly related to the requirements of the safety case and therefore define the safe operating envelope for the installation. Additional information on LCOs can be found Article 14 – Assessment and Verification of Safety and Article 19 – Operation.

10.41 EDF Energy NGL has arrangements to deal with conditions that are identified that may not have been previously analysed or that may challenge the claims and justifications made in the safety case. Such conditions may become apparent, for example, from periodic plant inspection or maintenance activities, from safety case reviews or from unanticipated operational occurrences.

Use of safety performance indicators in the UK

10.42 International experience, particularly following major events, has reinforced the usefulness of Safety Performance Indicators (SPI) to manage and prioritise safety. The use of SPIs is not mandatory in the UK but is recognised as good practice by ONR, and by the

licensees. In consultation with industry, ONR developed a framework for using SPIs, largely based on the model set out in IAEA TECDOC 1141 [93]. Pilot projects were undertaken to further refine the approach.

10.43 The UK nuclear industry's Safety Directors Forum subsequently published a good practice guide entitled 'Development and use of Safety Performance Indicators' [94]. The purpose of this guide is to help nuclear operators develop, implement, and use SPIs as part of their management of safety arrangements and to present examples of proven effective practices.

10.44 SPI related data is collected, collated, and analysed routinely at the EDF Energy NGL nuclear power plants. The information is used both on the sites and in the corporate centre as a contribution to the management information routinely considered by managers and leaders within EDF Energy NGL. Where adverse trends or generic safety issues are indicated by the SPI data, sites will investigate the causes and put in place any necessary corrective actions.

10.45 SPI data is made available to ONR inspectors should they wish to examine it and some of the information is included in the routine interactions between ONR, the stations and the EDF Energy NGL corporate centre. Each NPP site holds an annual review meeting with ONR, which follows a generic agenda structured around key themes to demonstrate the safety performance of the site over the past year. Prior to the meeting, a comprehensive information pack is produced, which includes relevant SPI data to illustrate aspects of safety performance, including trending. Actions may be placed on the licensee at these meetings when significant adverse trends are indicated. An example of SPIs can be seen in figure 10.1.

Figure 10.1: Safety Performance Indicators for the EDF Energy NGL Fleet

Indicators		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Number of Events ranked 1 or greater on INES, per reactor		0.47	0.27	0.47	0.53	0.27	0.07	0.47	0.20	0.27	**0.27**
Number of Nuclear Safety Events ranked 0 or greater on INES, per reactor		7.40	10.00	6.13	5.93	6.73	5.47	6.27	6.47	6.40	**4.73**
Number of cases of non-compliance with technical specifications for operation, per reactor		1.00	0.80	0.60	0.60	0.67	0.87	0.53	0.60	0.47	**0.47**
Number of alignment errors. (Per reactor)		2.87	3.13	0.93	1.67	1.67	1.00	1.33	1.20	1.47	**1.07**
Number of unscheduled reactor trips per reactor (7,000 hours critical)	Automatic	0.57	0.30	0.49	0.89	0.56	0.35	0.63	0.49	0.23	**0.12**
	Manual	0.19	0.42	0.37	0.20	0.32	0.00	0.27	0.00	0.12	**0.24**
Average operational collective dose, per nuclear unit in service. (in man-Sieverts).	PWR	0.048	0.554	0.296	0.096	0.255	0.031	0.383	0.028	0.719	**0.309**
	AGR	0.067	0.021	0.020	0.050	0.032	0.013	0.012	0.015	0.014	**0.013**
Personal Exposure	Number of individuals with doses above 20 mSv	0	0	0	0	0	0	0	0	0	**0**
	Number of individuals with doses between 16 and 20 mSv	0	0	0	0	0	0	0	0	0	**0**
	Number of individuals with doses between 14 and 16 mSv	0	0	0	0	0	0	0	0	0	**0**
Number of notable radiation protection events		18	20	10	23	28	26	30	18	19	**8**
Availability (%)	EDF Energy Plants	77.3	83.0	81.6	76.1	65.8	61.7	60.4	77.9	73.0	**72.7**
	PWR	100.0	82.0	83.8	89.4	80.6	99.4	64.2	98.7	73.7	**84.6**
	AGR	73.7	83.1	81.2	74.0	63.5	55.9	59.7	73.1	72.8	**69.6**
Unplanned inoperability (%)	EDF Energy Plants	2.3	5.1	5.0	3.1	4.0	5.0	12.3	4.8	4.0	**12.1**
	PWR	0.0	0.1	0.0	2.2	0.2	0.6	0.0	1.3	0.6	**0.0**
	AGR	2.7	5.8	5.7	3.3	4.7	6.2	14.3	5.9	4.9	**15.3**
Occupational accident rate with sick leave (per million hours worked)		0.4	0.3	0.2	0.5	0.3	0.3	0.3	0.5	0.3	**0.8**
Occupational accident rate TRIR (per million hours worked)		0.6	0.7	0.4	1.1	1.0	0.7	0.5	0.8	1.0	**1.0**

10.46 EDF Energy NGL uses a Performance Management process to set business objectives and the associated SPIs and Key Performance Indicators. There is an annual process that determines the suite of metrics and sets appropriate targets and goals.

10.47 The suite of metrics consists of:

- Tier 1 metrics – Results based measures focused on safety performance, operational reliability, and financial contribution (See figure 10.1).
- Tier 2 metrics – Leading measures focused on improvement actions, and enablers to deliver Tier 1 performance.
- Tier 3 metrics – Fleet Programme process measures, which track specific focus areas of the fleet programme and are reviewed by the relevant fleet manager and peer groups.

10.48 The content of the Tier 1 and Tier 2 suites are reviewed every year to ensure they are aligned to business objectives and reflect current business activities. The goals and targets are normally set to align with the WANO/INPO upper quartile performance. The overall suite, and other fleet performance monitoring arrangements, are reviewed against the IAEA Safety Performance Indicator framework to ensure all components of the nuclear safety attributes in the IAEA framework are covered adequately.

10.49 The performance data against the Tier 1 and Tier 2 metrics is reviewed monthly by the senior management team. The metrics are published internally so the safety performance of the company is available to all staff.

NNB GenCo (HPC) Ltd's measures to implement arrangements for safety

10.50 NNB GenCo has arrangements to ensure the ongoing development of a strong nuclear safety culture. These have drawn from on EDF and EDF Energy NGL proven practice, as well as from benchmarking of international best practice, namely, that of the IAEA and WANO organisations.

10.51 The NNB GenCo nuclear safety policy identifies the standards, commitments and accountabilities to achieve nuclear safety-related objectives and includes the development of a strong nuclear safety culture to ensure the overriding priority is afforded to nuclear safety by all personnel.

10.52 A nuclear baseline (an organisational structure that identifies the posts that must be filled by persons who are suitably qualified and experienced) is in place to demonstrate compliance with the nuclear site LCs. Personnel competency is assessed, recorded and (where required) improved to ensure nuclear safety. The baseline also identifies positions with an intelligent customer role. NNB GenCo performs its intelligent customer role through deployment of its review and acceptance process to oversee and accept the work done by contractors on its behalf.

10.53 NNB GenCo provides training to staff and contract partners on nuclear safety culture, human performance and error reduction techniques, organisational learning and Counterfeit, Fraudulent and Suspect Items (CFSI). Key messages are regularly reinforced in work briefings, site walkdowns, webinars, print and web content.

10.54 The NNB GenCo Nuclear Safety Committee considers and provides advice as required to the NNB GenCo Board on all matters that may affect nuclear safety or radiological matters on or off the nuclear licensed site. An Internal Nuclear Regulation function within the Safety and Regulation Directorate provides an independent regulation function, assessing activities across the Hinkley Point C project, and advising the NNB GenCo Executive.

10.55 NNB GenCo has an established project culture, aimed at developing a common set of attitudes and behaviours. This includes project values, life-saving rules, quality commitments, nuclear safety culture awareness, use of organisational learning and leadership development.

10.56 NNB GenCo periodically assesses nuclear safety culture arrangements within the Hinkley Point C supply chain. NNB GenCo supports suppliers in addressing any shortfalls in their nuclear safety culture arrangements, including providing bespoke nuclear safety culture training and forums for contract partner stakeholders to discuss and challenge the implementation of nuclear safety culture improvement initiatives.

10.57 Organisational learning is managed in a bespoke tool that covers learning reports, actions, audit findings and observations on a range of issues. Learning from experience can be demonstrated through the application of lessons learned from sister EPR™ plants and from Hinkley Point C Unit 1 to Unit 2.

Sizewell C's measures to implement arrangements for safety

10.58 Sizewell C Ltd has arrangements to ensure the ongoing development of a strong nuclear safety culture throughout the life cycle of the project. These have been drawn from the approaches of NNB GenCo (HPC) Ltd and EDF, as well as benchmarking international best practice.

10.59 The nuclear safety policy identifies the standards, commitments and accountabilities to achieve nuclear safety-related objectives and includes the development of a strong nuclear safety culture to ensure priority is afforded to nuclear safety by all personnel. Underlying procedures exist to ensure implementation of the policy requirements and expectations.

10.60 A live integrated nuclear baseline is in place to demonstrate compliance with the nuclear site LCs. It identifies posts and roles that have a direct or indirect impact to nuclear safety and those that have an intelligent customer role, to oversee and accept the work done by contractors on Sizewell C Ltd's behalf. There is a competency framework in place to ensure individuals are suitably qualified and experienced in nuclear safety.

10.61 Employees and contractors are made aware of key policies and procedures, and the purpose of the Integrated Management System, during the induction process, and must always comply with the arrangements. The induction includes an introduction to nuclear safety culture.

10.62 The Sizewell C Ltd Board is ultimately responsible for all nuclear safety decision making. The Nuclear Safety Committee, required under LC13 (Nuclear Safety Committee), provides independent advice to the Sizewell C Ltd Board on all matters that may affect nuclear or radiological safety matters on or off the nuclear licensed site. The Independent Nuclear Assurance function within the Safety, Security and Assurance Directorate provides internal assurance and challenge, assessing activities across the project, and advising the Executive Leadership Team. Compliance against the Nuclear Site Licence conditions is also monitored. Sizewell C Ltd is also subject to ongoing independent regulation by ONR.

10.63 Sizewell C Ltd has a 'one Sizewell C' project culture approach across all nuclear safety, industrial safety, quality, environmental management, sustainability and security, which is underpinned by the project values and behaviours.

10.64 Sizewell C Ltd's strategic approach to organisational learning, is similar to that used at Hinkley Point C. An organisational learning process is in place, which includes a reporting tool, Insight. Learning reports are reviewed at daily and weekly screening meetings, categorised and actions assigned and tracked. There is a strong focus on learning from experience, demonstrated through the application of lessons learned from sister EPR™ plants and Hinkley Point C.

10.65 Sizewell C Ltd is implementing an integrated approach to delivery and functional assurance, which will be applied proportionately and integrated in an overall assurance framework. The framework is aligned with government and industry relevant best practice and is applied across three 'Lines of Defence'. This includes application by the supply chain and external resources who will carry out their own level of self-assurance and culture of compliant delivery to meet their contractual obligations. There is then a systematic programme of audit, inspection, and surveillance on a sampling basis, within all tiers of the supply chain.

Organisational leadership and management for a positive safety culture

10.66 ONR recognises that organisational and cultural shortcomings are common contributors to, or consistently identified as, underlying causes of accidents and serious events around the world – not just in the nuclear industry. The organisational and cultural aspects are often complex, but several common factors have been identified from event investigations and research studies and these include the following:

- Ineffective leadership
- Inadequate management oversight and scrutiny of safety
- Poor decision making and lack of effective challenge
- Failure to apply lessons from within and outside the organisation

10.67 Leadership and cultural aspects of safety cannot be easily prescribed in laws, but poor leadership and culture is likely to impact adversely on safety outcomes. Management and organisation for safety is more easily prescribed and requirements are outlined in the UK, for example, through the Management of Health & Safety at Work Regulations 1999 (MHSWR99) [45]. LC17 (Management Systems) [13], is more principle based and requires licensees to establish and implement management systems that give due priority to safety.

10.68 In 2025, ONR published further guidance for its inspectors on the assessment of management systems and associated quality management arrangements (see Article 13 – Quality Assurance). Most UK licensees have adopted the recommendations contained in IAEA safety requirements General Safety Requirements (GSR) Part 2 [77] and its associated safety guides GS-G-3.1 [95] and GS-G-3.5 [96] for implementing effective safety management systems.

10.69 In line with IAEA GSR Part 2, ONR uses the term 'Leadership and Management for Safety' (LMfS) to identify important factors in the effective management of the nuclear hazards and for promoting a positive safety culture, thereby contributing to the safety of facilities and activities at nuclear installations (see figure 10.2).

10.70 The assessment of a dutyholder's performance in relation to LMfS may be informed by application of the following assessment methodologies:

- **Culture 'warning flags'** [97]. ONR has developed guidance for use by inspectors to help them identify the precursors or 'warning flags' of deteriorating organisational culture in dutyholder organisations. Examples include complacency and overconfidence, compromised decision making and deviation from standards and behaviours. The warning flags are used by inspectors on a regular basis to identify patterns or trends relating to organisational culture in a dutyholder (including positive as well as negative indicators) that may warrant follow-up by ONR.
- **LMfS review** [98]. The purpose of an LMfS review is to provide insights that enable the development and resourcing of ONR's annual intervention plans, as well as to inform

dutyholder attention levels. The LMfS review identifies and analyses information from a wide range of sources, including incident reports, safety performance indicators and inspections. The results of such reviews are fed into ONR's inspection planning process and have contributed to the identification of themed inspections on topics that warrant further regulatory attention.

- **Culture assessment** [99]. ONR has published a flexible framework of qualitative research methods that enable specialist inspectors to undertake targeted assessments of safety culture, assessments of culture change, or to diagnose organisational problems that may be adversely impacting upon safety outcomes. Such assessments typically involve a team of inspectors carrying out reviews of documents, interviews, and observations of activities on-site, followed by structured data analysis, to provide an insight into the culture of an organisation. ONR's approach to these assessments is enabling and collaborative in nature, fostering a common understanding between the regulator and dutyholder of the issues that may be underlying poor performance, which is then used to drive prioritised improvement plans at a strategic level. ONR's experience of carrying out such assessments to date has been positive of the value they add over and above routine inspections and licensee self-assessment activity.

Figure 10.2: ONR Leadership and Management for Safety Assessment Principles

10.71 Another important aspect of ONR's strategy on LMfS is the corporate inspection function. The purpose of corporate inspection is to look at a licensee's organisation, including central or corporate functions and ensure regular interactions with directors and senior management. This focuses on the oversight and management of activities within the scope of the nuclear site licence and complements site-based activities. Corporate inspection embodies the concept of regulatory leverage, applying regulatory effort and attention to promote improvement across a licensee's organisation, for example in corporate functions or in the attitudes, actions and behaviours at the higher levels of management. Corporate inspectors are in place for EDF Energy NGL and NNB GenCo (HPC) Ltd. Licensee corporate bodies may

also be subject to assessment of dutyholder attention levels, as per the process described above.

10.72 ONR has established an annual process for assigning regulatory attention levels to each dutyholder, based on an assessment of the dutyholder's overall safety performance: 3 – Routine, 2 – Enhanced or 1 – Significantly Enhanced. This process includes an assessment of the dutyholder's performance in relation to LMfS. The results of the assessment of dutyholder attention levels are published in the Chief Nuclear Inspector's (CNI) Annual Report [100]. An action plan is developed, where appropriate, to secure the return of the dutyholder to a routine attention level.

10.73 ONR's specialism group on Human and Organisational Capability is well established. The group is responsible for oversight and coordination of ONR's plans and activities on LMfS, Licensing, Human Factors, Supply Chain and Quality (see Article 13 – Quality Assurance). This includes ownership of ONR's suite of guidance in related topic areas. Members of the group take the lead in liaising with relevant nuclear industry working groups and encouraging licensees to share ideas and good practices to drive continual improvement. Current areas of focus for the ONR corporate discipline group include the following:

- **Leadership and Culture.** ONR's Chief Nuclear Inspector identified leadership and culture as a priority theme for the UK nuclear industry during 2020-23. This materialised as a series of priority inspections, supported by new regulatory guidance, and included a focus on the culture of the regulator as well as that of the dutyholder. ONR continues to influence and engage the UK industry on safety culture through the Safety Directors' Forum, considering the requirements of IAEA GSR Part 2. In 2022, ONR published new guidance for inspectors on safety leadership [101] and has recently carried out research in cooperation with industry to develop a validated safety culture model and an associated survey instrument (see example below).
- **Corporate Governance for Nuclear Safety.** ONR recognises that the system by which licensee boards direct and control the activities of their organisations has a significant influence on nuclear safety outcomes. In 2023, ONR published new guidance for inspectors on corporate governance for nuclear safety [102], drawing on guidance on corporate governance from the UK Financial Reporting Council. ONR undertakes periodic interventions to examine the effectiveness of board oversight of nuclear safety.
- **Supply Chain** (see Article 13 – Quality Assurance)
- **Safety Culture of the Regulator**. ONR recognises that the culture and practices of the regulator have a significant influence on the safety culture, and by inference the safety performance, of licensees. ONR contributes to work by international bodies, such as the Nuclear Energy Agency's Working Group on Leadership and Safety Culture, in this area. In 2022, ONR commissioned an independent assessment of its own culture (see example below). This also addressed a finding (related to the development of ONR's Integrated Management System, which including matters on leadership and safety culture) from the 2019 IAEA IRRS mission to the UK (Recommendation R9)

UK Nuclear Industry Safety Culture Inventory (NISCI) Model and Survey Tool

10.74 In 2022, ONR reviewed existing measures of safety culture in use in the nuclear industry and found them to lack strong validity, meaning that they may not accurately measure what they say they measure, and may not predict important safety outcomes. ONR therefore commissioned a team of academics from Alliance Manchester Business School (AMBS) to develop a model and measure of safety culture.

10.75 The 18-month research project comprised a literature review and interviews with subject matter experts to develop an initial model. The model was then validated in two phases to determine its accuracy and appropriateness through a combination of interviews and two quantitative surveys. All Great Britain's nuclear site licensees participated in this research and the second survey received responses from 3480 licensee staff and contractors.

10.76 The result is a state-of-the-art safety culture model and measure, known as the Nuclear Industry Safety Culture Inventory (NISCI), which is uniquely suited to the GB nuclear industry and is validated to a high level of psychometric rigour [103]. ONR has since contracted a supplier to develop the NISCI into a software tool, which enables user organisations to accurately measure their safety cultures and benchmark their results. When used alongside qualitative data and evidence from the wider environment, the NISCI provides a powerful means of maintaining and continuously improving safety in GB's nuclear industry. NISCI has already been successfully used by several nuclear organisations.

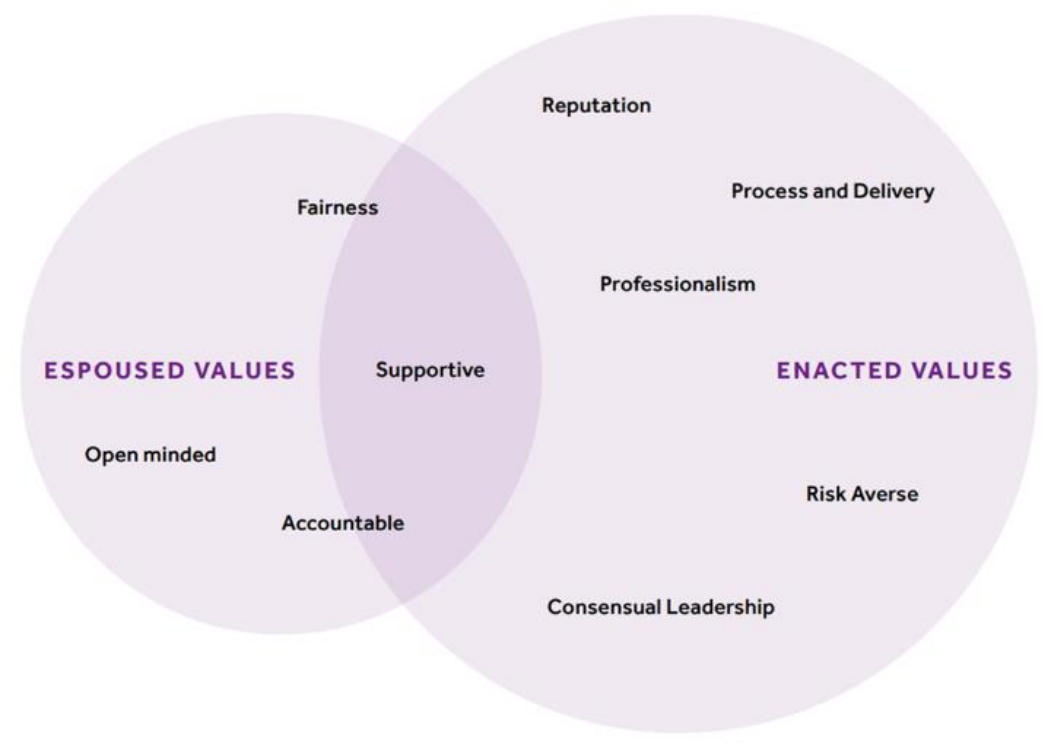
Independent Culture Assessment of the UK nuclear regulatory body

10.77 In 2022, ONR commissioned a research team at AMBS to carry out an independent assessment to identify how its culture impacts delivery of its mission - to protect society by securing safe nuclear operations [104]. The rigorous 12-month study drew on interviews with staff and stakeholders, focus groups, a staff survey, a document review and observations of meetings and external interactions, as well as learning from other regulators internationally.

The wide-ranging, multi-method approach made it one of the most comprehensive assessments to be carried out by any nuclear regulator to date and this work was recognised as a good performance in the IAEA IRRS follow-up mission to the UK in 2024.

10.78 AMBS's study found that external stakeholders see ONR as a trustworthy and transparent regulator, allowing it to positively influence dutyholders. Its enabling approach to regulation is highly regarded. The study also found that ONR's four stated organisational values – accountable, open-minded, fair and supportive – were apparent in its external interactions. However, only the value of 'supportive' was seen as being lived internally, where instead the predominant values focus on reputation, professionalism, risk aversion, consensual leadership, process orientation, drive for excellence and independence (see figure below).

10.79 ONR is using the insights from the AMBS study to identify learning opportunities and strategies to improve the effectiveness of its everyday work, on both an individual and organisational level. This includes work to ensure ONR's stated values are embedded in all its internal and external work, for example, ensuring leaders consistently role model accountability, open-mindedness and fairness, and that staff feel empowered to raise concerns and report errors, contributing to learning opportunities.



Summary of significant changes since previous report

10.80 During the reporting period, developments under this Article are as follows:

- An IAEA OSART mission took place at EDF Energy NGL's Heysham 2 NPP.
- Establishment of Sizewell C NPP's arrangements to give priority to nuclear safety (start of construction) and further development of the arrangements at Hinkley Point C.
- The development and implementation by ONR of two new regulatory guidance documents on corporate governance for nuclear safety and organisational culture 'warning flags'.

Notable achievements

10.81 **Development of model of safety culture and associated survey tool**: ONR, working alongside GB's nuclear industry, has developed a state-of-the-art model of safety culture, and an associated survey tool. The model and tool provides a powerful benchmarking capability for the GB nuclear industry to accurately measure their safety cultures and benchmark their results, allowing them to further improve their safety performance. The newly developed model and survey tool has already been successfully used by several nuclear organisations in the UK (See paragraphs 10.74 to 10.76 for more details).

10.82 **Independent culture assessment of the UK nuclear regulatory body:** ONR commissioned an independent body to carry out an assessment to identify how its culture impacts the delivery of its mission - to protect society by securing safe nuclear operations. The rigorous 12-month study drew on interviews with staff and stakeholders, focus groups, a staff survey, a document review and observations of meetings and external interactions, as well as learning from other regulators internationally. The study provided reassurance of ONR's trustworthiness, transparency and enabling approach while also giving insights into how ONR can further improve its organisational effectiveness (See paragraphs 10.77 to 10.79) for more details).

Article 11 – Financial and Human Resources

Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.

Each contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each installation, throughout its life.

Summary statement for article

11.1 The UK fulfils the obligations of Article 11. It has comprehensive arrangements in place to ensure that adequate financial and human resources are available to support the safety of each nuclear installation throughout its life.

Legal requirements

11.2 The principal legal requirement for nuclear site licensees to have adequate resources is contained in LC36 (Organisational Capability). This requires the licensee to provide and maintain adequate financial and human resources to ensure the safe operation of the licensed site (see Table 5 – Licence Conditions).

The provision of adequate financial resources

11.3 ONR has issued guidance on how the licensee can comply with the requirement for adequate financial resources. The essence of this guidance is that ONR gains confidence that licensees provide and maintain adequate financial resources to fulfil their obligations in respect of safety, by demonstrably understanding and managing the hazards and risks associated with their undertakings. This means that they are reducing risk so far as is reasonably practicable (SFAIRP) and implementing improvements in a timely manner, maintaining an adequate organisational capability, assessing what financial resources are necessary to continue to meet those needs and assigning those resources accordingly. Although it has not yet happened, for example, if a safety issue could not be resolved to the satisfaction of the inspector, and financial resource issues were identified as a possible factor, ONR would seek to limit operations to ensure safety is maintained whilst seeking external advice on the issue before taking a decision on appropriate enforcement action.

11.4 Regarding the financial responsibilities of the operator for potential damages to the public or the environment – under Section 19 of the Nuclear Installations Act 1965 (NIA65) [31], the Government approves a nuclear operator's third-party liability insurance (or other financial arrangements). ONR seeks assurance from the Department for Energy Security and Net Zero (DESNZ) on the issue of liability before issuing a nuclear site licence. Should an operator's arrangements change, approval of new arrangements must be sought from the Government.

11.5 When issuing a licence to an organisation for the first time, ONR seeks advice from DESNZ that the prospective licensee has the resources to be a nuclear site licensee for the activities envisaged. NIA65 permits only a corporate body to be a nuclear site licence holder. This provides assurance of continuity of commitment even if that company is taken over by, or merges with, another company.

Financing safety improvements during operational life

11.6 The costs of making any necessary safety improvements during the operating life of a nuclear installation are treated as part of the installation's normal operating costs. The principal elements of operating costs comprise:

- Materials and services (the cost of engineering, including contractors, and consumable spares for maintaining the nuclear installations, and other miscellaneous charges such as insurance)
- Staff costs (salaries and pension provisions)
- Statutory outages
- Investment
- Regulation and the provision of security services

11.7 EDF Energy NGL's focus on asset management aims to optimise investment to improve and maintain safety performance and manage risk. Processes include strategic lifetime planning and short, medium, and long-term investment planning. Directors and heads of function plan and control the financial resources necessary to achieve safety standards, meet liabilities, maintain an effective management system, and achieve the company's objectives.

Financing radioactive waste management at nuclear installations

11.8 The audited accounts of UK nuclear installation operators include details of waste management costs and the provisions made to meet these costs. The costs associated with managing the most hazardous radioactive waste that is destined for disposal at a Geological Disposal Facility (GDF) comprise of:

- Costs actually incurred during the operational phase.
- Liabilities associated with the management of the radioactive waste and , spent fuel before ultimate disposal during the decommissioning phase such as interim storage until a GDF is available and conditioning of waste to make it suitable for interim storage and disposal.

11.9 The cost of managing radioactive waste during the operational phase is an operational cost spread across the materials, services, and staff costs in the reported accounts. The materials and services costs in the accounts include costs associated with disposal of Low Level Waste (LLW) where the operator of the waste facility sets a price that reflects all operational and liability cost considerations – this includes costs associated with obtaining Letters of Compliance (LoC) with respect to the most hazardous radioactive waste destined for a GDF from Radioactive Waste Management (RWM), Nuclear Waste Services [105] that give confidence that the waste meets the expected criteria for acceptance at a future GDF.

11.10 All disposals of radioactive waste, including those to the environment, are undertaken in accordance with regulatory authorisations. The environment agencies and ONR recover costs in granting, monitoring, and enforcing the authorisations or permits from the operator.

Financing decommissioning programmes

11.11 UK government policy is that all nuclear operators take the necessary steps to ensure that decommissioning work is adequately funded. For new-build nuclear power stations, these arrangements are set out in a Funded Decommissioning Programme (FDP). Under the Energy Act 2008 [39], it is a criminal offence for the operator to use a site, or permit another person to do so, without an FDP that has been approved by the Secretary of State. After the FDP is approved, the operator is required to make annual and 5-yearly reports to the Secretary of

State to enable monitoring of the operator's waste and decommissioning liabilities and the financial provision made for them. This may result in modifications being made to the FDP.

11.12 For the existing fleet of operating reactors currently operated by EDF Energy NGL, the Nuclear Liabilities Fund (NLF) has been established to cover the costs of decommissioning and the discharge of certain nuclear liabilities not covered under contract with third parties. The NLF is underwritten by the UK Government and administered by trustees appointed by DESNZ and EDF Energy NGL. EDF Energy NGL is required to make payments into this fund; financial details of EDF Energy NGL's liabilities and the NLF are set out in the respective companies' annual accounts. The fund is backed by the Government and the UK taxpayer and is managed in line with the Nuclear Liabilities Funding Agreement (NLFA). The value of the fund in 2024 was circa £20.6 billion. The funding arrangements for decommissioning EDF Energy NGL's nuclear power stations and discharging its uncontracted liabilities are contained within the NLFA. Under this agreement, EDF Energy NGL is required to produce plans that look forward on both a three-year timescale and lifetime basis for the decommissioning of its stations, including the necessary pre-closure planning work. These are subject to review and approval by the NDA. EDF Energy NGL also produces an annual report describing changes in the estimated costs of decommissioning and uncontracted liabilities over the previous financial year. This is also subject to review and approval by the NDA. Uncontracted liabilities include certain costs associated with spent fuel storage and removal, for example, funding the dry spent fuel storage facility at Sizewell B. The NDA have approval rights relating to EDF Energy NGL station life extensions, dependent on the impact on liabilities.

11.13 EDF Energy NGL, as a private company and site licensee, is solely responsible for decommissioning its plants. However, there are agreements in place to provide the Secretary of State for DESNZ with an option to acquire EDF's AGR nuclear power stations for a nominal sum after they are closed, either to continue to operate them if this is safe to do so, or to decommission them, for example by adding them to the NDA's portfolio of sites. An agreement has been signed between the Secretary of State for DESNZ and EDF Energy that, for the older fleet of AGRs, will see EDF Energy carry out defuelling but following Fuel Free Verification (FFV), the sites will then be transferred into the NDA's [106] portfolio. The activities to prepare and defuel qualify for NLF funding if they are a qualifying liability under the NLFA.

11.14 There is a cross-industry collaborative programme to prepare for and execute AGR defuelling led by EDF Energy NGL; the AGR Operating Programme. Other delivery partners include Sellafield Ltd [107], Direct Rail Services [108] and the NDA. Ultimately governed by DESNZ, the programme aims to maximise the value to the UK through safe and optimised AGR defuelling. Utilising the existing spent fuel route from the AGR sites, the programme will establish the capability to move all nuclear fuel safely and efficiently from the 14 AGR reactors into pond storage at Sellafield prior to ultimate disposal within a GDF.

11.15 For new nuclear power stations, the Energy Act 2008 requires that operators have secure financing arrangements in place to meet the full costs of decommissioning and their full share of waste management and disposal costs. These arrangements are set out in an FDP that is approved by the Secretary of State prior to construction of the new nuclear power plant commencing. The FDP is subject to annual and 5-yearly reviews.

11.16 For Hinkley Point C, the FDP was approved by the Secretary of State in accordance with the requirements of the Energy Act 2008, and comprises of:

- The Decommissioning and Waste Management Plan (DWMP), which sets out the operator's plans for dealing with its liabilities (covering decommissioning, spent fuel management, waste management and waste disposal) and its costings for specific aspects of those plans.

- The Funding Arrangements Plan (FAP), which sets out how the operator will make financial provision to meet the costed liabilities in the DWMP. It is in the form of a contract between the operator and the independent fund company that has been set up to hold monies for the plant's decommissioning and clean up. The FAP sets out the roles and responsibilities of the fund and how payments to the fund will be calculated. It also explains how the priority of FDP payments is achieved over payments to investors.

11.17 Sizewell C Ltd is in the process of finalising arrangements for its FDP. These arrangements largely mirror those already agreed and established at Hinkley Point C and ensure that Sizewell C Ltd has a plan to decommission the power plant, and that there is a means by which appropriate financial provision is in place to discharge all liabilities once the power station ceases generating electricity. Following a Financial Investment Decision, Sizewell C Ltd will issue its FDP to the Secretary of State for approval in accordance with the requirements of the Energy Act 2008.

The provision of adequate human resources

Regulatory review and control

11.18 Several LCs set requirements on management of human resources and training (see Table 5 – Licence Conditions).

- LC36 includes a specific requirement for the licensee to provide and maintain adequate human resources to ensure safe operation.
- LC10 (training) requires the licensee to make and implement adequate arrangements for suitable training of all persons on site who have responsibility for any operations that may affect safety.
- LC12 (duly authorised and other suitably qualified and experienced persons) requires the licensee to make and implement adequate arrangements to ensure that only suitably qualified and experienced persons perform duties that may affect safety. This includes the appointment of duly authorised persons to control and supervise specific safety related operations.

11.19 ONR's nuclear safety inspectors review the capability and arrangements of licensees against these LCs supported by ONR's guidance in relevant TIGs [46] and TAGs [47], considering particularly whether the organisation has the capability, i.e., capacity and competence to secure and maintain the safety of its operations.

11.20 In addition, the HSWA74 [30] places responsibility for health and safety on every employer on the licensed site, for example, on EDF Energy NGL sites, all contracting companies also have legal responsibilities. These responsibilities include ensuring the competence and training of staff with safety related roles. Specific requirements are included in the MHSWR99 [45] in particular, Regulation 13 on capabilities and training.

11.21 ONR expects the licensee to show that provision of adequate resources, delivery of training and the means of assuring competence are set out in policies, plans and processes that are supported by commitments from senior managers.

Regulatory expectations for organisational capability

11.22 ONR has produced guidance to set out its expectations regarding a 'capable licensee' in its TAGs, TIGs and SAPs. These guides address areas such as: managing organisational change, developing a 'nuclear baseline', organisational capability, training and competence management, intelligent customer capability and the use of contractors, the role of licensees' own internal assurance and challenge functions, supply chain and design authority. It has also

worked with the nuclear industry to develop a good practice guide entitled 'Nuclear Baseline and the Management of Organisational Change' [109].

11.23 ONR expects that the licensee should be able to identify and maintain the core capability that it needs to maintain effective management for nuclear safety. It expects the licensee to have, within its own organisation, sufficient competent persons to be able to always maintain control and oversight of safety. This includes technical (for example, design authority, intelligent customer, engineering, and safety case capability), operational and managerial elements. Together, they combine to ensure that the safety case for the installation is understood, maintained and delivered, and that the site, and plants or projects are operated in accordance with the safety case and the conditions of the nuclear site licence. ONR also requires the licensee to provide evidence that it is sustaining a capable design authority.

11.24 ONR expects that changes to the licensee's organisation (including structure, staffing, resources, or competences) should be subject to proportionate and systematic evaluation to ensure they do not adversely affect the capability of the organisation to deliver safety and security.

11.25 Prospective new nuclear licensees are required to submit a Safety Management Prospectus (SMP), which sets out and demonstrates how their organisational structures, resources, capabilities, governance, and management arrangements are suitable to manage nuclear safety. Together with the nuclear baseline, the SMP is regarded by ONR as the safety case for the organisation's capability. ONR's expectations in this area are set out in 'Licensing Nuclear Installations' [52].

Regulatory expectations for training and qualification

11.26 ONR's approach is to seek confidence that the licensee has implemented effective arrangements for training and competence assurance for all personnel whose activities may impact upon safety. This should cover both licensee employees and others, such as contractors, whose actions could impact upon nuclear safety. It does this by assessing the adequacy of, and compliance with, LC arrangements, notably LC10. ONR's expectations are set out in the associated ONR TAG, 'Training and Assuring Personnel competence'.

11.27 ONR looks for clear links between an individual's post and roles and the training required. For example, within EDF Energy NGL, training profiles have been developed for both posts and roles that set out 'essential' and 'performance' training requirements. ONR also regards the design, control, and maintenance of training records as an essential requirement in support of LC10 and LC12. ONR inspectors routinely assess training compliance during System-Based Inspections (SBIs), which assess whether systems will perform the safety functions claimed in the safety case. SBIs are explained in Article 14 – Assessment and Verification of Safety.

11.28 LC7 (incidents on the site) requires the licensee to develop adequate arrangements for the notification, investigation and reporting of incidents on site. Licensees' arrangements for investigations include determination of whether deficiencies in resources, training, or competence, are a causal factor or a root cause. The licensee must then identify any necessary preventative and corrective actions. ONR expects the licensee to have robust management arrangements for conducting reviews of all available sources of internal and external operational experience and to adjust training provision accordingly.

EDF Energy NGL approach to human resources

Organisational capability

11.29 Operational nuclear power plants in the UK produce baseline statements of their resource requirements to ensure sufficiency of staff. Analysis of resource requirements is

completed for both posts and roles. This information is analysed to identify potential vulnerabilities such as 'singleton' posts (posts that only one individual is currently qualified to fill) or demographic challenges. It enables development of succession plans and associated activities such as knowledge management. Resilience of senior managers is monitored, considering experience and length of time in post. Workforce planning is conducted at a local level and aggregated into company-wide plans.

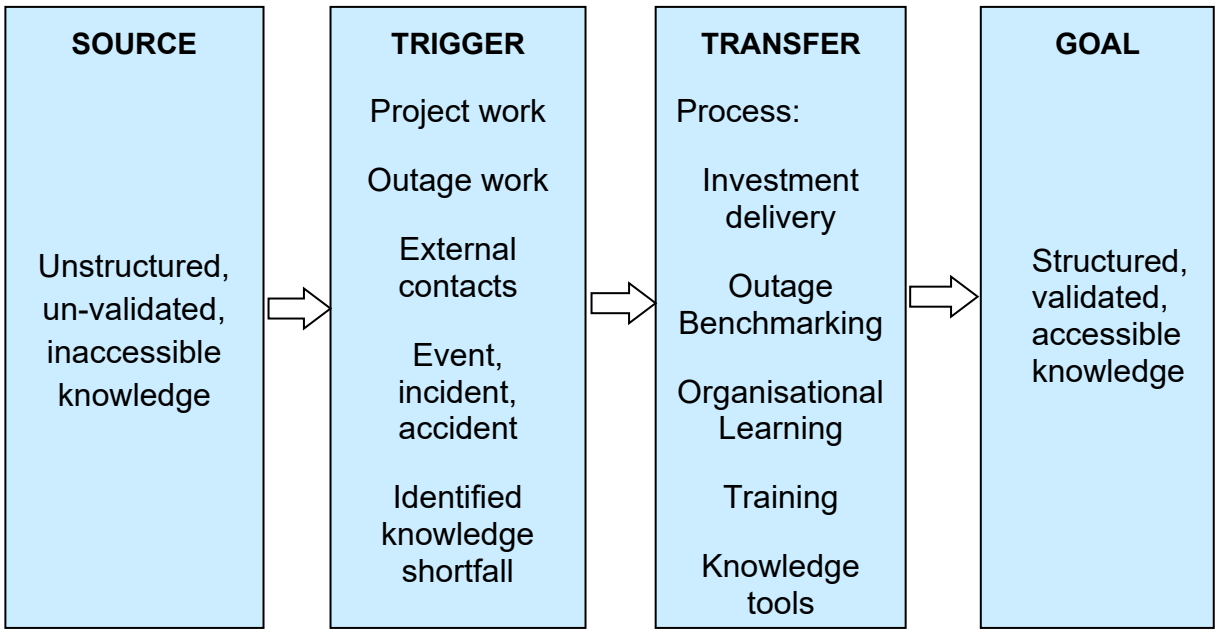
11.30 Levels of experience, health of succession and flight risks are tracked and monitored closely through the organisational capability risk assessment with governance in place to escalate both current and future risks including oversight of mitigations. Where necessary, fleet 'recovery' programmes have been established to manage common skills risks. Opportunities have been realised to proactively manage the redeployment of employees from defuelling stations into other locations where individual aspirations and mobility supports this.

11.31 Internally a Joint Capability Forum has been established to consider the skills position across the Nuclear family including the introduction of current and future skills heat maps. This forum previously developed the pipeline approach for Hinkley Point C, with the learning being taken from this to consider further areas where pipelines would be beneficial such as Sizewell C and Nuclear Services. Establishing a managed approach helps to maintain organisational capability whilst managing the transfer and retention of employees to support future business needs.

Example knowledge management and retention

11.32 Within EDF Energy NGL, there are many processes that are routinely used to gather and manage knowledge as part of normal daily activities. Knowledge management is a specific process, requiring additional personnel and tools to manage, that can be initiated by several different triggers. Once initiated the aim is to use existing processes to ensure knowledge becomes easily accessible for the future. The knowledge management process is shown graphically in figure 11.1.

Figure 11.1: Knowledge Management Process



11.33 From figure 11.1 it can be seen that there are many 'Triggers' that should initiate the relevant process to 'Transfer' relatively unstructured or inaccessible source knowledge into a more structured or accessible format. Many knowledge collection and management tools have been developed to support this. These include handover techniques and both interview and

questionnaire-based approaches that provide an adequate level of guidance to support knowledge management associated with personnel movement. These tools may be used without requiring expert facilitators.

11.34 It is not possible to capture all knowledge, so a risk based, graded approach is needed to ensure that available resources are focused on the areas or individuals where the greatest risk exists. In many cases a very simple qualitative approach will be adequate. Managers/supervisors will be able to review their teams and identify possible risks based on factors such as:

- Age/Length of experience
- Singleton Suitable Qualified and Experienced Personnel (SQEP);
- Involvement in specific projects
- Stated retirement plans
- Career development plans

11.35 A more formal risk assessment tool is also available for use in cases where it is beneficial, perhaps to provide more guidance where an initial qualitative overview identifies several 'at risk' individuals.

11.36 The goal of knowledge management is to ensure that acquired knowledge becomes, or remains, shared and accessible. Hence, whenever possible, the knowledge is built into existing documentation or training material and so becomes accessible using companywide methods/processes.

11.37 EDF Energy NGL's engineering and technical capability comprises staff at both operating NPPs and at central headquarter locations (see figure 6.1 under Article 6 – Existing Nuclear Installations). These staff provide the in-house resources available to respond to requirements for technical analyses. Where it is economic and practicable, technical services may be procured from suitably qualified and experienced specialists in other utilities or organisations, under appropriate contractual arrangements.

11.38 Management of change is one of EDF Energy NGL's 34 key management system processes. It includes specifications covering development of the nuclear baseline statements and application of the management of change process itself. Governance is provided at both site and corporate levels.

11.39 Nuclear Services, originally Technical Services Organisation (TSO), was established in 2019 as a business unit of EDF Energy to maintain, share and develop niche nuclear skills. It allows qualified and experienced personnel to support multiple licensees from within the EDF nuclear family across the breadth of the nuclear lifecycle. In 2025, Nuclear Services became a separate legal company with equal ownership by the three licensees it serves: NNB GenCo (HPC) Ltd, Sizewell C Ltd, and EDF Energy Nuclear Generation Ltd. Nuclear Services is fundamental to ensuring benefits in two critical areas are delivered:

- Maintaining and developing high end and, in some cases niche nuclear skills. Grouping these capabilities together makes it easier to achieve this over the extended periods of time needed to support a nuclear business and industry. Maintenance of these skills and experience in a cost-effective way not only benefits the licensees but also the UK as a whole.
- Supporting the replication of design and also the development of the safety cases and the approach to operations. The replication delivers a 'fleet effect' that enables learning to be readily implemented and provides significant efficiency savings. This learning, and more efficient use of resource, benefits safety by driving risk reduction. Replication

and commonality of approach is also an effective benefit for efficient and enabling regulation.

11.40 EDF Energy NGL has developed a long-term people strategy outlining its resource needs through to the end of operation and beyond, to the next life cycle phases. The company is active in developing 'pipelines' through apprenticeship and graduate recruitment programmes.

11.41 The decision about whether to use contracted personnel on work that may affect nuclear safety is based on several considerations. EDF Energy NGL's guidance requires several questions to be addressed as part of the decision-making to ensure that the nature of the work is suitable and that safety can be appropriately controlled by the licensee.

Training and competence

11.42 Within EDF Energy NGL, the training and qualification process is one of EDF Energy NGL's top tier management system processes. It includes:

- Analysis of jobs and tasks
- Development of training methods
- Delivery of training assessment of trainees against desired outcomes
- Refresher training as required
- Regular evaluation of training
- Ensures that staff are SQEP for the roles being undertaken

11.43 The content of initial training programmes is based on fleet analysis of job performance requirements including industry guidance, regulatory requirements, and management expectations. These are collated in programme specific task-to-training matrices, and site-specific programme content is included in these matrices. For operations and maintenance training programmes, training needs are derived from a task-to-training matrix. Training is identified at a component level and a difficulty, importance and frequency rating applied by suitably qualified and experienced reviewers to determine the extent of refresher training needed. For engineering support personnel (including system, design, component, safety group and procurement engineers), training programmes are derived from competency requirements. Competency training matrices identify initial and continuing training requirements at competency level. Site specific programme content is also included in these matrices.

11.44 All new recruits follow a standard company induction process for basic training. Each staff member has a post and training profile (PTP), which outlines the experience, qualifications and training required to fulfil the post requirements. Recently recruited staff will follow a training programme which has been systematically derived and may include, depending on programme, classroom training, on job training, mentoring, practical workshops, self-guided and digital, online learning.

11.45 Dedicated full-time certified training instructors at NPPs are selected on the basis that they have proven competence and experience. Subject matter experts that are employed in the work area in which they provide training are also utilised as instructors. Computer-based simulators are available on site for all operating reactors and form part of the training of plant operators. The simulators, which have been progressively updated, can simulate a range of potential accident scenarios and fault sequences. International operational experience is routinely reviewed by EDF Energy NGL and assessed by the relevant curriculum review

committee to ensure that this is integrated into initial and continuing training wherever appropriate.

11.46 Simulator training takes place at a frequency defined within the EDF Energy NGL task-to-training matrix that is derived using a systematic approach. The training is assessed, reviewed, and updated as per the systematic approach. The change of stations from generation to defuelling will mean different requirements will be placed on operation personnel and training requirements have been updated to reflect the new defuelling requirements. EDF Energy NGL has completed the training for operators at Hunterston B and Hinkley Point B and is currently training operators for the next stations to enter defuelling. The change has also been incorporated into emergency arrangements, to ensure that emergency arrangement training reflects the changing operating mode.

11.47 Mock-ups of plant items are also utilised to allow rehearsal of practical skills under controlled conditions. Emphasis is placed on training that enables staff to implement accident management strategies, utilising appropriate instrumentation and items of plant that are qualified for operation in severe accident environments.

11.48 Retraining of the licensee's personnel may be considered when an individual fails a training or interview assessment. Retraining of personnel may also occur when a gap in performance or gap to excellence is identified using EDF Energy NGL's organisational learning tools and processes. A change in plant, job scope or process would also trigger a request for an individual to be retrained. Additionally, EDF Energy NGL's systematic approach to training identifies specific tasks of nuclear safety significance, which are routinely retrained at a set frequency.

11.49 Procedures for assessing competence prior to undertaking a safety related role are part of the arrangements made under LC10, which addresses training. For operations and maintenance personnel for example, training programmes within EDF Energy NGL also include on-the-job training and training performance evaluation as part of the qualification process.

11.50 Duly Authorised Persons (DAP) are identified as individuals who are in direct control or supervision of operations or activities that could impact on the safety envelope of the facility. Their appointments are therefore subject to additional management controls covering areas such as appointment and assessment. This is to ensure that they understand the basis for safety to ensure that operations remain within the safe operating envelope. However, the general principle that persons whose activities may impact upon nuclear safety should be appropriately trained, and their competence adequately assured, is similar for SQEPs and DAPs.

Training of external personnel

11.51 When licensees use contractors for safety related work, they must satisfy themselves that the contractors have the appropriate qualifications and training to undertake the tasks safely. The training of contractors' staff so that they comply with site safety rules is part of the contractual agreements for such work. When safety-related work is contracted to organisations external to the licensee, the licensee acts as an 'intelligent customer' and provides appropriate oversight and control following a graded approach.

Improvements to training programmes

11.52 Within EDF Energy NGL, a series of training review committees (at operational, tactical and strategic levels) ensures that initial and continuing training programmes are kept up to date, for example, taking into account operational experience (OPEX), self-identified training needs or as a result of changes to plant configuration arising from plant modifications. Plant

modification proposals, made under the arrangements under LC22 (modification or experiment on existing plant) must identify where instructions and procedures need to be changed and the associated training needs. For large modifications that need stage 'Consents' to be granted by ONR, evidence of satisfactory training is likely to be a requirement prior to a Consent being granted to bring the modified plant into routine service.

11.53 OPEX is used to improve the effectiveness of training in many ways, for example:

- Personal OPEX – anecdotes based on instructors' personal experience or an event/situation they are familiar with.
- Handouts of 'Event Reports', 'Learning and Just-In-Time (JIT) Briefs' that are read by the trainees and then discussed.
- Event Reports, Learning Briefs and JIT Briefs are utilised as case studies for group syndicate exercises.
- Event Reports, Learning Briefs and JIT Briefs are converted into laminated posters and positioned around training rooms to raise trainee awareness and to stimulate thinking and discussion.
- OPEX folders are maintained containing a chronological selection of historical and current OPEX relating to specific training sessions/topics.
- Props exhibiting 'real life' damage, for example, burnt out electrical props from actual events showing what can really happen.
- OPEX is utilised to set-the-scene at the start of training sessions – thereby reinforcing the relevance of the training session/topic.
- Bespoke training sessions are delivered on Windscale, Three Mile Island, Chernobyl and Fukushima during engineering support personnel and maintenance courses.
- Other non-nuclear OPEX events such as the Kegworth air disaster, Buncefield oil depot fire and the Severn Tunnel rail accident are utilised on operations courses.
- The use of WANO Significant Operational Experience Reports – predominantly on operations courses.

11.54 Training provision within EDF Energy NGL also takes account of feedback from trainees and their line managers. The company's training arrangements are subject to rigorous self-evaluation as well as review by the licensee's internal assurance function and quality department as well as routine and team inspections by ONR inspectors. Oversight of the training and qualification process is provided by a fleet performance improvement manager who meets regularly with a peer group comprising station and corporate performance improvement managers. Corporate and station training specialists also meet as a peer group to share good practice, monitor performance, and identify improvements.

Training programme accreditation

11.55 Following a management of change process, training oversight arrangements for EDF Energy NGL have been streamlined and no longer include external accreditation, however some Training Standards and Accreditation Board (TSAB) expertise has been retained and made available to EDF Energy NGL on a consultancy/external evaluation basis.

11.56 This process replaces the previous accreditation pass/fail audit style approach with one based on risk and performance that focuses on previously identified themes. It is more flexible and agile as it replaces a 4-yearly training interaction with a combination of quarterly programme health reports, use of the Fleet Elevation tracker to manage shortfalls, and builds

on the Governance, Oversight, Support, Perform approach and observations of training. The intervention comprises a four-day review conducted by a fleet-led team of 6–8 personnel selected for their expertise from across the fleet, rather than a two-week review conducted by a team of 15–20 personnel including international subject matter experts. Assessment is based on the WANO maturity model that EDF Energy NGL has adapted for training and considers how far the station is from 'world class'.

11.57 To ensure an appropriate level of training Governance and Oversight is being applied, there has been a self-identified need to reestablish a level of external (independent) evaluation of training and the deployment of the Systematic Approach to Training (SAT). It is also recognised that to ensure a sustainable solution, the external evaluation of training should be an integrated part of normal Training Governance and Oversight arrangements, and not an additional standalone process. This is currently being formalised with Fleet Training Oversight Arrangements, strengthening the use of External Evaluation.

11.58 The proposed approach has been benchmarked against the latest INPO strategy for accreditation of training (Accreditation Performance Continuum) and is in line with its key attributes. A 'proof of concept' pilot for the external evaluation of training was conducted during December 2024 at Torness Power Station.

Hinkley Point C operational capability

11.59 The Hinkley Point C operational capability requirement is set by the Pre-Operations directorate, because Hinkley Point C is still under construction. The Pre-Operations directorate key deliverables include:

- Defining the future operations culture and staffing requirements.
- Building on experience and learning from EDF SA and China General Nuclear Power Corporation (CGN).
- Building operations team capability in preparation for commercial operation.

11.60 This work is being carried out in a team incorporating experience from NNB GenCo and EDF Energy NGL, principally Sizewell B, EDF Energy NGL Human Resources, and the Nuclear Skills Alliance (NSA).

11.61 The NSA is a structured collaboration between EDF Energy NGL and NNB GenCo. The NSA brings together technical training teams into a single function to deliver the technical skills and competences to support EDF Energy's existing and new nuclear businesses. The NSA is responsible for delivery of technical training to the existing nuclear generation fleet, and the future technical training needs to operate Hinkley Point C.

11.62 To meet this need, the NSA is developing the training programmes needed to support the training of staff for operations at Hinkley Point C. The systematic approach to training (SAT) is used to ensure that these programmes provide efficient and effective training that meets the operational capability requirements. The pre-operations deputy director is Hinkley Point C's intelligent customer and custodian of the arrangements to meet LC10 and LC12. Oversight is provided by the joint EDF Energy NGL/Hinkley Point C Programme Board.

11.63 Formation of the NSA, a structured collaboration between Hinkley Point C and EDF Energy NGL training teams, facilitates access to the SAT-derived, accredited, training programmes that serve the current fleet. Although there are design differences between the EPR™ design at Hinkley Point C and other EPR™s across the world, significant benefit can be obtained from international EPR™ operational experience. The operational experience shared by CGN (Taishan) and EDF SA (Flamanville 3) has yielded useful methods, media and material that can support the development of training solutions for operations at Hinkley Point C.

11.64 Analysis of the existing Flamanville 3 programmes in maintenance, engineering support and technical and safety has begun to determine the extent to which they apply to Hinkley Point C. The operations programme used to train and qualify main control room operators has already commenced, and the first groups of EPR™ operators have already commenced their simulator training. This group takes advantage of the availability of the Flamanville 3 reference simulator, procedures, and expertise. In parallel, the SAT development of the Hinkley Point C reference training programme necessary to authorise personnel before first operations at site has started.

11.65 For areas with significant technical differences between Hinkley Point C and the Flamanville 3 EPR™ design that would impact the EPR™ training programmes (for example the additional safety features of the Hinkley Point C EPR™ or its digital control and instrumentation systems), a specific focus is applied, acknowledging the additional effort likely to be needed to develop training for skills in these areas. The Hinkley Point C Project Integrated Work Schedule includes the activities needed to develop these staff, procure the Hinkley Point C reference simulators and complete site training facility. These are key deliverables of NSA on behalf of the Pre-Operations Directorate.

Sizewell C operational capability

11.66 While Sizewell C has a different ownership structure to Hinkley Point C, the EPR™ technology is being replicated between the sites and strong links between the two projects ensure that learning is shared, and Sizewell C can benefit from Hinkley Point C's experience. Sizewell C Pre-Operations is at an earlier stage of maturity when compared to Hinkley Point C, as would be expected, though the same principles will be applied to the development of the function and the relationships with supporting organisations. For example, Sizewell C Ltd aims to utilise the expertise built up in the Nuclear Skills Alliance (NSA) to deliver the operational training programmes. The Sizewell C Pre-Operations team is aligned with the Hinkley Point C Pre-Operations team, which will continue as the function develops. In addition, Sizewell C Ltd is a co-owner of Nuclear Services, an organisation that provides technical support to EDF Nuclear Operations and Hinkley Point C, ensuring that Sizewell C continues to benefit from the decades of operational experience held within the UK fleet.

Maintaining and enhancing the national nuclear skill base

11.67 Existing operations, decommissioning and clean-up, together with the current programme of new nuclear build, means the UK nuclear industry has a sustained recruitment demand and a continued requirement for skills training and reskilling of the workforce.

11.68 Employers have sought a skills partnership with government that is strategic, across the UK, covers all parts of the sector and represents views on the skills needs and solutions. Most importantly, this partnership needed to be led and driven by employers themselves and in late 2015 the Nuclear Skills Strategy Group (NSSG) was established as the lead strategic skills forum representing the nuclear industry's skills demands in the UK.

11.69 In August 2023, the Nuclear Skills Taskforce was established to build on the NSSG's work. In May 2024, the Taskforce published the National Nuclear Strategic Plan for Skills (Nuclear Skills Plan) [110], which exemplifies a collaborative national endeavour between government and industry to address the skills gap in the nuclear sector.

11.70 Following the publication of the of the Nuclear Skills Plan, the Taskforce was stood down and the NSSG was replaced with a new governance structure to deliver the plan:

- Nuclear Skills Executive Council (NSEC): Ensures the delivery of the Skills Plan by abiding by the commitments that members have signed within the Nuclear Skills Charter.

- Nuclear Skills Delivery Board (NSDB): Ensures the Nuclear Skills Plan appropriately meets the NSEC's delivery requirements.
- Nuclear Sector Skills Team (NSST): A full-time delivery team consisting of project leads and enabling roles from across the NSEC organisations advancing the delivery of the Nuclear Skills Plan.

The National Nuclear Strategic Plan for Skills Key Themes
11.71 **Collaborate across the sector.** Strengthening collaboration across the nuclear sector to foster sustainable partnerships and opportunities. A pioneering approach that will provide for the current and deliver the future nuclear workforce through attraction, retention, and training. This involves both national and regional partnerships, with an emphasis on knowledge sharing and joint regional development, for example via Regional Skills Hubs which have been established in the North West, South West, Midlands and Scotland. It includes sponsoring a national communications campaign, "Destination Nuclear" to elevate the sector's visibility. 11.72 **Deepen the workforce pool.** Increasing employment opportunities through upskilling programmes to attract and develop mid-career entrants, increase the number of subject matter experts, and provide experienced instructor resources to further education. This theme also encompasses supporting nuclear bursary and sponsorship schemes to increase Science, Technology, Engineering and Mathematics (STEM) careers and social mobility opportunities. 11.73 **Invest in the existing workforce.** Celebrating the workforce and their vital role, building a sense of community, and offering more opportunities for career growth and development within the sector by creating mechanisms to motivate, excite and retain talent for the long-term. 11.74 **Lead and steward for the long-term.** Ensuring long-term leadership and stewardship in the nuclear sector through new opportunities for future leaders to develop, grow and experience working in different organisations and locations. Additionally, seek to increase Equality, Diversity and Inclusion in all nuclear sector organisations to champion opportunities on an enduring basis.

11.75 The industry-led Nuclear Workforce Assessment 2024 (NWA) report [111] was published by Cogent Skills in March 2025 on behalf of the nuclear sector. The report confirms the ongoing challenge faced by the sector in terms of the capabilities it requires in the short term (until 2030) and then beyond. The report shows that the gap between the current workforce and workforce demand in 2030 has reduced to 23k from 40k since the 2023 NWA report.

11.76 The work of the Nuclear Skills Plan under the sponsorship of key CEOs through the NSEC will continue to monitor and address these skills risks.

11.77 The NDA has a statutory duty as set out in The Energy Act 2004 [112] to take appropriate action to ensure that adequate skills are available for it to carry out its duties. It has a budget allocated annually to develop the skills needed to deliver its objectives through a skills and capability strategy. UKNNL is the lead civil fission laboratory for the UK. Following the publication of a strategic review in December 2024, its mission is defined as 'to enable and deliver nuclear outcomes for Government, and to support growth of the UK nuclear sector'. To achieve this, UKNNL will become the Government's lead civil technical and strategic advisor for nuclear fuels and nuclear materials, carry out research to continue securing the safe operation of nuclear plants domestically and internationally, deliver practical nuclear research and enable decommissioning programmes, provide expertise and facilities to be a platform for

the private sector to accelerate the deployment of technology to market, and champion and nurture advanced nuclear skills.

Summary of significant changes since previous report

11.78 During the reporting period, developments under this Article are as follows:

- Nuclear Services became a separate legal company with equal ownership by the three licensees: NNB Generation Company (HPC) Ltd, Sizewell C Ltd, and EDF Energy Nuclear Generation Ltd.
- Establishment of the Nuclear Skills Taskforce and publication of the National Nuclear Strategic Plan for Skills, to deliver the required future nuclear workforce capability and capacity as a national endeavour.
- Sizewell C Ltd developed its organisational capability sufficiently for granting a Nuclear Site Licence in 2024.

Notable achievements

11.79 **Publication of the National Nuclear Strategic Plan for Skills:** The National Nuclear Strategic Plan for Skills (Nuclear Skills Plan) launched in 2024, is a collaborative effort between government, industry, and academia, setting out targeted action to address the skills gap and secure the UK's nuclear workforce (See paragraphs 11.68 to 11.74 for more details). Delivery of the Nuclear Skills Plan and its projects are underway:

- Nearly 4,000 early-career starters entered the sector in 2024/2025, including 475 graduates and 678 apprentices employed as a direct result of the Nuclear Skills Plan.
- An additional 21 nuclear fission PhD students funded, supporting a pipeline of future subject matter experts.
- Regional Skills Hubs established across the UK, enabling the Nuclear Skills Plan to be delivered locally by tailoring national initiatives to each region and maximising the social, impact, mobility, STEM outreach and supply chain relationships.
- The Destination Nuclear national communications campaign exceeded its target metrics for engagement, attracting new talent to the sector by raising awareness and shifting perceptions of careers in nuclear.
- A pilot by the National College for Nuclear is underway to enable industry sector experts to support the delivery of education and training to increase the capacity and capability of the sector's educational provision.

11.80 **Establishment of Nuclear Services by UK licensees:** Nuclear Services became a separate legal company with equal ownership by the three licensees: NNB Generation Company (HPC) Ltd, Sizewell C Ltd, and EDF Energy Nuclear Generation Ltd. This achieves two key benefits:

- Grouping of high-end of niche skills areas makes it easier to develop and maintain these skills over extended periods of time and the replication.
- Replication of design, development of the safety cases and the approach to operations delivers a 'fleet effect' that enables learning to be readily implemented and provides significant efficiency savings (See paragraph 11.39 for more details).

Article 12 – Human Factors

Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

Summary statement for article

12.1 The UK fulfils the obligations of Article 12. It has comprehensive arrangements to ensure that capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

Human factors in the design and assessment process

12.2 The UK's nuclear installation licensees and regulators recognise that human performance plays a vital role in ensuring safety and security. Human Factors are concerned with all aspects of human performance, and the factors affecting this performance, which can impact on safe and secure operation.

12.3 ONR's Safety Assessment Principles (SAPs), Human Factors principles series [28] and Technical Assessment Guides (TAG [47] set out ONR's expectations for licensees' treatment of Human Factors. Many of the licence conditions [13] and therefore the Technical Inspection Guides (TIG) [46] have strong Human Factors components.

12.4 Human Factors analyses are applied proportionally to all activities and functions related to nuclear safety and security. Dutyholders employ Human Factors specialists to ensure that Human Factors principles and methods are appropriately integrated into the areas of engineering design, safety analysis, operations and security. These specialists are also used to manage Human Factors work carried out in support of these areas by the supply chains.

12.5 Where new nuclear installations are proposed, ONR expects Human Factors engineering, and safety and security analysis to be carried out as part of the design, safety, and security case process. This confirms that the design takes due account of the needs of the user and supports the demonstration that the risk from human error is reduced as low as reasonably practicable (ALARP). ONR expects, as stated within ONR's TAGs, the engagement of Human Factors specialists at an early stage of the design process. This is to ensure effective Human Factors integration into the design such that it takes account of human capabilities and limitations and thus supports reliable human actions.

12.6 ONR also expects, as stated in our SAPs [28] and TAGs, that the design of 'user interfaces', including systems, structures, components and equipment, follows good Human Factors practice ensuring that their design is compatible with human psychological and physical characteristics. This enables their associated tasks to be performed reliably and efficiently. For new designs, a structured Human Factors engineering design process is adopted and relevant standards applied. The user interface for the reactor main control room is based on a comprehensive and systematic allocation of function and task analysis, which identifies the operational requirements during normal, transient and fault conditions. A similar graded process is adopted for the design of new systems, structures, components, and equipment to ensure that the risk of examination, inspection, maintenance and testing errors are reduced to ALARP.

12.7 The design of the reactor control room enables the operator to carry out tasks and deliver safety functions during normal operations, postulated fault conditions and, where practicable, severe accidents. Appropriate provisions are provided in the control room and at

emergency locations to enable the monitoring of plant state in relation to safety, and to take any necessary safety actions. Due attention is also given to the specification and design of local control stations, and to the design of equipment having the potential to impact upon plant safety (for example, maintenance and testing equipment and computer-based systems used to present operating instructions).

12.8 ONR requires that all nuclear installations be re-assessed as part of the Periodic Safety Review (PSR) process (see Article 14 – Assessment and Verification of Safety). Human Factors analyses form an integral part of these reviews. In addition, proportionate Human Factors analysis is expected in licensees' plant modification processes. Where shortfalls in ergonomic standards are identified, licensees are expected to consider reasonably practicable improvements to provide a demonstration that the risk from human error is ALARP. The user interfaces of existing nuclear installations are subject to scrutiny during the PSR and any plant modification processes to ensure that they remain fit for purpose, and that operator actions are properly supported. Risk important structures, systems and components and equipment are also considered during PSR and plant modification processes to ensure they remain fit for purpose with respect to supporting related operator actions.

12.9 As part of the safety case supporting the operation of a nuclear facility, ONR expects licensees to consider the allocation of function analysis to appropriately allocate safety functions between human operators and the technology. Where safety functions are allocated to human operators, the expectation is that these are recorded, designed and substantiated appropriately. In general, where a plant failure or incorrect operation leads to a need for safety system operation, UK plants are designed so that they are rendered safe by the action of passive or engineered features. These generally offer greater reliability than the human operator, especially where rapid safety system operation is needed. Where the analysis identifies the need for improvements to human, and hence system reliability, these are considered as part of the ALARP review process. This is explained in ONR's SAPs [28].

Human error identification and reduction

12.10 ONR's SAPs and supporting TAGs cover identification, prevention, detection, and correction of human errors in operation, and maintenance of nuclear installations. This is achieved through the integration of Human Factors into the safety analysis process, such that important human actions are identified within the fault, hazard, and engineering schedules, and in the Probabilistic Safety Analysis (PSA). Important human actions to inspect and maintain the structures, systems, and components, monitor the plant, diagnose faults, make decisions and implement necessary safety actions are subject to proportionate task and error analysis. These analyses take account of the physical, physiological, and cognitive demands that may be placed on the operator and on teams of operators. They address the potential consequences of failure to perform the safety actions successfully, and the potential for recovery from error. The analyses take account of, and form primary inputs to inform decisions on, plant staffing, on equipment and on other facilities that are provided to support the operator. In particular, the analyses are an important input to the design of the structures, systems and components (including user interfaces) and provide a basis for developing procedures and the content of personnel training. They influence the way in which the job is organised, as well as being used to determine and demonstrate the feasibility of individual tasks. Ergonomics principles are applied to support reliable human performance and inform the design of the working environment, including factors such as access, noise, thermal and lighting conditions, and communications facilities. Issues related to fitness for duty, such as shift working patterns and working hours (particularly periods of extended hours) are also taken into consideration.

12.11 The PSA undertaken on the nuclear installations provides quantitative assessments of the risk to safety arising from plant designs and operations. The PSA highlights significant

contributors to risk and considers the impact of human actions on safety. The licensees ensure that, where operator actions are identified and modelled in the PSAs, suitable methods are used to assess the potential errors associated with these actions and to determine the consequent human error probabilities. This is based on structured qualitative analysis of the operator actions and performance shaping factors that influence them. In response to recommendations raised in the Chief Nuclear Inspector's (CNI) report on the Fukushima accident [113], licensees have, and continue to, extend their PSAs and assessments of human actions to include those included within severe accident guidelines.

12.12 Quantitative estimates of human error probability are produced for the significant human errors defined during the error identification process and these are supported by structured qualitative analysis. Errors modelled include those during maintenance activities that could later lead to equipment failure, operator errors that initiate events, and errors during post fault recovery. They also include errors of omission and errors of commission. The probabilities derived are informed by the qualitative analysis that identifies psychological factors (for example, stress, personal experience, and knowledge) and task-specific factors (for example, the physical environment, training, working practices, time constraints, adequacy of procedures and user interface). Dependencies between actions are also considered. The potential for impact of dependencies between separate operator actions activities (either by the same or by different operators) is assessed and the results are factored into the PSA. The potential for recovery from previous errors is also examined. This is especially pertinent where long timescales are available to take corrective action. As well as demonstrating that risks are tolerable, licensees also use this analysis to identify reasonably practicable improvements that may be made to ensure that the risk from human error is reduced to ALARP.

Methods and programmes of the licensee for analysing, detecting, and correcting human errors in the operation and maintenance of nuclear installations

12.13 The Human Factors Branch in EDF Nuclear Services (see Article 11 – Financial and Human Resources) provides capability for EDF Energy NGL and NNB GenCo (HPC) and Sizewell C Ltd.

EDF Energy NGL – human factors arrangements

12.14 EDF Energy NGL includes consideration of Human Factors within its Nuclear Safety Principles, which inform and govern the way that it designs and operates its nuclear power stations. These include, but are not limited to, requirements in relation to preventing 'human initiated faults', consideration of the human within 'protective systems', and ensuring that safety important operator actions are feasible and can be reliably performed.

12.15 The EDF Energy NGL Nuclear Safety Principles are implemented through several supporting processes with Human Factors considerations integrated within the design, project, and safety case processes. This ensures that proportionate Human Factors analyses are undertaken to support activities and functions that relate to nuclear safety. The approach taken to integration of Human Factors within EDF Energy NGL is graded to ensure that the level of Human Factors effort, and the prioritisation and scope of Human Factors activities undertaken, are proportional to the safety significance of the work.

12.16 EDF Energy NGL has a team of Human Factors specialists (within Nuclear Services) who support delivery of their processes, and they work side by side with staff outside the discipline such as architect engineers, designers, safety case engineers, and operators to ensure that Human Factors considerations are appropriately implemented and addressed. Human Factors considerations are also included, as appropriate, as part of support functions including Organisational Learning and Internal Nuclear Assurance.

12.17 Specific examples of Human Factors initiatives run by EDF Energy NGL include the following.

- Training on Human Factors in event investigations and access to Fleet Human Performance/Factors specialists to support investigations to ensure suitable consideration of Human Factors.
- Deployment of the Human Performance Evaluation Tool (HUET), which can be used as a standalone tool or in support of wider investigations.
- The ongoing use of diverse human factors data to identify human performance trends, monitor station improvements, provide a fleet wide thematic analysis on coaching in the field, events and incidents.
- Coaching of Central Control Room (CCR) Simulator Instructors and staff on Crew Resource Management.
- Development and implementation of a NGL safety culture assessment strategy to align with the WANO and IAEA guidance.

12.18 EDF Energy NGL has undertaken several initiatives to improve procedure quality, use and adherence. Effective procedures minimise the potential for error and contribute to event free operation. The EDF Energy procedure writer's guide for operations and maintenance procedures and the review guide are being used to produce enhanced and optimised procedures.

12.19 EDF Energy NGL enshrines procedural adherence within its arrangements, whilst also encouraging a questioning attitude in relation to maintaining safety. Procedures are verified and validated to ensure they are fit for purpose, so that they support reliable and effective task performance. Where procedures cannot be followed as specified, work is stopped, made safe, and the procedure changed using the document change process.

12.20 Prior to assigning a task or conducting a pre-job briefing, supervisors review unfamiliar procedures to ensure that the task is assigned to someone who is a suitably qualified and experienced. As part of the pre-job briefing or setting to work process, supervisors specify the procedures to be used by staff and communicate adherence expectations, including the identification of hazards and risks. Detailed guidance is provided and is graded according to the nature of the task and on the procedure to be followed. This ranges from 'information use' through to 'continuous use' where the procedure is required to be followed explicitly step by step using place-keeping and a range of specified human performance tools.

Self-assessment of managerial and organisational issues by the operator

12.21 EDF Energy NGL adopts approaches to assessing and monitoring nuclear safety performance. EDF's Fleet Human Performance Team play a key role in supporting this assessment process. Stations are held to account by their Director of Nuclear Operations. Governance and oversight are also delivered via several fleet managers/fleet leads who are responsible for the company's key processes. The leads monitor the health of the process and report via a series of delivery teams to the Executive Management Team, escalating issues as appropriate. The Human Factors team supports in the delivery of solutions to address identified issues. Fleet leads can also provide targeted support to sites as necessary. Other assessment activities include:

- A biennial (2-yearly) safety culture assessment of all sites, leading to identified improvement programmes if necessary.
- EDF Energy NGL's internal regulatory function undertakes management and leadership reviews of power stations and selected central support departments. A programme of nuclear safety culture reviews has commenced based on the IAEA model of safety

culture and an adapted version of the OSART framework. The fleet has now completed the programme of reviews.

12.22 EDF Energy NGL deploys Nuclear Safety Review Boards (NSRB) to supplement its programme of internal reviews and WANO peer reviews. The NSRB provides independent external advice and counsel to each station director and the chief nuclear officer on any issues related to the nuclear safety, operational performance, and management of the power station. It also provides independent external advice on long term strategies for improvement and reviews the effectiveness of the company's internal oversight function.

12.23 The Boards take the form of a week-long review of operations and management at each NPP every two years. The Boards are chaired by and contain independent members who have a track record either as a power station operator, regulator, or key nuclear industry supplier.

NNB GenCo – human factors capability

12.24 The strategy for implementing Human Factors on the Hinkley Point C project is outlined in a suite of Hinkley Point C Human Factors management plans, which describe planning and strategy documentation for the project. These outline the Hinkley Point C project arrangements to ensure Human Factors considerations are appropriately integrated in all stages, up to the Commercial Operation Date.

12.25 The suite of human factors plans are produced and owned by the Nuclear Services Human Factors Team. These plans define the expected scope of the Human Factors programme and describe what is necessary to deliver effective Human Factors at this stage of the Hinkley Point C project. The plans specify the Human Factors methods, tools, and processes to be followed. The suite of Human Factors management plans also provide a basis for estimating Human Factors resource requirements and describe the associated roles and responsibilities within each underlying Human Factors workstream.

12.26 The Hinkley Point C Human Factors Programme is scoped to achieve two goals:

- To ensure that Human Factors is sufficiently integrated in the design of Hinkley Point C to ensure that the risk of a nuclear safety significant incident as a result of human action or inaction is reduced to ALARP.
- To provide a clear, evidence backed, explanation of how the first goal has been achieved as a part of the nuclear safety case.

12.27 To ensure that Human Factors is effectively implemented across all aspects of the design and operation of Hinkley Point C, the Human Factors programme has been subdivided into several targeted work-streams to address the following three elements.

- Integration of Human Factors into the design including civil work and building layout, mechanical and electrical systems design, human machine interface and control room design).
- Integration of Human Factors into safety studies including human reliability analysis and the substantiation of Human Based Safety Claims.
- Integration of Human Factors into operational documentation, development, commissioning, and decommissioning, including validation and Integrated Systems Validation.

12.28 Each design work-stream follows a stepwise process that involves assessing and screening of structures, systems, and components according to nuclear safety risk and complexity of human actions to assign a Human Factors risk significance level to each equipment. The Human Factors requirements and design inputs have been defined according to the Human Factors risk rating. Finally, as the design work is completed, it is assessed for

Human Factors compliance both via Hinkley Point C's review and acceptance processes and, for more significant Human Factors risk aspects, via dedicated Human Factors tests and trials.

12.29 The Hinkley Point C Project has a core Human Factors team drawn from EDF's Nuclear Services Human Factors branch to support the Hinkley Point C Design Authority.

12.30 The principal coordination of the Human Factors technical input to the Hinkley Point C design was historically provided by a Responsible Designer Human Factors team; this has now transitioned to be the responsibility of the Nuclear Services Human Factors branch.

Arrangements for the feedback of experience in relation to human factors and organisational issues

12.31 EDF Energy NGL has developed an integrated organisational learning process that aims to identify and manage performance gaps in behaviours, plant, processes, or organisation, proactively as well as reactively and by using lessons learned from internal and external operational experience. Elements include the Corrective Action Programme, which is used to identify and resolve adverse conditions, OPEX and self-assessment/benchmarking. EDF Energy NGL has performance improvement teams including organisational learning specialists.

12.32 Human performance improvement plans are produced at each site. Plans identify areas of operations susceptible to human error, either latent or active, based on previous OPEX, recent performance standards or planned work activities and tasks.

12.33 Specific examples of human and organisational factors initiatives run by EDF Energy NGL that have informed, or been informed by, learning from experience include the following:

- Work to optimise the quality of event investigation and the implementation of the significant adverse condition investigation review panel. EDF recognise the importance of Human Factors in event investigation, thus include HF expert representation on the most significant event investigations, with a view to identifying HF root causes and solutions. The Human Factors capability also provides support and feedback to lead investigators in the field.
- Learning from other organisations includes EDF Human Factors involvement in intra and inter-industry groups. Human Factors learning from these extra-EDF sources is used to enhance the consideration of Human Factors within PSRs.
- Use of independent external organisations to assess organisational safety culture.
- Development and extension of EDF Energy NGL human factors arrangements to promote more consistent and risk informed application of human factors within safety cases. New processes have been developed to support safety case development, ensuring that potential latent errors resulting from previous human performance issues are identified and corrected.
- A revised approach to the consideration of human factors as part of PSRs, with a focus on optimisation of processes and ongoing assessment.
- Consideration of Human Factors issues when changing site status from generation to defuelling. For example, proactively capturing individual aspirations to ensure that these are recognised when planning a station's change in generation status. This approach recognises the Human Performance detriment that employment and career uncertainty can bring.

12.34 UK licensees have a system for reporting receipt and assessment of reports of nuclear plant events and are members of WANO, and as such, share operational experience internationally. In addition, ONR operates the IAEA's incident reporting system on behalf of the UK and shares reports/learning. Nuclear utilities co-operate in programmes of peer evaluation

and operational experience feedback. They also participate in WANO and IAEA, which give an international perspective on performance levels.

Regulatory review and control activities

12.35 ONR SAPs, TIGs and TAGs form the basis against which the regulatory assessment of Human Factors is carried out. They identify, explicitly, the need for a nuclear licensee to consider a comprehensive set of influences on human performance. These address areas such as Human Factors integration, allocation of function, human machine interfaces, workspaces and work environment, procedure design and administrative control, staffing levels and task organisation and human reliability analysis.

12.36 Some aspects of Human Factors are specifically addressed by the nuclear site LCs, for example, the conditions for training, duly authorised and suitably qualified and experienced persons, and operating instructions. However, in addition to these, other LCs also have Human Factors implications, which together address a range of Human Factors topic areas. Compliance with the LCs is monitored as part of each nuclear site inspector's normal duties. To ensure this is done effectively, ONR's inspectors have access to formal training to help them to identify Human Factors concerns, which enables them to discuss these with the licensee or raise them with ONR's specialist Human Factors inspectors.

12.37 ONR's Human Factors inspectors proactively identify areas of the licensees' operations for examination based on their awareness of issues identified through a variety of sources. These include national and international operational experience, developments in Human Factors techniques and research, discussions with other UK regulators, the licensee's personnel and other international regulators, and intelligence gathered during historical inspection and assessment activities. ONR may carry out targeted inspections of Human Factors-related issues. Such inspections provide confidence that the licensee's Human Factors analyses are implemented in practice. ONR also maintains exchange arrangements on Human Factors, and other technical areas, with regulatory bodies and research establishments in other countries.

12.38 Regulatory assessment of the licensee's or Requesting Party's treatment of Human Factors is made throughout the life cycle of a nuclear installation. When a safety case is submitted to ONR, nuclear site inspectors, project inspectors and Human Factors specialists agree on the scope of any Human Factors assessment work appropriate to the case in question. By requiring that Human Factors be integrated into the design process, ONR has ensured that licensees place considerable emphasis on the inclusion of Human Factors analysis in the early stages of plant design to ensure that the design properly reflects the capabilities and limitations of human performance, and that reliable operator performance is adequately supported.

12.39 As part of its wider regulatory vires, ONR publishes a research strategy [114] and a Regulatory Research Register [115], the aim of which is to address regulatory knowledge gaps and thus improve ONR's ability to make robust, supportable, regulatory decisions. The Human Factors topic is well represented within this strategy and the Regulatory Research Register, demonstrating ONR's recognition of the importance of Article 12 of the Convention.

12.40 Current Human Factors research topics include:

- ONR-RRR-096 – The efficacy of peer checking
- ONR-RRR-110 – Development of Guidance on the Use of Electronic Procedures
- ONR-RRR-111 – Human Performance During Severe Accidents
- ONR-RRR-119 – Enhanced Decision-making

Summary of significant changes since previous report

12.41 During the reporting period, developments under this Article are as follows:

- The development of the Nuclear Learning Pathway by ONR and the Chartered Institute of Ergonomics and Human Factors (CIEHF) to develop technical competence in human factors and effective communication of human factors principles (See paragraphs 12.42 to 12.43)

Notable achievements

12.42 ONR and industry have identified a national shortage of Human Factors capability within the UK nuclear industry. To address this, ONR is actively working with the industry and the UK CIEHF to develop the Nuclear Learning Pathway [116]. This is a new and innovative way for learners to develop technical competence in human factors and effective communication of human factors principles. The Pathway offers four learning routes (Operations, Design, Safety Case, Combined Human Factors), aimed at personnel responsible for different aspects of nuclear safety, with increasing levels of competence in each route.

12.43 The learning pathways allows the implementation of human factors principles; enabling dutyholders to understand and manage the human contribution to risk thereby reducing the potential for accidents and incidents, making nuclear facilities safer environments. It also reduces costs and improves efficiency by providing a shared industry resource to improve Human Factor capability within dutyholder organisations.

Article 13 – Quality Assurance

Each Contracting Party shall take the appropriate steps to ensure that quality assurance arrangements programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

Summary statement for article

13.1 The UK fulfils the obligations of Article 13. The information in this Article directly related to the **major common issue** on **securing reliable supply chains** from the joint eighth and ninth review meeting.

13.2 This Article has been addressed by considering the requirements in the IAEA's Safety Standard GSR Part 2, 'Leadership and Management for Safety' (LMfS) [77]. The scope of GSR Part 2 covers the requirements for establishing, assessing, sustaining and continuously improving effective leadership and management for safety in organisations concerned with, and facilities and activities that give rise to, radiation risks. Pending the issue of supporting guides for GSR Part 2 by the IAEA, cognisance is still taken of the Safety Guides: GS-G-3.1 (2006), 'Application of the Management System for Facilities and Activities' [95], which provides guidance on implementing the generic management system requirements; and GS-G-3.5 (2009), 'The Management System for Nuclear Installations' [96].

13.3 There are three companies that hold nuclear site licences for the Nuclear Installations scoped by the Convention in the UK, and their activities can be summarised as follows:

- EDF Energy NGL is operating eight Nuclear Power Plant (NPP) sites (with three in decommissioning)
- NNB GenCo (HPC) is constructing a two-unit NPP at Hinkley Point C
- Sizewell C Ltd is preparing to construct a two-unit NPP at Sizewell C

13.4 In addressing this Article, the key features of the quality assurance arrangements developed and deployed by these licensees are described in overview.

Regulatory requirements for quality assurance programmes/quality management systems of the licence holders

13.5 ONR applies a graded and risk informed approach to management system requirements for the operation of each nuclear facility, proportionate to the risks associated with achieving safe outcomes. This is achieved by attaching 36 licence conditions (LC) [13] to the site licence of all operators of nuclear facilities.

13.6 LC17 relates to Management Systems and places a duty on licensees to establish and implement management systems that give due priority to safety. In addition, LC17(2) identifies that the licensee shall, within its management system, make and implement adequate quality management arrangements in respect of all matters that may affect safety.

13.7 ONR's inspectors assess the ongoing adequacy of the licensees' quality management systems as part of their routine inspection programmes, and through targeted engagements with other regulatory bodies e.g. Environment Agency.

13.8 In assessing the adequacy of the Licensees' LC17 arrangements, ONR makes use of the relevant good practices set out in established international standards, including but not limited to IAEA Safety Standard GSR Part 2 and ISO 9001. The use of these standards by ONR is detailed in ONR's inspection guidance documents.

13.9 The licensees considered in this report have achieved, and maintain, third party certification of their integrated management systems to various standards, including but not limited to ISO 9001. Consideration has been or is being given to the alignment with, and certification to, ISO 19443 by the licensees.

13.10 In addition to the 36 LCs, The Energy Act 2013 (TEA13) [32], also identifies ONR as the enforcing authority in relation to articles for use at work that are designed, manufactured, imported, or supplied for UK nuclear applications. This gives ONR the power to inspect UK based suppliers to UK nuclear licensed sites. Although ONR has no authority to carry out inspections of overseas suppliers, ONR conducts such inspections as appointed agents of the licensees, under commercial agreements agreed between the licensees and their suppliers.

13.11 To enable direct engagement with suppliers (vendors), ONR has developed a regulatory approach that primarily focuses on the adequacy of the licensee's Supply Chain Management (SCM) arrangements but also considers the adequacy of arrangements in their suppliers for high-risk articles and substances.

13.12 One of the main aims of the approach is to influence improvements in licensee and vendor SCM arrangements and reduce risks to enable safe, right first-time delivery of products and services. Details are given in ONR Technical Assessment Guide (TAG)-77 'Supply chain management arrangements for the procurement of nuclear safety related items or services'[117].

13.13 It is the responsibility of UK licensees to establish adequate arrangements in respect of matters that may affect safety. This includes establishing adequate supply chain and quality management arrangements to ensure that suppliers can meet specified requirements that align to the required standards.

13.14 In support of its regulatory framework, ONR has developed and maintains the Safety Assessment Principles (SAPs) [28] and supporting TAGs [47] and TIGs [46), which take account of relevant IAEA Standards and Guidance. The totality of this information provides a framework to guide regulatory decision-making.

13.15 Within these documents, the fundamental importance of Leadership and Management for Safety (LMFS), and the adequacy of the licensee's quality management arrangements are acknowledged. However, given the importance of assurance activity within the management system, ONR has better defined expectations within a new TAG focussed on Management Systems and Quality Management Arrangements [118].

Overview and status of licensees' integrated management systems

13.16 Within the UK, all licensees utilise an integrated management system approach. It promotes a consistent approach to areas outside of the quality/safety management system including (where applicable) environment, security, transport and safeguards, and other business activities, to reduce the likelihood of incompatible arrangements.

13.17 EDF Energy NGL's integrated management system is mature. However, it has continued to evolve to take account of changing circumstances and to address improvement opportunities.

13.18 The NNB GenCo (HPC) management system, whilst mature, has continued to evolve to meet project demands including mechanical, electrical and Heating Ventilation and Air-Conditioning (HVAC) installation, and will continue to do so as the project progresses to commissioning and subsequent operations.

13.19 Given the relationship between the licensees of Hinkley Point C and Sizewell C, a decision has been made by Sizewell C Ltd to intelligently replicate the management system of NNB GenCo (HPC). Therefore, their management system follows a broadly similar structure

and contains arrangements that are proportionate to the current phase of the project. However, the structure and format of the management system may change as the project progresses.

Main elements of quality management systems

Graded application of management system requirements

13.20 The application of management system requirements is graded by the licensees to provide a hierarchy of controls to activities depending on the safety significance and the related risk of the activities carried out. This approach ensures that appropriate and proportionate levels of controls are in place (including scrutiny, supervision, inspection, monitoring, documentation, training, audit, and surveillance) with respect to the safety significance of the activities undertaken, items procured or aspects of the plant design itself.

Documentation of the management system

13.21 The management systems are developed by the licensees to demonstrate compliance with the nuclear site LCs, pertinent legal requirements, and national and international quality management standards. The arrangements are subject to periodic review to ensure the management system arrangements remain fit for purpose and identify opportunities for continual improvement.

13.22 Within the management systems of the three licensees', documentation is structured in a hierarchical format, which typically contains policies, organisational information, processes and procedures, and working level documentation.

Planning

13.23 The licensees develop business plans for the various stages in the plant life cycle, for example, design, construction, commissioning and testing, operation, and decommissioning. The licensee identifies where the achievement of business plans requires the input of other organisations.

13.24 Responsibility is retained by the licensee for the achievement and effectiveness of the plans and where appropriate, measurable objectives and targets are set for the achievement of performance. There are frequent and structured reviews of safety performance against specified performance indicators. These review processes include the monitoring of targets and the implementation of corrective actions.

Responsibility and authority for the management system

13.25 The management systems are authorised for use by the licensees' senior management and are mandatory for all employees and relevant contractors. Licensees' arrangements include mechanisms to inform senior management of the adequacy of the management system, and the compliance with it.

Process management

13.26 The licensees have identified and defined the processes required to achieve their objectives and process owners are allocated to ensure that processes are maintained. To optimise the effectiveness of processes, the licensees ensure that processes are planned, documented, assessed, reviewed, and improved. Work performed under each process is carried out under controlled conditions using approved procedures and instructions that are subject to periodic review. The licensees retain overall responsibility and intelligent customer capability where processes are contracted to other organisations.

Independent assessment

13.27 In respect of independent assessment, the licensees deploy a diverse means of independent assessment for their management system arrangements, including the procurement of nuclear safety related items and services.

13.28 These activities are dictated by the size, structure and status of the licensee and are commensurate to the risk, but a number of the assessment methods are common, including but not limited to:

- An overall oversight programme that includes management system compliance auditing.
- Regulatory oversight by the internal regulator.
- Regular assessments of the effectiveness of their processes.
- Independent surveillance of activities associated with design, procurement, manufacturing, delivery, storage, construction, testing and commissioning, and hand over to operations.

13.29 The roles and responsibilities for undertaking these assessment activities are clearly defined within the management system and are routinely communicated to staff. For NNB GenCo (HPC) the responsibilities for carrying out these quality control activities are detailed in the 'Guide to HPC Project Quality' along with the reporting lines and functions responsible for considering the outcomes from these quality control activities and taking the appropriate corrective and preventive actions.

13.30 Third-party certification of the licensees' management systems has been maintained from LRQA Ltd who are United Kingdom Accreditation Service (UKAS) accredited. The certifications currently held by the licensees are summarised in figure 13.1.

Figure 13.1 – Third-party certifications

EDF Energy NGL	NNB GenCo (HPC)	Sizewell C Ltd
ISO 9001:2015	ISO 9001:2015	ISO 9001:2015
ISO 14001:2015	ISO 14001:2015	ISO 14001:2015
ISO 45001: 2018		
ISO 55001: 2014		

Audits of vendors and suppliers

13.31 EDF Energy NGL and NNB GenCo (HPC) have developed, implemented and continue to refine their arrangements to effectively manage the supply chain to assure themselves of the quality of the items and services supplied and ensure that safety is not adversely affected. Sizewell C Ltd are in the process of implementing their arrangements, given the status of the project but they are intended to be broadly similar to that of NNB GenCo (HPC).

13.32 An integral part of these arrangements is the evaluation and selection of suppliers and contractors, including the suitability of contractors to comply with the requirements of the licensee's management systems.

13.33 Work carried out by on-site contractors is subject to supervision and monitoring, to ensure safety, quality, and environmental performance are achieved. The exact method of supervision and appointment of the responsible persons are dependent on the complexity and location of the works, which are set out in the appropriate management arrangements.

13.34 In relation to off-site suppliers, arrangements are in place to effectively coordinate audits of the supply chain. Audits and assessments are managed in integrated tools to optimise

planning, reporting, management of findings and trend analysis. An integral part of these arrangements is the evaluation and selection of suppliers and contractors, including the suitability of contractors to comply with the requirements of the licensee management systems and contract requirements.

13.35 The supply chain management arrangements, including the audit and inspection of vendors and suppliers to the Hinkley Point C project has been an area of significant regulatory focus for ONR given the extent of the supply chain, and this is likely to be similar for Sizewell C Ltd. As a result, ONR's regulatory approach is focussed on seeking assurance that the licensees' oversight arrangements are effective in producing systems and components to the required quality standards, supported by robust quality assurance and record management arrangements.

Performance monitoring

13.36 Monitoring and measurement of performance is a fundamental element in the management system oversight of all licensees.

13.37 In order to provide senior management with appropriate assurance on performance, the licensees apply a multi-layered oversight, audit and review approach to measure conformance including self-assessment, task-independent audit and review, and external independent audit and review. These activities are targeted based on risk and the latter are carried out by third party organisations. In addition to the audits and reviews carried out by the licensee, ONR, as part of its regulatory activities, carries out inspections of the licensees' arrangements.

13.38 Audit and assessment arrangements are embedded within topic areas. Results are used to monitor overall performance, compliance and identify improvement opportunities related to the topic area. Improvement activities are communicated throughout the fleet using the organisations reporting mechanisms.

13.39 To consolidate the outputs of the various activities, the licensees' have developed and maintain a quality performance monitoring regime that is discussed at various levels in the respective organisations. These reports, facilitated by integrated IT systems, show the high-level performance metrics related to the activities being undertaken e.g. operations at the five NPPs.

13.40 During the period, an IAEA Operational Safety Review Team (OSART) mission was conducted at the Heysham 2 NPP (see Article 10 – Priority to Safety) for further details.

Management system review

13.41 The licensees' have continued to carry out periodic reviews of their management systems in accordance with the international quality standards. These reviews are undertaken to ensure the continued effectiveness of their arrangements and to provide a basis for continued improvement.

13.42 During the reviews, information from several sources is taken into consideration, including the licensees' performance, supplier performance, results from all forms of audits and assessments, performance of processes, non-conformances and corrective actions, lessons learned from other licensees and operators, and opportunities for improvement. The reviews identify weaknesses and obstacles to good performance and determine where changes and improvements are required to be made to policies, objectives, and processes.

13.43 The outputs from the reviews have been shared with ONR and discussed in subsequent engagements. Moreover, by sharing the information, ONR is able to take account of the information when formulating future strategies and plans.

Quality of supplied items

13.44 Licensees and their suppliers establish arrangements to ensure the quality of supplied items. The mechanisms to achieve this are diverse, and multiple aspects are set out within this article. However, one area of increasing risk was identified in the joint eighth and ninth review meeting as a **major common issue on securing reliable supply chains, but more specifically, the risk related to Counterfeit, Fraudulent and Suspect Items (CFSI)**.

13.45 During the period, ONR has continued to influence the awareness of CFSI risks across the nuclear fleet and supply chain, both nationally and internationally. Reporting of CFSI events is logged and monitored by ONR and communicated throughout the UK nuclear fleet, with details such as description of item(s), safety criticality, supplier, and nature of CFSI routinely shared.

13.46 A key mechanism to influence the licensees' awareness was through the issue of a dedicated Supply Chain Management CFSI Alert Note in December 2022 [119], which was relevant to both ONR and dutyholders. To ensure the Alert Note resonated with the target audience a series of confirmed CFSI examples were provided, including examples related to grey market goods.

13.47 Following the issue of the Alert, ONR has continued to undertake dedicated CFSI inspections to ensure licensees' have robust CFSI mitigations. This has included thematic inspections to consider the extent and effectiveness of CFSI management at all levels within the licensees' and their supply chains.

13.48 ONR has also participated in international regulators' inspections in response to major CFSI events. This has included a significant multinational inspection of Japan Steel Works (see example below).

Japan Steel Works

13.49 Japan Steel Works (JSW) is a manufacturer of high-integrity components for the nuclear industry and delivers to customers such as Framatome who in turn supply nuclear licensees, including Sizewell C Ltd and NNB GenCo (HPC), after further assembly.

13.50 In May 2022, JSW substantiated a whistle-blower's complaint that "inappropriate conduct in quality inspections" existed at their Muroran factory. The Muroran factory manufactures components for power generation, nuclear power-related components, castings and forgings for general industries and other cast and forged steel components.

13.51 JSW set up a Special Investigation Committee (SIC) to inquire into the circumstances, which described in its report its findings of misconduct at the Muroran factory. JSW committed to make improvements to its organisation and arrangements, including reforms to the organisation's structure and culture.

13.52 JSW supplies its nuclear products to many countries and so several national regulators had common interest in checking JSW's reformed arrangements. Therefore, in June 2023, inspectors from ONR and the regulatory bodies of Finland, Japan, France, Czech Republic, and the USA participated in a multinational inspection.

13.53 The inspection was held over three days at Muroran and focused on JSW's arrangements to secure the nuclear safety of components, particularly any improvements designed to make misconduct less likely, and on Framatome's associated oversight arrangements.

13.54 The inspection team concluded, from the evidence, that JSW has in place, and is improving, arrangements to secure the nuclear safety of components and these arrangements will make misconduct of the kind described in the SIC Report less likely.

13.55 The inspection team also concluded from the evidence that Framatome has put in place, and is resourcing, satisfactory arrangements to oversee manufacturing quality of products at JSW.

13.56 Within the licensees management arrangements, there are mechanisms in place to mitigate the risks associated with procurement activities. These mechanisms operate on a graded approach and typically consider high risk procurement sources and/or the availability of the items on the market.

13.57 Where 'at-risk' procurements are necessary, the licensees apply an enhanced level of assurance, which may include verification, validation and/or qualification. An example of an 'at-risk' procurement is 'grey market goods'.

13.58 Grey markets are where goods are sold outside the authorised distribution channels by entities that may have no relationship with the original producer of the goods. These channels are often used by licensees to mitigate operational challenges e.g. obsolescence and/or ageing plant.

13.59 In these scenarios, although not illegal, procurement risks are increased and ONR has influenced the licensees and their supply chains to enhance their awareness of the risks and establish appropriate mitigation measures including quality assurance and control.

Improvement

13.60 The licensees' use several processes to support continual improvement of their management systems, including the use of IT tools to systematically collate learning. Once the need for improvement is identified, work is planned to ensure that it is properly resourced. Depending on the scale of the improvement, it may be included in the business plan or a specific improvement plan to ensure that its progress is monitored to completion.

13.61 Due to EDF being a common shareholder within the UK licensees, the organisations share learning and collaborate on improvement initiatives (where applicable). This has included a supply chain mapping IT tool, and CFSI.

13.62 In relation to CFSI, the licensees have sought to improve their CFSI arrangements in line with EDF SA's response to a letter from the Chair of the French nuclear regulator, ASN, to the Chair and Chief Executive Officer of EDF SA in relation to EDF's management of activities to mitigate counterfeiting, falsification and fraud within the factories of EDF's suppliers and their subcontractors [120]. This will be a matter for future engagement with ONR.

Domestic collaboration

13.63 The licensees actively support various nuclear safety related working groups and forums that have been established to improve safety performance such as the UK Safety Directors' Forum (SDF) and its associated specialist sub-groups (see example below).

Supply Chain Quality Working Group (SCQWG)

13.64 The UK Nuclear Industry Safety Directors' Forum (SDF) sponsors several workstreams to advance and improve performance and assurance across the nuclear sector. This includes the Supply Chain Quality Working Group (SCQWG).

13.65 The SCQWG was created in November 2014 to understand the latest challenges related to supply chain oversight practices and examine potential risks that the nuclear industry will need to consider, to ensure safe and reliable nuclear operations.

13.66 The group that comprises key UK nuclear licensees, the MoD, and ONR, is seeking to improve Right First Time delivery of materials and services across the nuclear enterprise through a series of strategic objectives. Through quarterly meetings, several Good Practice

Guides have been generated that are considered relevant good practice (RGP) across the UK nuclear industry.

13.67 The SCQWG has also improved the awareness of the licensees of the existing and emerging safety risks within the nuclear supply chains and of the mitigating actions that the licensees need to take. In relation to CFSI, this has resulted in the group launching dedicated CFSI training material, which is available to licensees with the option to freely rollout across their organisations and supply chains.

13.68 The training material has also been shared with fellow regulators where appropriate to aid their understanding and knowledge of the topic. For example, the information was shared with the Authority for Nuclear Safety and Radiation Protection (ANVS), in the Netherlands.

13.69 The group share supply chain Operational Experience from within and outside the UK nuclear industry. The group members present at various forums and functions throughout UK industry. This includes the Nuclear Industry Association (NIA) Quality Group, which provides a forum for quality and supply chain leaders from key suppliers and from within their extended supply chains to share learning.

International collaboration

13.70 ONR participates in various international forums that directly or indirectly relate to quality assurance. One of the primary forums, is the Nuclear Energy Agency (NEA) Working Group on Supply Chain (WGSUP), which is responsible for supporting and advising the Committee on Nuclear Regulatory Activities (CNRA) in carrying out its programme of work in areas related to nuclear supply chains.

13.71 The WGSUP provides a mechanism for nuclear safety regulators and technical support organisations (TSOs) to share their knowledge in making policy and licensing decisions, as well as oversight practices related to the supply chain. The group also focuses on supply chain-related issues of operating nuclear power reactors and those progressing towards nuclear authorisation/licence application or under construction in NEA member and partner countries.

13.72 In addition, to policy and licensing matters, the WGSUP facilitates an active and timely exchange of commendable practices, information on specific challenges and emerging risks like CFSI, as well as lessons learnt to help regulators perform these functions more effectively and efficiently. This intelligence has been a key input to supporting ONR's activities in relation to the major common issue on securing reliable supply chains from the joint eighth and ninth review meeting.

Summary of significant changes since previous report

13.73 The UK has no significant changes to highlight under Article 13 during the reporting period.

Article 14 – Assessment and Verification of Safety

Each Contracting Party shall take the appropriate steps to ensure that:

I. comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body.

II. verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.

Summary statement for article

14.1 The UK fulfils the obligations of Article 14. It has arrangements in place to ensure that comprehensive and systematic safety assessments are carried out throughout the life of a nuclear installation; and that verification by analysis, surveillance, testing and inspection is carried out to ensure that the operation of a nuclear installation continues to be in accordance with its design, applicable safety requirements, and operational limits and conditions.

14.2 This Article also provides information on the major common issues of **possible impact of global climate changes on the safe operation of nuclear installations** and **strategies for ageing management in support of the operation of nuclear installations** from the joint eighth and ninth review meeting.

Legal requirements for safety assessment and safety verification

14.3 The ONR's Licence Conditions (LCs [13] require the licensee to put in place arrangements to ensure that an adequate safety case is produced and maintained before construction and throughout the life of a nuclear installation. The conditions require the licensee to verify that the installation is operated and maintained within the limits and conditions identified in the safety case. The LCs (see Table 5 – Licence Conditions) most relevant to safety assessment and/or safety verification and hence the Convention consist of:

- LC13 (Nuclear Safety Committee)
- LC14 (Safety documentation)
- LC15 (Periodic review)
- LC16 (Site plans, designs and specifications)
- LC19 (Construction or installation of new plant)
- LC20 (Modification to design of plant under construction)
- LC21 (Commissioning)
- LC22 (Modification or experiment on existing plant)
- LC23 (Operating rules)
- LC24 (Operating instructions)

- LC27 (Safety mechanisms, devices and circuits)
- LC28 (Examination, inspection, maintenance and testing)
- LC29 (Duty to carry out tests, inspections and examinations)
- LC30 (Periodic shutdown)

14.4 In addition, important to the competency, capability and control and supervision of personnel who are involved in safety assessment and/or safety verification are LCs 10 (training), 12 (duly authorised and other suitably qualified and experienced persons), 26 (control and supervision of operations) and 36 (organisational capability). The licensee must also have arrangements for compliance with relevant statutory provisions of the Health and Safety at Work Act 1974 (HSWA74) [30]. Examples include the Management of Health and Safety at Work Regulations 1999 (MHSWR99) [45], which require the licensees to make assessments of the health and safety risks of their activities, and the Ionising Radiation Regulations 2017 (IRR17) [42], which provide for the protection of all workers and members of the public from ionising radiations, as well as other appropriate legislation (see Article 7 – Legislative and Regulatory Framework for further details).

Assessment of safety

Safety assessment of Nuclear Power Plants

14.5 During the design and construction phase of a Nuclear Power Plant (NPP), to comply with LC19, the licensee is required to implement adequate arrangements to control the construction. Where ONR so specifies, the licensee will require consent from ONR to proceed from one stage to the next of the construction. Likewise, for LC20, ONR can specify that a modification to the design of the plant under construction requires consent from ONR.

14.6 To comply with LC23, each NPP must have a valid safety case, which is essentially a written demonstration that relevant standards and legal requirements have been met and that risks have been reduced so far as is reasonably practicable as required by UK law.

14.7 LC14 requires that arrangements be made for the production and assessment of safety cases consisting of documentation to justify safety during the design, construction, manufacture, commissioning, operation, and decommissioning phases of the installation. Therefore, the safety case is not a one-off series of documents but a living framework that underpins all safety-related decisions made by the dutyholder.

14.8 ONR does not prescribe the format of safety cases but ONR's Safety Assessment Principles does set out what is expected to be demonstrated by a safety case in the SAPs [28], and Technical Assessment Guides (TAGs) [47], including NS-TAST-GD-051.

NPPs under design and construction: UK EPR™ approach to safety assessment

14.9 In line with ONR's regulatory expectations, the Hinkley Point C and Sizewell C projects must produce adequate safety cases to support the design, construction, commissioning and (future) operation of the facility. These assessments are produced against a well-defined set of arrangements for their production and assessment, formalised within the Hinkley Point C/ Sizewell C project procedures.

14.10 The UK EPR™ reactor design was subject to the UK Generic Design Assessment (GDA) process and a design acceptance confirmation (DAC) and a statement of design acceptability (SoDA) were issued when this process was completed in 2012. The completion of the GDA process resulted in the identification by the regulators of 714 GDA Assessment Findings that needed to be resolved by the licensees (with many of the resolutions generic to both Hinkley Point C and Sizewell C projects). As of end of 2024, 476 of the 714 findings have

been closed, with appropriate milestone tracking in place for the remainder.

14.11 The design assessed during GDA was based upon the Flamanville 3 (FA3) EPR™ design as it was at the start of GDA. Modifications to this design occurred during GDA to incorporate UK specific requirements, post Fukushima learning etc. and this became the initial design for the UK EPR™. Learning from FA3 and other international EPR™ projects has led to further design modifications post-GDA.

14.12 The design for Hinkley Point C was brought together from the GDA design of the UK EPR™ and site-specific elements, including changes required for a twin unit site. This resulted in the production of a Pre-Construction Safety Report (known as PCSR 2012). Whilst this document was not used to justify the commencement of any site activities at that time, it was an important starting point for the Hinkley Point C safety assessments with the combination of the generic and site-specific elements.

14.13 As the first UK EPR™ project, the Hinkley Point C design forms the basis for the design to be built at Sizewell C. The design and delivery of Sizewell C is replicated from the Hinkley Point C approach. This recognises that the design and delivery of Hinkley Point C can be considered relevant good practice (i.e. meeting the duty to control risks ALARP) and avoids the need for the unnecessary re-opening of previously justified design and build approaches, providing the circumstances remain applicable (for further details, see section 5.1.6.6 of ONR TAG on regulating duties to reduce risks to ALARP [121]).

14.14 A number of iterations of the site safety report have been produced for Hinkley Point C with the most recent being the issuance of the Summary Safety Case Document 2 in 2023. This report will be adapted to form the basis of the first site wide safety report for Sizewell C, which will be the PCSR.

14.15 In accordance with LC19, both Hinkley Point C and Sizewell C projects have been split into numerous phases with associated holdpoints. ONR may specify that the project cannot proceed past a particular hold-point without the consent of ONR.

14.16 Strong configuration management is fundamental to maintaining a good quality safety case that is aligned to the current design. As noted, modifications to the design have continued to result from international EPR™ projects, UK requirements and site specifics. In addition, construction and manufacturing may result in the need to justify changes such as non-conformances. These design changes are controlled via a design change process as required by LC20. Safety significant changes must undergo formal safety assessment to a level proportional to their risk.

14.17 Since the EPR™ is an evolutionary design, with many decisions on fundamental safety approaches dating back to the 1990s, the assessment that risks have been reduced to As Low As Reasonably Practicable (ALARP) needs to largely build on the evolutionary developments and the use of Operational Experience (OPEX) and learning from earlier plants. Where further decisions have then been made that alters the EPR™ design to suit the UK and site context, these are underpinned by additional optioneering and assessment that risks have been reduced to ALARP.

Operating NPPs: Approach to safety assessment and analysis

14.18 EDF Energy NGL has developed its own Nuclear Safety Principles that set out the deterministic and probabilistic acceptance criteria against which it judges each safety case. In addition to these principles, the dutyholders conduct their assessments in line with a range of British, European, and international standards.

14.19 The magnitude, complexity, and evolution of the safety case through the life of each plant requires the implementation of robust systems to manage its development. The licensees put systems in place to properly manage the changes to the safety cases to ensure that these

accurately reflect the as-built and as-operated plant. Thus, the documentation that forms the safety case is subject to appropriate management systems required by LC17 (discussed in Article 13 – Quality Assurance), and any changes to the safety case are regulated as modifications under LC22 or LC20.

14.20 The analyses of normal operating conditions show that resultant radiation doses due to ionising radiations, both to members of the workforce and the public, are, and will continue to be, below regulatory limits and, furthermore, are ALARP (see Article 15 – Radiation Protection).

14.21 The accident analyses use the complementary approaches of Design Basis Analysis (DBA), Probabilistic Safety Analysis (PSA) and Severe Accident Analysis (SAA), as appropriate. The dutyholders prepare an analysis of the foreseeable faults and hazards and the safety measures in place to: prevent such faults, protect the plant if they do occur; and to mitigate the consequences should protection fail.

14.22 It is a requirement on dutyholders that internal and external hazards on nuclear facilities be identified and their effects considered in safety assessments. Internal hazards are those hazards to plant, structures and personnel that originate within the site boundary but are external to the primary circuit in a reactor. External hazards are those that originate outside the site boundary (e.g. natural hazards such as seismic events).

14.23 A comprehensive fault schedule that includes internal initiating events as well as internal and external hazards is the starting point of both deterministic and probabilistic safety analyses. Further details about the safety analysis of UK NPPs is given in Annex 5 – Safety Analysis of UK Nuclear Power Plants

Climate Change

14.24 The UK regulatory regime and licensees consider the effects of climate change on the NPPs, including (but not limited to) its impact on the safety case and hazard analyses.

14.25 During the reporting period, both regulators and UK licensees have carried out work related to climate change, which are discussed in the following paragraphs. The discussion in the paragraphs below relate directly to the major common issue of **possible impact of global climate changes on the safe operation of nuclear installations** from the joint eighth and ninth review meeting.

Chief Nuclear Inspector's Themed Inspections on Climate Change

14.26 ONR introduced Chief Nuclear Inspector's (CNI) themed inspections in 2017, which are designed to examine and provide assurance on important regulatory matters, key areas that are strategic or broader in nature than more routine regulatory inspection activities. As climate change is a challenge for most dutyholders across the nuclear sector, ONR conducted a climate change intervention across all UK nuclear facilities.

14.27 In May 2023, ONR held an industry engagement day ahead of the planned CNI themed inspections on climate change. This engagement day was for UK's nuclear licensees to understand ONR's expectations for the CNI themed inspection. ONR requested licensees to complete a self-assessment questionnaire on their arrangements and resilience in relation to climate change effects, as part of the first phase of the CNI themed inspection.

14.28 The second phase of the CNI themed inspections were climate change site-based inspections that were conducted at five UK Nuclear licensed sites during 2024, including operating reactors Heysham 2 and Sizewell B. The sites selected for inspection were informed by the responses within the self-assessment questionnaires completed by the dutyholders as well as factors including site lifetimes, safety significance and opportunities for learning.

14.29 The site-based inspections considered the effectiveness of site licensees' arrangements to monitor and review climate change information to determine if additional measures are needed to ensure that activities remain protected in the future. ONR also looked for evidence that recent climate change projections are being included in relevant safety cases and hazard definitions. The themed inspection team engaged with environmental agencies on the inspections and at the inspections at Heysham 2 and Sizewell B, ONR were joined by the Environment Agency.

14.30 The findings from the self-assessment questionnaires and the site-based inspections were collated and a final industry engagement day on the topic of climate change was held in February 2025. The industry day discussed ONR findings in relation to how the industry is managing risks associated with climate change, and future regulatory activities to ensure the industry remains resilient against climate change effects.

14.31 A full summary report will be published late in Summer 2025 outlining all results and conclusions from the CNI themed inspection, presenting a summary of the national situation on climate change and the approach of the UK's nuclear industry. The work also involved workshops with other national regulators in Europe, such as ASN, FANC, STU and ANVS , to gain insights from them and to share learning.

14.32 In addition to the CNI themed inspection above, ONR has ongoing regulatory engagements with NPP dutyholders with regards to external hazards safety cases where climate change is considered.

14.33 During the reporting period ONR also engaged with the government, other national and international regulators and wider public on the topic of climate change:

- During the reporting period, ONR, working together with the Environment Agency, Natural Resources Wales and the Scottish Environment Protection Agency published updates to the 'Use of UK Climate Projections 2018 (UKCP18) Position Statement' [122] and 'Principles for Flood and Coastal Erosion Risk Management' [123]. The CNI themed inspection on climate change has identified the need to further review this guidance to ensure it remains fit-for-purpose.
- During the reporting period, ONR hosted a three-part series of workshops [124] on its regulation of climate change, co-produced with non-governmental organisations (NGOs). The sessions gave NGOs an insight into how ONR considers climate change when regulating the nuclear industry. Attendees discussed their viewpoints with ONR inspectors and explored the national guidance, standards and best practice relating to the regulation of climate at each stage of a nuclear site's life cycle.
- In February 2024, ONR hosted a meeting with the French Nuclear Safety Authority (ASN), the Dutch Authority for Nuclear Safety and Radiation Protection (ANVS), and Belgium's Federal Agency for Nuclear Control (FANC) to share learning and experiences on the topic of Climate Change. A second meeting took place in January 2025; the Radiation and Nuclear Safety Authority of Finland (STUK) also participated in the meeting, along with attendees from the first meeting.

14.34 In December 2024, ONR published its response [125] to the fourth round of climate adaptation reporting in accordance with the Adaptation Reporting Power (ARP), under the Climate Change Act (2008). The report focuses on the aspects of the nuclear industry that UK ONR regulates, summarising its state of preparedness. The ARP invites organisations with functions of a public nature or statutory undertakers to report against the current and future projected impacts of climate change, and their adaptation proposals. The government, in particular the Department for Environment, Food and Rural Affairs, intends to use the information to feed into the UK's Climate Change Risk Assessment.

Climate ADAPT Programme – Dutyholder Activities

14.35 In 2023 a Climate Change Adaptation Programme, Climate ADAPT, was established within EDF Nuclear Services for EDF UK's nuclear business. Climate ADAPT is a comprehensive initiative aimed at facilitating the ability of EDF's site licence holding business units to assess, plan, and implement sustainable measures to enhance the ongoing resilience of the company's nuclear assets in the face of observed and projected climate change. This work is vital to ensuring the continued safe and efficient operation of the UK NPPs while minimising potential physical risks associated with climate change. The programme seeks to embed a managed adaptive approach.

14.36 Since establishment, Climate ADAPT has been developing a generic and flexible framework of arrangements to facilitate licensees to manage the physical risks of climate change, this includes:

- Developing a set of Climate Change Adaptation Principles.
- Developing a process for performing Climate Change Risk Assessment and subsequent Adaptation Planning – a pilot project is planned for 2025 at Sizewell B NPP.
- Developing arrangements for the proactive, periodic and proportionate review of hazards affected by climate change to enable appropriate recharacterisation in a timely and risk informed manner to ensure that risk and margins are positively managed.

14.37 Climate ADAPT's centralised position within Nuclear Services enables the programme to drive an aligned and efficient approach to climate change risks across the organisation, foster collaboration and share learning effectively.

14.38 Climate ADAPT has brought together existing links with external working groups/activities on the topic of climate change such as IAEA, WANO, European Nuclear Installation Safety Standards and the British Standards Institution to facilitate internal benchmarking and relevant good practice (RGP). Additionally, Climate ADAPT has forged new links with a counterpart programme based in EDF France to further drive collaboration across the wider EDF Group and information sharing.

Safety assessment by the dutyholder: safety reviews

14.39 Major Periodic Safety Reviews (PSRs) are carried out by licensees every ten years (or more frequently, if necessary, for example following a major event). The legal basis for PSRs in the UK is embodied in the LCs. LC15 requires licensees to 'make and implement adequate arrangements for the periodic and systematic review and reassessment of safety cases.' PSR is therefore a well-established practice in the UK. ONR's PSR TAG [126] sets out what ONR expects to see in the PSR. The programme for the UK's nuclear installations' PSRs is given in figure 14.1 below.

14.40 The purpose of the review is to revalidate the extant safety case, to ensure the plant and operations remain adequately safe and fully reflect the site licence requirements. This is achieved by reviewing the previous 10 years of operation together with considering changes in activities or plant conditions that impact on nuclear safety over the following 10 years. The review takes into consideration compliance with modern standards and potential impact of ageing and obsolescence. ONR can, as it deems necessary, direct licensees to undertake a further review at any time (as per LC15).

14.41 The PSRs aim to confirm that plant condition and the arrangements are adequate to maintain safety until at least the next review. As stated above, PSRs complement the normal operational monitoring of safety, and proper management of ageing effects, which is also

regulated by ONR. Therefore, although the PSRs may conclude that the arrangements are adequate for another ten years; operation will be dependent upon a robust safety case underpinned by continuing satisfactory results from routine inspections. Should any inspection or safety-related factor emerge in the interim period that may cast doubt upon the continuing validity of the safety case (and hence, of the safety of reactor operations), this would require the licensee to resolve the matter to ONR's satisfaction or to suspend power generation.

Figure 14.1: Status of Periodic Safety Reviews at EDF Energy NGL Stations

NPP Sites	Operational Since	1st Review	2nd Review	3rd Review	4th Review
Hinkley Point B*	1976	1996	2006	2016	2026
Hunterston B*	1976	1996	2006	2016	2026
Dungeness B*	1983	1997	2007	2017	2027
Heysham 1	1983	1998	2008	2018	2028
Hartlepool	1983	1998	2008	2018	2028
Heysham 2	1988	1999	2009	2019	2029
Torness	1988	1999	2009	2019	2029
Sizewell B (PWR)	1995	2005	2014	2024	2034

*Hinkley Point B, Hunterston B and Dungeness B stations are currently shutdown and undergoing decommissioning. However, in accordance with LC15, these sites will have to complete PSRs until such time they are no longer a licensed site. These three sites are expected to be out of the scope of the Convention by the time of their 4th PSR. However, for Hinkley Point B and Hunterston B, elements of the 4th PSR will be considered as part of their post-defuelling safety case.

14.42 ONR findings from its assessments of the completed PSR reports for each station are published on the ONR website [127].

Sizewell B Third Periodic Safety Review

14.43 During the reporting period, the third PSR (PSR3) for Sizewell B was completed. The approach taken by the licensee for PSR3 was closely aligned to the IAEA guidance on PSRs [56]. The IAEA approach allows the PSR to become more focused on reviewing the effectiveness of the licensee's business processes, which address fundamental issues related to the maintenance of, and justifiable improvements in, nuclear safety.

14.44 ONR's assessment judged parts of the Sizewell B PSR3 submission to be adequate; but it also identified shortfalls in aspects of the systematic review of the safety case (deterministic safety analysis and hazard analysis), and with the timely resolution of shortfalls. The licensee has acknowledged these shortfalls and has agreed the scope of the work required to resolve them.

14.45 Following the assessment, ONR issued a decision letter requiring the licensee to resubmit those aspects of the PSR that are incomplete. ONR intends to undertake an LC15 compliance inspection, targeted on shortfall resolution, at an appropriate point in the future but no later than January 2028.

14.46 ONR did not identify any immediate safety concerns with regards to the operation of the Sizewell B station. ONR concluded that if any anomalies are identified by EDF Energy NGL during the work required to address the shortfalls in PSR3, these can be adequately addressed through the licensee's safety case anomalies process.

Improvements as a result of safety assessments and reviews

14.47 In accordance with legal duties, the licensee safety assessments consider means to reduce risks ALARP at NPPs (see paragraphs 14.54 to 14.57). Additionally, the results of the PSRs have produced, and continue to produce, worthwhile improvements to safety. Major safety upgrades arising from safety assessments, periodic reviews, or from event-driven reviews during the reporting period are outlined in Annex 4 – Safety Related Issues and Safety Upgrade Programmes.

Safety Assessment of Shutdown/Defuelling Stations

14.48 Following the permanent shutdown of Hinkley Point B, Hunterston B and Dungeness B power stations, EDF Energy NGL developed essential defuelling safety cases to demonstrate to ONR that defuelling activities can be safely commenced. Following ONR's assessment of these safety cases and permissioning of the defuelling activities, these sites started defuelling the reactors.

14.49 Following the defuelling of reactors at each station, EDF Energy NGL will submit a post-defuelling safety case to ONR, outlining how activities on site will be carried out from this point until the site is de-licensed. Inspections will be carried out by ONR to confirm the adequacy of and implementation of the defuelling arrangements. During this inspection ONR will sample license holders' defuelling records to assess compliance with LC25 ('Operational Records').

14.50 When the site is free from all fuel, the regulation of the site will transfer to ONR's decommissioning, fuel and waste division. At this point, in accordance with Article 2 of the Convention, the NPP site will be out of the scope of the CNS. Hunterston B completed fuel free verification in April 2025, whilst Hinkley Point B and Dungeness B continue to defuelling activities.

14.51 For the remaining operating Advanced Gas-cooled Reactors (AGRs) (Hartlepool, Heysham 1, Heysham 2 and Torness), EDF Energy NGL has recognised that there is an appreciable risk of the reactors reaching end of generation (EoG) ahead of their planned closure dates due to a compelling technical or commercial reason. To mitigate against this risk, NGL has developed 'essential' defuelling safety cases. These are intended to be baseline safety cases for defuelling that enables progress to be made on defuelling preparations and implementation work ahead of the planned closure dates. The essential defuelling safety cases for Hartlepool and Heysham-1 were assessed by ONR in January 2025. The essential defuelling safety cases for Heysham 2 and Torness are expected to be submitted for assessment in mid-2025.

Regulatory review of dutyholders' safety submissions

14.52 ONR assesses the safety of proposed and existing sites and nuclear installation designs through review of the licensees' safety submissions.

14.53 When licensees submit requests for permission to carry out activities supported by safety submissions, ONR sets standards for the reviews and assessments using the guidance in the SAPs and TAGs as well as other guidance such as WENRA and industry RGP.

14.54 In its assessment of safety cases, ONR seeks assurance that risks have been reduced to ALARP, as this is required by law. ONR inspectors make use of the SAPs numerical targets

when considering whether radiological hazards are being adequately controlled and risks reduced to ALARP (for further details, see section 5.3.1 of ONR TAG on regulating duties to reduce risks to ALARP [121]).

14.55 Some of the numerical targets are in the form of dose levels, and align to specific legal requirements (see Article 15 – Radiation Protection for more details); others are expressed as frequencies or risks. Each target is set in terms of a basic safety level and a basic safety objective. It is ONR's policy that a new facility or activity should at least meet the basic safety levels, however, even if the levels are met, the risks may not be ALARP. In such cases, the designer and dutyholder must reduce the risks further. Basic safety objectives form benchmarks that reflect modern standards and expectations and mark the start of the broadly acceptable levels. Separate targets are defined for normal operations, design basis fault sequences, individual risks, accident frequencies and societal risk.

14.56 In line with wider international guidance, ONR expects the severe accident analysis to contribute to the demonstration that large early releases have been 'practically eliminated'. For this, the safety case should show either that it is physically impossible for the accident state to occur or that design provisions mean that the state can be considered extremely unlikely with a high degree of confidence.

14.57 The document Risk Informed Regulatory Decision Making [56] (re-published during the reporting period) sets out ONR's risk-based framework for making regulatory decisions.

14.58 It should be noted that ONR does not 'approve' or 'certify' the codes and standards chosen by the dutyholders. The choice of codes or standards to underpin the design and safety case is a matter for the dutyholder. ONR will assess the safety case and among other things will take a view on the standards that have been used. Where a standard is well known to ONR or an internationally recognised standard has been used, for example, ASME III, there is unlikely to be any need for detailed examination of the standard itself; however, the standard's application may be reviewed. Where the standard being used is new or unfamiliar to ONR, then particular focus will be given to the selection and justification of this by the dutyholder.

14.59 In their assessment of a NPP safety case, ONR's inspectors seek certain attributes in the licensees' safety submissions. The safety case should be intelligible, valid, complete, evidential, robust, integrated, balanced, and forward looking [128].

14.60 ONR specialist inspectors have the capability to commission analysis work from several Technical Support Contractors (TSC). This work is used to support their technical assessment of safety case submissions. TSCs do not make regulatory judgements but provide expert advice to ONR inspectors.

14.61 The output of the assessment by an inspector from a particular technical discipline is captured in an assessment report, which is approved by the head of the relevant technical discipline. ONR project or site inspectors bring together and integrate the findings from assessment reports covering each of the relevant technical areas and provide an overall conclusion regarding the adequacy and acceptability of the assessed safety case, leading to a recommendation as to whether permission should be granted for the requested activity. This is formally documented in a project assessment report (PAR). To ensure openness and transparency of regulatory decisions, PARs are published on the ONR website [127].

Verification of safety

Examination, inspection, maintenance, and testing

14.62 LC28 requires licensees to ensure that all aspects of the plant that may affect safety receive regular and systematic Examination, Inspection, Maintenance, and Testing (EIMT).

The purpose of this is to ensure the plant remains capable of performing the functions required by the safety case, with the required level of reliability. This LC also lists other requirements, including preparation of a maintenance schedule and notification, recording, investigation and reporting of any matters revealed by EIMT that indicate that the safe operation or safe condition of the plant may be affected.

14.63 Licensee arrangements with regards to examination, inspection, maintenance, and testing are discussed further in Article 19 – Operation.

Surveillance of compliance with operational limits and conditions and configuration management

14.64 LC23 requires '…the licensee shall, in respect of any operation that may affect safety, produce an adequate safety case to demonstrate the safety of that operation and to identify the conditions and limits necessary in the interests of safety.' These (and relevant operating instructions) are in the form of 'technical specifications' for the operating reactors in the UK. This is discussed in paragraphs 19.9 to 19.15.

14.65 EDF Energy NGL power plants have arrangements and processes for verifying that the plant remains within the requirements, parameters and timescales set-out in the technical specifications (which embody the safe operating envelope as justified by the safety case).

14.66 The licensees have systems to ensure that deviations from operational limits and conditions are documented and reported. Where events of non-compliance occur, these are reviewed and if necessary, investigated by the licensees and reported to ONR in accordance with the arrangements under LC7 (incidents on the site). This is further discussed in Article 19 – Operation.

14.67 PSA based methods are used to support plant configuration control at some of the operating plants in the UK. Newer AGRs (Heysham 2 and Torness) use a PSA based risk indicator to contribute to decisions on plant configuration. Sizewell B employs a risk monitor tool, 'RiskWatcher', to assess changes in risk (core damage frequency) due to unavailability of components or systems. Risk monitors are also used by the work management departments as part of work planning to highlight potentially avoidable peaks in risk. The risk monitor is also utilised by operations staff to monitor 'on-line' risk as planned maintenance activities are executed and to assess the risk implications of emergent defects on safety related components.

Ageing Management Programmes

14.68 The discussions in the sections below relate directly to the major common issue of **strategies for ageing management in support of the operation of nuclear installations** from the joint eighth and ninth review meeting.

14.69 ONR expects that during the design phase, licensees will take account of the effects of ageing on the plant during all its lifecycle stages. This is reflected in ONR's SAPs, where EAD.1 to EAD.5 set out specific expectations regarding plant ageing and degradation. Specifically, EAD.2 states that adequate margins should exist throughout the life of the facility to allow for the effects of material ageing and degradation processes on structures, systems, and components. In addition, EAD.3 states that, where material properties could change with time and affect safety, provision should be made for periodic measurement of the properties.

14.70 There are many structures, systems and components that are subject to ageing. ONR monitors and reviews developments through routine interactions with the licensees, and during periodic shutdowns where inspection work may be undertaken to establish the current condition and confirm the rate of degradation. As the stations approach EoG, ONR intends to focus more on the management of plant ageing to ensure margins of safety are maintained.

14.71 Ageing and Obsolescence Programmes have been established in EDF Energy NGL for several years, identifying identical replacements with the same function and operating intent. The programmes recognise that the required function of systems will change over time and the required replacement during defuelling could be different to the generating requirements.

14.72 Details of site-specific and fleetwide ageing management programmes are given in Article 6 – Existing Nuclear Installations and Annex 4 – Safety Related Issues and Safety Upgrade Programmes.

Chief Nuclear Inspector's Themed Inspections on Ageing Management

14.73 At the start of this reporting period, ONR concluded an ageing management themed intervention across all UK nuclear facilities. As part of this exercise, ONR evaluated EDF Energy NGL's arrangements following queries from internal and external stakeholders regarding the lack of a consistent approach for demonstrating the effectiveness of the ageing management process. In response, an ageing management improvement programme was developed by EDF Energy NGL resulting in the establishment of station guidance documentation.

14.74 Following ONR's evaluation, which included a series of site inspections across nuclear installations in the UK (including the Sizewell B power station), ONR determined that the EDF Energy NGL arrangements for ageing management had been adequately implemented in line with ONR's expectations.

14.75 Across all the sites visited, ONR found that a common challenge for licensees was ensuring the capability and skills needed for the effective ageing management of facilities. Improved knowledge transfer was identified as essential to mitigate risks of diminishing knowledge and experience and rare skill sets being lost.

14.76 Following the completion of the themed inspections, ONR published a report looking at how the nuclear sector manages ageing plants and facilities to ensure the necessary standards of safety are maintained [129]. Aspects of ageing management are now considered as part of the normal regulatory control of activities (as described in paragraph 14.83 to 14.93).

14.77 During the reporting period, ONR also published a TAG on Ageing and Degradation (A&D) Management [130]. The purpose of this TAG is to promote consistency in inspectors' A&D adequacy judgements on Structures, Systems and Components (SSCs) and to support Beyond Design Life considerations.

Licensee oversight arrangements

14.78 EDF Energy NGL operates in accordance with a single unified management system that integrates safety, health, environmental, security, quality and economic objectives. The management system defines the responsibilities of key post holders, the line management organisation and the main interfaces between the company and other organisations.

14.79 EDF Energy NGL's management system draws on best practice, as defined in the IAEA Safety Requirements and domestic standards whilst also ensuring that the requirements of the nuclear site licences are fulfilled.

14.80 EDF Energy NGL operates a 'defence-in-depth' approach towards oversight in order to monitor performance and conformity to both its internal standards and external regulations. EDF Energy NGL operates a multi-layer model with increasingly independent oversight being exercised through:

- Management accountability – responsibility for ensuring compliance with the management system arrangements lies with the leaders of the organisation.

- In-process oversight through peer checking and self-assessment – company processes include arrangements for any inspection, testing, verification and validation activities, including their acceptance criteria and the responsibilities for carrying them out.
- Functional oversight – review and audit by company experts. Each process is assessed by the responsible champion each year to provide assurance that it is working effectively and to identify opportunities for improvement.
- Independent internal oversight from the independent nuclear assurance (INA) function that reports to the Board independently of the operating arm of the company and has an independent reporting route to the EDF Group Inspector General for Nuclear Safety. INA has a team of three evaluators based at each power station. They also have a central team providing independent assessment of significant plant and safety case changes and support for fleet-wide and corporate audits and inspections.
- Each station has a Nuclear Safety Committee (NSC) that advises on safety matters. The committee is required to consider all significant changes to the safety case (including plant modifications and changes to organisational structure) before they are submitted to ONR. The membership of the NSC consists of the station director, senior safety officers of the company and independent safety experts.
- The Nuclear Safety Review Board takes the form of a week-long review of operations and management at each nuclear power plant. Each station is reviewed every two years. Each Board includes external members with a track record either as a power station operator, regulator or key nuclear industry supplier.
- The Inspector General for nuclear safety and radiation protection reports to the Chief Executive Officer of EDF Group and provides high level oversight of nuclear activities across EDF Group, including EDF Energy NGL.

14.81 External oversight is sought from and provided by the following bodies:

- WANO peer reviews are periodically performed on each of the EDF Energy NGL stations. The peer review frequencies have been aligned across the industry with routine reviews now being completed on a four-year cycle. The defuelling and decommissioning plants will not participate in the peer review cycle.
- An OSART mission to Heysham 2 took place in October 2023. EDF Energy NGL has sought, through DESNZ, a follow up review at Heysham 2 in 2026.

14.82 For Hinkley Point C and Sizewell C, all major safety submissions including any submitted for permissioning by ONR, are subject to a rigorous internal governance process. As well as the potential for all documentation to be subject to scrutiny by the respective Design Authorities, separate independent challenge forms additional layers of a barrier model approach to ensuring high quality submissions. The Independent Technical Assessment team provide an internal regulator function undertaking independent assessment of submissions. All major safety submissions are also submitted for advice from the NSC. The Hinkley Point C and Sizewell C NSCs advise their respective Boards in these matters. Its endorsement is part of the decision-making process to allow submission of major safety submissions to the regulator as part of the permissioning process.

Verification of safety: regulatory review and control of activities

14.83 An ONR inspector (or team of inspectors) is allocated to a nuclear installation site before the start of construction. During the construction and commissioning phases, the site inspector(s) will conduct frequent inspections and discussions with the licensee, witness key tests and check test reports.

14.84 Once the reactor is operational, the nuclear site inspector(s) allocated to the site spend a part of their working time on their site. They ensure that the licensee is complying with the LCs and the arrangements made under them. ONR's approach is to ensure that inspectors do not remain at one site for an indefinite period. Instead, there is a periodic change, normally after a few years, for several reasons, ranging from changing regulatory priorities to career development. This also serves to ensure the continued independence of ONR inspectors.

14.85 Individual site intervention plans are produced according to generic templates based on a matrix that includes the LCs and relevant legislation, the key safety systems and structures (derived from the safety case) and themes based on recent operational experience feedback. Before the start of each year, the plan is modified, as necessary, to take account of feedback, regulatory issues and developments affecting the plant. Unplanned and reactive inspection work is also integrated, as necessary, into the site inspection activities throughout the year. Site inspectors are supported by other ONR inspectors who carry out specialist assessments or inspections as necessary.

14.86 Site intervention plans are produced, monitored, and reviewed within an Integrated Intervention Strategy (IIS), the purpose of which is to ensure that ONR focuses its resources where they are most needed and that the planning process is transparent to stakeholders. The IIS considers issues of local environment, priorities and changes in the industry. The site intervention plan is enhanced to include other factors that ONR considers to be important to the overall safety of the site. These include:

- Any site related work arising from progressing outstanding PSR requirements or other reviews of the safety case
- Emergency arrangements
- Strategic themes important for safety such as organisational resilience and supply chain
- Operational experience and organisational learning
- Leadership and management for safety (also see Article 12 – Human Factors)

14.87 Team inspections that address specific or more generic aspects of the safety of the nuclear installations are carried out at the plants and at the licensees' corporate centres. For such inspections, a multi-disciplinary group of inspectors will visit the site or centre. They report their findings to the operator, so that improvements are made, where appropriate.

14.88 Reactive inspections are undertaken in response to specific events where operational matters may affect safety. Further investigation may be undertaken by ONR inspectors and appropriate regulatory action taken, in line with its enforcement policy statement [53] and the regulatory strategy for the site. From time to time, ONR inspectors also undertake unannounced inspections and out of hours inspections.

14.89 LC29 requires licensees to carry out and report the results of tests, inspections and examinations specified by ONR. This condition may, where used, be regarded as a verification activity by the nuclear regulator or to intervene to improve knowledge or secure a safety improvement.

14.90 ONR also carries out programmes of system-based inspections (SBIs), which are intended to establish that the basic elements and requirements of a site/facility safety case are met in practice, that the systems are fit for purpose and that they will fulfil their safety functional requirements.

14.91 Each SBI is undertaken by a small team of inspectors from appropriate disciplines. The SBI typically takes place over a two-day period and includes document review, discussions with licensee staff and plant walk-downs. SBIs are structured around compliance with six LCs; these cover training, operating rules, operating instructions, safety mechanisms, maintenance,

and leakage of radioactive materials.

14.92 Once the inspection is complete, an overall judgement is made by ONR's inspection team as to whether the relevant safety systems and structures adequately fulfil the requirements of the safety case. Broadly, the outcomes of ONR's SBI interventions have allowed ONR to gain high confidence that the safety systems of the operating reactor fleet continue to deliver the function required by the reactor safety cases.

14.93 Summary reports of all inspections carried out by ONR are published on the ONR website [131].

Summary of significant changes since previous report

14.94 During the reporting period, developments under this Article are as follows:

- Sizewell B has completed its third PSR.
- For those NPPs that have transitioned to defuelling, EDF Energy NGL has submitted relevant defuelling/post-defuelling safety cases, which have been assessed by ONR. EDF Energy NGL has developed essential defuelling safety cases for the remaining AGRs that have been assessed (or are in the process of being assessed) by ONR.
- Dutyholders and ONR have commenced a number of workstreams to consider the impact of global climate change on the safe operation of nuclear installations.

Notable achievements

14.95 During the reporting period, UK licensees and regulatory agencies have undertaken a substantive programme of work in relation to climate change:

- **Chief Nuclear Inspector's themed inspection on Climate Change:** Joint regulatory exercises between ONR and the Environment Agency on several UK nuclear licensed sites, (including 2 NPP sites) followed by an industry engagement day. This has allowed the regulators establish a holistic view on the nuclear industry's overall approach to climate change, to highlight findings related to the management of climate change risks and proactively monitor how these are addressed going forwards.
- **EDF Nuclear Services' Climate ADAPT programme:** Climate ADAPT initiative is aimed at facilitating the ability of EDF's site licence holding business units to assess, plan, and implement sustainable measures to enhance the ongoing resilience of the company's nuclear assets in the face of observed and projected climate change.

14.96 This two-pronged approach to climate change by regulatory agencies and licensees allows the UK to proactively identify and implement measures to mitigate the effects of climate change to ensure the ongoing safety of NPPs in the UK. The high profile nature of the initiatives also ensures the dedication of appropriate resources to addressing the impact of climate change.

Article 15 – Radiation Protection

Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

Summary statement for article

15.1 The UK fulfils the obligations of Article 15. It has comprehensive arrangements to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses that exceed prescribed national dose limits.

15.2 A summary of the laws and regulations relevant to nuclear safety, environmental and radiation protection can be found under Article 7 – Legislative and Regulatory Framework.

Regulatory expectations for the process to optimise radiation doses

15.3 Optimisation is the process of determining what level of protection and safety makes exposures to ionising radiations, and the probability and magnitude of potential exposures, as low as is reasonably achievable (ALARA). In the UK, the as low as reasonably practicable (ALARP) principle is used by ONR and is fundamental to all health and safety legislation. The widely used International Commission on Radiological Protection concept, ALARA, is equivalent to ALARP (see Annex 3 – SFAIRP, ALARP and ALARA for a more detailed discussion of these concepts). As part of the demonstration that risks have been reduced to ALARP, dutyholders must consider all relevant factors relating to engineering, operations, and management of safety. These expectations are often referred to as relevant good practice (RGP) and include an option adopted elsewhere in similar circumstances and the extent to which this option has worked in practice. This can often provide strong indications of what the ALARP solution might be. Where RGP is not clearly established, the operator must assess the significance of the risks (both their extent and likelihood) to determine what action is required.

15.4 Some irreducible risks may be so serious that they cannot be permitted. At the other extreme, some risks may be so trivial that it is not worth incurring significant time, trouble, or cost to reduce them further. The licensee must take measures to reduce risk unless the detriments in terms of time, trouble, and cost of taking particular actions are clearly excessive (in gross disproportion) compared with the benefit of the risk reduction. Financial equivalent values can be used in the ALARP analyses, noting that the cost benefit analysis is only one input to the ALARP decision.

15.5 Licensees are required by IRR17 [42] to restrict exposures to the lowest reasonably practicable level by applying the hierarchy of control principles in order of priority, namely engineering controls, administrative controls, and personal protective clothes/equipment. For example, this requires use of shielding, physical separation, containment, ventilation, interlocks and warning devices, where these are reasonably practicable, before considering how exposures can be further reduced by the application of systems of work or use of personal protective equipment.

15.6 A dose constraint is a prospective restriction on the individual dose delivered by a source of ionising radiations, which serves as an upper bound on the dose in optimising the protection and safety of persons who may be affected by the source. IRR17 Regulation 9 requires employers to use dose constraints, where appropriate, in the planning stage of

radiation protection. This is achieved through good planning of work activities to restrict individual exposures so far as is reasonably practicable (SFAIRP). In general, the UK licensees have considerable experience in developing dose databases that provide accurate dose forecasts for planned tasks.

15.7 IRR17 does not specify a level of dose below which optimisation is always regarded as satisfied. The duty on the employer (for nuclear sites this is generally the licensee but may also include other employers with staff working at the site) given in Regulation 9(1) is to restrict, SFAIRP, the extent to which employees and other persons are exposed to ionising radiations. This requirement has no lower dose boundary and is satisfied when the radiation exposures are deemed to be ALARP.

Implementation of radiation protection programmes by dutyholders

Dose limitation

15.8 The ONR's Safety Assessment Principles (SAPs) [28] include some lower numerical effective dose targets for normal operation called Basic Safety Objectives (BSO) of 1 mSv/year for employees working with ionising radiations, 0.1 mSv/year for other employees on the site, and 0.02 mSv/year for any person off the site. The BSO is that dose value below which the regulator will not normally seek further improvements if it is satisfied by the licensee's arguments. However, the objective does not represent a notional value of optimisation and an employer at a nuclear licensed site should still seek further dose reductions below the BSO if these were reasonably practicable. The SAPs include some higher numerical dose targets for normal operation called Basic Safety Levels (BSL), some of which are also dose limits in IRR17. There are levels of 20 mSv/year for employees working with ionising radiations (which is also the dose limit for employees in IRR17), 2 mSv/year for other employees on the site, and 1 mSv/year for any person off the site (which is also the dose limit for other persons including the public in IRR17). In practice, doses recorded for employees at nuclear installations are usually well below dose limits for normal operations and even peak doses have only been a fraction of the limits for several years.

15.9 IRR17 also allows for an effective dose limit to an individual worker of 100 mSv in any period of five consecutive calendar years. This is subject to a maximum dose of 50 mSv in any one year, but only if the licensee can demonstrate to ONR's satisfaction that an annual limit of 20 mSv is impracticable for that person. This higher annual dose limit is very rarely used in the UK.

15.10 IRR17 also sets a limit for employees on equivalent dose to the lens of the eye of 20 mSv in a calendar year or, where permitted by ONR, 100 mSv in five years subject to a maximum limit of 50 mSv per year. IRR17 also sets a limit on equivalent dose to the skin of 500 mSv in a calendar year and sets lower effective dose limits for employees under the age of 18 years as well as other persons who are not employees.

15.11 If an employee is likely to receive a radiation dose greater than three-tenths of a relevant dose limit in a year (for example, 6 mSv in the case of whole-body exposure), IRR17 Regulation 21 requires the employer to designate that employee as a classified person (a Category A employee in IAEA terminology). For classified persons, the employer must arrange for any significant doses (internal or external) they receive to be assessed by a dosimetry service approved by the Health and Safety Executive (HSE) [132]. HSE also approves dosimetry services to co-ordinate individual doses and to produce and maintain dose records for classified persons. HSE has a computerised system that receives and processes the annual dose summaries for classified persons. Dose records are kept until the person has (or would have) reached the age of 75 years.

15.12 Where designated classified persons receive exposure from multiple sites operated by different employers, the 'outside worker' provisions of IRR17 may apply. In such cases, classified persons are required to carry radiation passbooks, which contain personal identification details together with their current cumulative dose. Information in the radiation passbook enables the licensee to properly control the cumulative dose of the worker, which may have been accrued on different sites.

15.13 Under IRR17 Regulation 9, if an employee has a recorded whole-body dose greater than 15 mSv (or a lower dose established by the employer) for the year, the employer must carry out an investigation. The purpose of this investigation is to establish whether sufficient action is being taken to restrict exposure to ionising radiations, SFAIRP.

15.14 IRR17 Regulation 26 requires that, where a licensee suspects or has been informed of an exposure in excess of a dose limit, ONR is notified, whether this arises from a single incident or from dose accumulated over time. The employer undertaking work with ionising radiations must carry out a thorough investigation.

15.15 Assessment of intakes of radioactive material by workers and the resultant doses is carried out by means of air sampling (personal and area), bio-assay, and in-vivo monitoring. IRR17 includes regulations to ensure that appropriate steps are taken for the assessment of internal exposure.

15.16 An example of EDF Energy NGL's control of doses received by workers is given below.

Sizewell B Pressuriser Full Structural Weld Overlay Project

15.17 The pressuriser full structural weld overlay project undertaken during Sizewell B Refuelling Outage 19 (RO18) was a first-of-a-kind project at Sizewell B. A pre-project ALARA review was conducted to ensure doses were minimised, with forecast collective radiation exposures estimated to be ~254 man.mSv.

15.18 The work involved adding weld overlays of the pressuriser surge line safe end weld and weld overlays of the pressuriser safety relief and spray line safe end welds:

- Weld layers #1 to #3 (with associated grinding and Ultrasonic Testing) with the surge line and pressuriser bowl filled.
- Weld layers #4 to #9 (6 layers) with the surge line and pressuriser bowl empty, with the plant at mid-loop.
- Weld layers #10 to #13 (4 layers) with the surge line and pressuriser bowl filled i.e., when the plant had returned from Mid-Loop (note that due to a mid-project review of doses and dose rates, an ALARA justification was made to undertake this work with the pressuriser bowl empty).

15.19 Radiation dose control performance was excellent; the project was delivered for just under 113 man.mSv (45 % of the estimate). Some of the difference against the original estimate can be attributed to the assumptions made for worker positioning under the pressuriser, where a conservative position was used with a higher radiation dose rate compared to the actual position where workers were able to stand lower down and in a lower dose rate.

15.20 There was a clear benefit from pre-outage mock-up training, the installation of additional shielding such as the flexible tungsten segments on the spray line, and the use of the suite of remote monitoring tools such as cameras and teledosimetry. There was a positive working relationship between the vendor and the RP team with a good focus on worker doses and performance, ensuring individual doses were balanced and minimised across the operatives in the field.

15.21 Up to 2019, most of the dose on EDF Energy NGL sites related to reactor vessel entry work that was largely undertaken by contract staff. No further vessel entry campaigns are anticipated. In 2020 doses were lower as work was deferred due to the Covid-19 pandemic. In 2021 and 2023, much of the dose was related to Sizewell B outages RO18 and RO19, including the thermal sleeve replacement work. For EDF Energy NGL sites, five of which are operational sites and three of which are defuelling sites, data for all employee and contractor doses for 2018–2024 is given in figure 15.1 below.

15.22 The total collective dose to all persons working on EDF Energy NGL sites during calendar year 2024 was 0.48 person-Sv, 0.23 person-Sv to employees, and 0.26 person-Sv to contractors.

15.23 No person exceeded the statutory annual dose limit of 20 mSv specified in IRR17, nor the EDF Energy NGL dose restriction level of 10 mSv. No worker has exceeded the company dose restriction level of 10 mSv per annum since 2006.

15.24 The maximum individual dose received by an EDF Energy NGL employee in 2024 was 3.3 mSv. The maximum individual dose received by a contractor in 2024 was 4.4 mSv. In 2024, the average dose received by EDF Energy NGL employees was 0.046 mSv and by contractors was 0.038 mSv.

15.25 Electronic Personal Dosimeters (EPD) are used at all EDF Energy NGL sites as the legally approved dosimeter to make assessments of individual radiation exposure.

Figure 15.1: Doses at EDF Energy NGL Sites

Exposure Type		2018	2019	2020	2021	2022	2023	2024
Employees	Collective dose (person-mSv)	255.763	253.349	153.056	222.220	181.838	279.155	225.413
	Average dose (mSv)	0.045	0.046	0.033	0.047	0.038	0.058	0.046
	Maximum dose (mSv)	5.693	4.156	2.587	2.294	2.727	4.289	3.318
Contractors	Collective dose (person-mSv)	560.684	460.724	62.102	329.578	57.581	636.267	258.819
	Average dose (mSv)	0.065	0.061	0.011	0.053	0.009	0.088	0.038
	Maximum dose (mSv)	4.682	4.372	1.660	5.907	1.179	4.948	4.410
Total Collective Dose (person-mSv)		816.47	714.073	215.158	551.798	239.419	915.422	484.232

15.26 An example of good dose management practices is discussed below.

Sizewell B Zinc Injection

15.27 Zinc injection into the Reactor Coolant System (RCS) of Pressurised Water Reactors (PWRs) is a well-established technology for mitigation of Primary Water Stress Corrosion Cracking (PWSCC) and reduction of out-of-core dose rates.

15.28 Zinc injection at Sizewell B Power Station has been considered for many years, as detailed in numerous Nuclear Service (NS) Chemistry reports since 2013. A decision paper was approved by the Plant Health Committee (PHC) in 2020, endorsing zinc injection at Sizewell B as an appropriate technology to reduce occupational radiation exposure and provide second order mitigation to known PWSCC risks. A further report was issued by NS Chemistry

in 2023, which provides the technical recommendation that it is likely that the benefits of zinc injection will be realised at Sizewell B.

15.29 EDF is committed to complete all required plant mods, tests and commissioning activities by end of RO21 (2028) to safely start injecting zinc in cycle 22 (2028).

15.30 To connect the new equipment to the RCS, a pipework modification to tie-in to the existing Chemical Volume and Cleanup System (CVCS) pipework will be required. Monitoring of the zinc concentration in the RCS will be facilitated by sampling of reactor coolant, via the Nuclear Sampling System, and chemical analysis using new equipment to be installed in the Radiochemistry Lab as part of the project. Sampling and analysis to determine the RCS zinc concentration will continue throughout all plant operating modes and will become part of routine monitoring of the RCS chemistry. The dose benefits from zinc injection will be realised after approximately 3 cycles post commencing of zinc injection as shown from international OPEX. During this time, zinc is absorbed into the oxide layer and displaces cobalt in the RCS, which is then removed by the resin beds and filters throughout the cycles.

15.31 The CVCS mixed bed resins will be upgraded and a gamma spectrometry programme implemented. The resin upgrades and the commencing of zinc injection are intrinsically linked for the objective of reduction of dose rates, whilst gamma spectrometry is required to measure the individual effect of each task on primary circuit activity and the implied benefit to dose rates. These two aspects of the project are required to commence zinc injection and the timing and order in which they each occur is crucial to understand the baseline primary circuit activity, then the effects of resin changes and finally the effects of zinc injection.

Public doses

15.32 For the assessment of compliance with dose limits relating to members of the public, the licensee is required to derive realistic estimates of the average effective dose (and where relevant, equivalent dose) to the appropriate representative person for the expected pathways of exposure. These are submitted to ONR annually.

15.33 Arrangements to control exposures to the public from a nuclear licensed site are partly regulated through IRR17 where the licensee must take all necessary steps to restrict exposures to other persons (other than employees) SFAIRP. In addition, arrangements to optimise doses to members of the public from disposal of radioactive waste are regulated through discharge authorisations and permits under the Environmental Authorisations (Scotland) Regulations 2018 (EASR18) [35] and the Environmental Permitting (England and Wales) Regulations 2016 (EPR16) [34] respectively.

Control of exposure

Qualified experts

15.34 In the UK, the qualified expert in relation to occupational radiation protection is the Radiation Protection Adviser (RPA). At nuclear installations, the licensee is required under IRR17 to appoint and consult an RPA to provide expert advice on compliance with those regulations. HSE has published a statement [133], setting out criteria for core competences of individuals and bodies to meet in order to obtain a RPA recognition in the form of a Certificate of Core Competence from an HSE-recognised RPA Assessing Body. The purpose of the recognition procedure described in this Statement is to give employers confidence that any person or body recognised as an RPA has essential competence in giving advice on compliance with IRR17 and the applicability of REPPIR19.

15.35 The qualified expert in relation to radioactive waste management and environmental radiation protection is the Radioactive Waste Adviser (RWA). Anyone who has a relevant

permit or registration under EASR18 or EPR16 to manage radioactive waste needs to appoint a RWA. The RWA scheme was developed jointly by the Environment Agency, SEPA and the Northern Ireland Environment Agency (NIEA) with extensive stakeholder engagement. The environment agencies including NRW have published a statement [134] on RWAs.

Controlled areas

15.36 In the UK, a controlled area is an area in which specific protection measures and safety provisions are, required for controlling normal exposures or preventing the spread of contamination during normal working conditions, and preventing or limiting the extent of potential exposures. A supervised area is an area, other than a controlled area, in which occupational exposure conditions are kept under review, even though specific protection measures and safety provisions are not normally needed.

15.37 Designation of controlled or supervised areas is required by IRR17 Regulation 17. The main purpose of designating controlled areas is to help ensure that routine and potential exposures are effectively prevented or restricted. This is achieved by controlling who can enter or work in such areas, and under what conditions. Normally, controlled areas will be designated because the employer has recognised the need for people entering the area to follow special procedures to restrict exposure to ionising radiations. Regulations 19 and 20 specify requirements for designated areas to ensure that there are appropriate arrangements for control and monitoring of radioactive contamination, including contamination of workers.

15.38 Evidence from UK installations suggests that the spread of contamination beyond the boundaries of controlled areas is uncommon. This is generally achieved by applying strict controls to such activities as changing of clothing and personal monitoring at various stages within the controlled area, rather than just at the boundary between controlled and other areas.

Local rules and procedures

15.39 IRR17 Regulation 18 requires licensees to prepare written local rules to identify key working instructions intended to restrict any exposures in designated controlled or supervised areas. The local rules for a controlled area usually include arrangements for access restriction; individual dose investigation levels; contingency arrangements; identification and description of the areas covered; and confirmation of the appointed Radiation Protection Supervisor (RPS). The guidance to IRR17 [42] contains advice on the essential and optional contents for local rules. The RPS has a major role in helping to ensure that the work carried out is done so in compliance with the arrangements licensees have put in place to comply with IRR17 particularly, in supervising the arrangements set out in the local rules. The RPS does not need to have the same depth of knowledge of IRR17 as a RPA but must be suitably trained and appointed in writing by the licensee.

Protective equipment

15.40 IRR17 Regulations 10 and 11 require licensees to ensure that any personal protective equipment provided pursuant to Regulation 9 is appropriate and that it is subject to routine examination and maintenance. Licensees are also required, under Regulation 15, to ensure that appropriate information, instruction, and training are provided to workers who use personal protective equipment. To meet the personal protective equipment requirements in IRR17, licensees have developed their own arrangements to ensure compliance. ONR checks that the requirements are met as part of its inspection programme. HSE has published guidance on the use and maintenance of respiratory equipment [135].

Environmental discharges and monitoring

15.41 Nuclear installations require permits to dispose of radioactive waste, whether by discharge directly to the environment, or by burial, incineration, or transfer of waste off-site. Permits:

- Specify the disposal routes to be used and place limits and conditions on disposal.
- Place a requirement to minimise:
    - Waste generation
    - The quantity of radioactivity discharged to the environment
    - The radiological effects on the environment and on members of the public to ensure that impacts are reduced to ALARA
- Require monitoring, sampling and analysis to determine compliance with authorisation conditions, reporting of the quantities of radioactive waste disposed and of non-compliance with limits.
- May specify improvements in waste management arrangements.
- Require operators to use Best Practicable Means (BPM) in Scotland or Best Available Techniques (BAT) in England and Wales to minimise discharges to reduce impacts to ALARA.

15.42 IRR17 Regulation 31 requires incidents, like the release (unless in accordance with a discharge authorisation or permit) or spillage of radioactive substances in excess of certain quantities, to be investigated. LC 34 (leakage and escape of radioactive material and radioactive waste) requires radioactive material or radioactive waste on a nuclear licensed site to be adequately controlled or contained, and that any leak or escape of such material to be notified, recorded, investigated, and reported in accordance with LC7 (incidents on the site) arrangements.

15.43 EPR16 includes the concept of BAT. This is broadly equivalent to the application of BPM and the Best Practical Environmental Option (BPEO) (as described below), with essentially the same assessment and determination processes and that deliver the equivalent level of environmental protection. Further references to BPM in this document should be interpreted as:

- BPM applied to authorisations granted under EASR 18 in Scotland
- BAT applied to permits granted under EPR16 in England and Wales

15.44 The limits on radioactive discharges are set based on the 'justified needs' of the licensees. The licensees make a case that the proposed limits are necessary to allow safe and continued operation of the plant. Licensees are required to use all reasonably practicable measures to minimise the production and disposal of radioactive waste to achieve a high standard of protection for the public and the environment. This includes a systematic and consultative decision-making process that emphasises the protection and conservation of the environment across land, air and water. The process establishes, for a given set of objectives, the option that provides the most benefit (or least damage) to the environment as a whole, at acceptable cost in both the long and short term. This option is called the best practicable environmental option. The environment agencies have published guidance for their assessment of BPEO studies at nuclear sites [136]. The Environment Agency has also published 'Radioactive Substances Regulation (RSR) – Objectives and Principles' [137].

15.45 In setting limits, the environment agencies use monitoring and discharge and plant performance data with suitable modelling. This is to ensure that the radiation exposure to the public as a consequence of the discharges would be less than the dose constraints and limits

in the UK that are established in EPR16 and EASR 18. The origin and application of these limits are discussed in Reference [138]. These dose constraints ensure that aggregated dose contributions from a nuclear installation or group of installations, along with potential doses from other sources, from all exposure pathways remain below the public dose limit of 1 mSv/year. Currently these are a:

- Source constraint of 0.3 mSv/year for an individual nuclear installation that can be optimised as an integral whole in terms of radioactive waste disposals.
- Site constraint of 0.5 mSv/year for a site comprising more than one source, for example, where two or more nuclear installations are located together.
- Dose limit of 1.0 mSv/year from all regulated sources of human-made radioactivity including the effects of past discharges but excluding medical exposure.

15.46 Gaseous and liquid discharges from each of the power stations are regulated by the environment agencies. Highlights from operating sites are shown in figure 15.2 for 2023 [139]. A summary of total doses received from NPPs between 2012 and 2023 can be found in figure 15.3.

Figure 15.2: Total Dose at Operating Nuclear Power Plants for 2023

Hartlepool, County Durham

- 'Total dose' for the representative person was 0.015mSv and increased in 2023
- Gaseous discharges of carbon-14 increased in 2023
- Liquid discharges of tritium, sulphur-35 and other radionuclides decreased in 2023

Heysham, Lancashire

- 'Total dose' for the representative person was 0.015mSv and decreased in 2023
- Liquid discharges of tritium from Heysham 1 decreased in 2023

Hinkley Point, Somerset

- 'Total dose' for the representative person was 0.032mSv and increased in 2023
- Gaseous discharges of carbon-14, sulphur-35 and argon-41 from Hinkley B decreased in 2023
- Liquid discharges of tritium from Hinkley B decreased in 2023

Hunterston, North Ayrshire

- 'Total dose' for the representative person was 0.013mSv and increased in 2023
- Gaseous discharges of argon-41 were reported as nil from Hunterston B in 2023
- Liquid discharges of plutonium-241 from Hunterston A were reported as nil and discharges of tritium and sulphur-35 from Hunterston B decreased in 2023

Sizewell, Suffolk

- 'Total dose' for the representative person was less than 0.010mSv and decreased in 2023
- Gaseous discharges carbon-14 from Sizewell B decreased in 2023

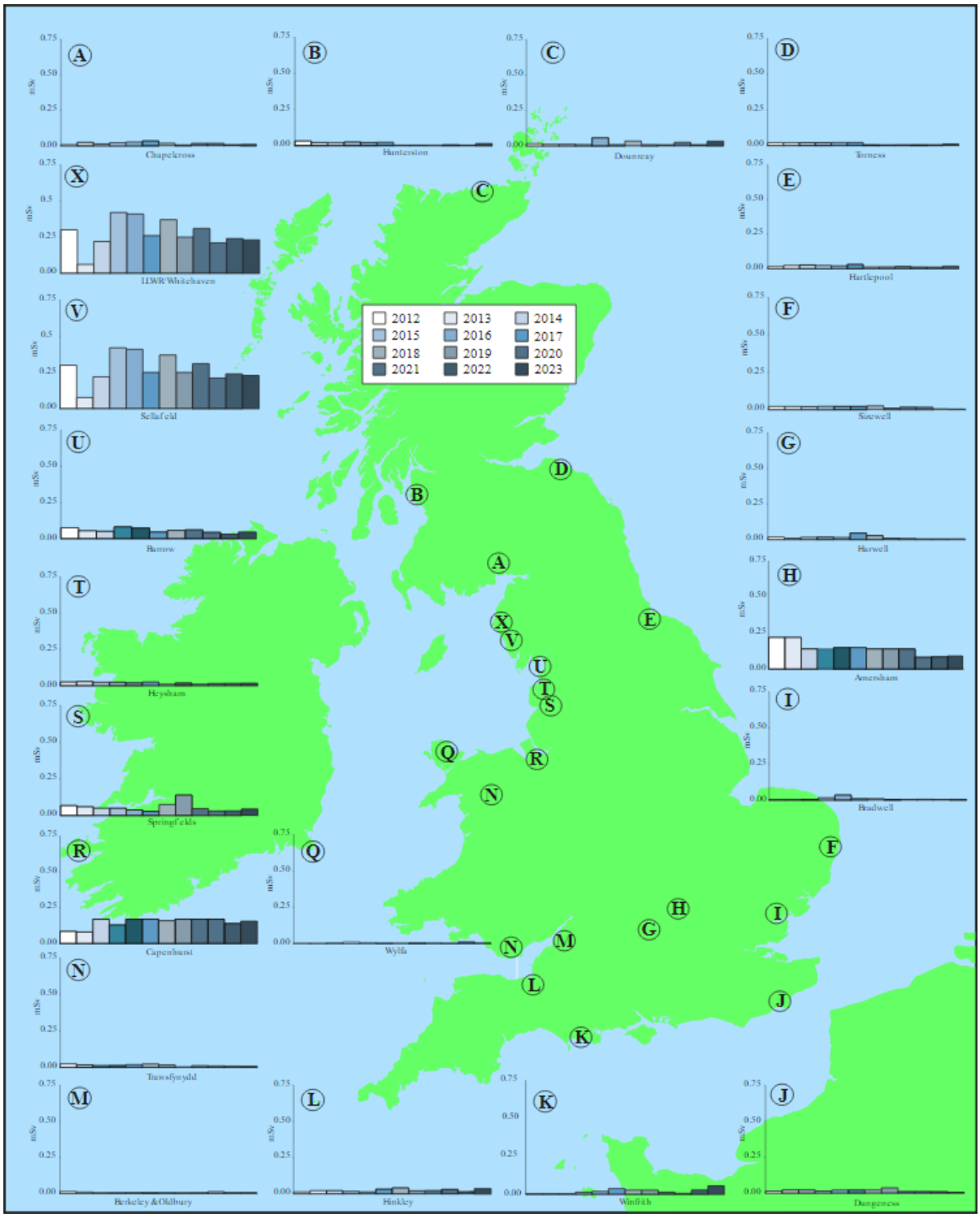
Torness, East Lothian

- 'Total dose' for the representative person was 0.007mSv and increased in 2023

Dungeness, Kent

- 'Total dose' for the representative person was 0.005mSv and decreased in 2023

Figure 15.3: Total Dose at Nuclear Power Plants, 2012–2023



Note: Small doses less than or equal to 0.005 mSv are recorded as being 0.005 mSv

Regulatory review and control of radiation exposure

15.47 ONR seeks to ensure that licensees have adequate arrangements in place to restrict exposures to ionising radiations SFAIRP in several ways. To take a view at a particular site, ONR undertakes assessments of safety cases against the SAPs and carries out inspections on site, including compliance against IRR17 and LC18 (Radiological Protection). To take a view on occupational exposure across the industry, ONR undertakes reviews across all GB nuclear sites. These are carried out in accordance with ONR guidance on IRR17 inspections [140]. This guidance was revised during 2022 and the review took into account Recommendation 14

of the 2019 IAEA Integrated Regulatory Review Service (IRRS) Mission to the UK. A further recommendation from the IRRS mission was for relevant regulators, including ONR, to establish and maintain a register of radiation generators. This recommendation was successfully closed following the development of a radiation generators register and the IRRS return visit to the UK in 2024.

15.48 To regulate doses to the public, ONR requests information on exposures (via all exposure pathways) from licensees on an annual basis. Using a sampling approach, ONR undertakes assessment of licensees' arrangements and arranges verification of off-site direct gamma and neutron dose rates through monitoring radiation levels by an independent technical support contractor.

15.49 In addition to the requirements placed on operators to monitor environmental radioactivity around their sites, the environment agencies undertake their own independent monitoring programmes, to verify doses received via other pathways. Radioactivity in surface and ground water, radiation dose rates on beaches and public occupancy areas, radioactivity in sediments, environmental material, etc. are monitored. Monitoring results are published annually.

15.50 The Food Standards Agency (FSA) [141] and Food Standards Scotland (FSS) [142] are independent government bodies set up to protect the public and consumer interests in relation to food. The environment agencies the FSA and FSS publish a joint report annually on Radioactivity in Food and the Environment (RIFE) in the UK, which also includes estimated doses to the public. The most recent RIFE report was published in 2023, [139]. Monitoring over recent years has confirmed that, in terms of radioactive contamination, terrestrial foodstuffs and seafood produced in and around the UK are safe to eat. Exposure of consumers to artificially produced radioactivity via the food chain remains well below the UK public dose limit of 1 mSv/year. In addition, the exposures of members of the public from all pathways resulting from aerial and liquid discharges and exposure to direct radiation from nuclear licensed sites remain below the dose limit of 1 mSv/year.

Summary of significant changes since previous report

15.51 During the reporting period, developments under this Article are as follows:

- In 2022, the UK completed a 5-yearly statutory post-implementation review of the IRR 2017 legislation. This was conducted in order to review whether the legislation has met its primary objectives and not introduced unintended consequences or disproportionate regulatory burdens. The main conclusion from the review was that IRR17 fulfilled its primary objectives, remains fit for purpose, improved radiological protection and effectively minimises exposures to ionising radiation [143].

Article 16 – Emergency Preparedness

Each Contacting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.

Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

Contracting Parties which do not have a nuclear installation on their own territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.

Summary statement for article

16.1 The UK fulfils the obligations of Article 16. This article also addresses the Challenge to the UK from the joint eighth and ninth review meeting on **further consideration of potential radiological consequences arising from postulated military actions that endanger nuclear installations**. It has done so with the production of Joint Agency Modelling (JAM), and its application to the war in Ukraine through modelled predictions of radionuclide dispersion. On the basis of this activity, the UK considers that this Challenge can be closed.

16.2 This Article also provides information that relates to the major common issue of **strengthening emergency preparedness and response arrangements and fostering cross border collaboration** from the joint eighth and ninth review meeting. The UK has addressed this major common issue through its activities within the Heads of European Radiological protection Competent Authority - Working Group for Emergencies (HERCA-WGE) for Ukraine when agreeing shared knowledge and alignment of urgent protective actions in the event of a radiation emergency.

Emergency plans and programmes

UK's Regulatory requirements for emergency preparedness

16.3 All UK civil nuclear sites are licensed by ONR under the Nuclear Installations Act 1965 (NIA65) [31]. The provisions of this Act enable ONR to set requirements on licensees through Licence Conditions (LC) [13]. LC11, applicable to all licensees, requires the licensee to make and implement adequate arrangements for dealing with any accident or emergency arising on the site and its effects. REPPIR [44] also places duties on operators to make and test emergency arrangements. REPPIR requires the operator to provide ONR with details of the operator's emergency plan where requested. ONR may then scrutinise it and has a broad range of regulatory powers to ensure the emergency plan meets defined requirements. The plan must include:

- The arrangements to set emergency procedures in motion.
- The arrangements to co-ordinate the on-site mitigatory action.
- Conditions or events that could be significant in bringing about a radiation emergency, a description of the action(s) that should be taken to control the conditions or events and to limit their consequences, including a description of the safety equipment and resources available.
- The arrangements for limiting the risks to persons on the premises including how warnings are to be given and the protective actions persons are expected to take on receipt of a warning.
- The arrangements for providing early warning of the incident to the responder or responders identified in the local authority's off-site emergency plan to set the off-site emergency planning in motion, the type of information that should be contained in an initial warning and the arrangements for the provision of more detailed information as it becomes available.
- The arrangements to prioritise keeping doses within the reference levels; including what protective actions are proposed to be taken, and how far each such action extends within any detailed emergency planning zone.

16.4 In addition, REPPIR requires licensees and local authorities to co-operate in the production and implementation of their emergency arrangements. Where an off-site emergency plan is required, it must be reviewed and tested at least every three years and kept up to date in the event of any material changes.

16.5 The nuclear licenced site recommends to the local authority the minimum extent of the detailed emergency planning zone around the facility according to the hazard. A geographic boundary of the detailed emergency planning zone is then determined by the local authority, considering local geographic, demographic, and practical implementation factors such as the avoidance of bisecting local communities, inclusion of immediately adjacent vulnerable groups, and the benefits and disbenefits of protective actions.

16.6 REPPIR also requires outline planning for very low probability but high severity events that might extend significantly over a wider geographical area.

Main elements of the UK national plan

16.7 The UK's emergency response operates on the principle of subsidiarity, this emphasises the importance of local decision-making that is supported where necessary, by coordination at a higher level. Central Government's Concept of Operations (ConOps) sets out the UK arrangements for responding to and recovering from emergencies, irrespective of cause or location, requiring coordinated central government action.

16.8 Where an emergency is of a scale or complexity that some degree of central government co-ordination or support becomes necessary, a designated Lead Government Department (LGD), or where appropriate a Devolved Administration, will be made responsible for the overall management of the central government response to the incident.

16.9 The Department for Energy Security and Net Zero (DESNZ) is the LGD for managing the response to a civil nuclear emergency in England, Scotland and Wales or an overseas nuclear emergency affecting UK interests. As LGD, DESNZ is responsible for coordinating the national government response to a civil nuclear emergency, supporting local action and, if needed, directing the national response. DESNZ is also the competent authority for international reporting to the IAEA.

16.10 The UK government has three pre-defined emergency levels that are used to determine the level of central government engagement and response required. These are:

- Level 1 – Significant Emergency (broadly equivalent of IAEA INES Rating[1] 5): one that requires central government involvement or support, primarily from a LGD or a devolved administration, alongside the work of the emergency services, local authorities, and other organisations. There is, however, no actual or potential requirement that would necessitate the activation of a collective central government response.
- Level 2 – Serious Emergency (broadly equivalent of IAEA INES Rating 6): one that has, or threatens, a wide and/or prolonged impact requiring sustained central government coordination and support from several departments and agencies, usually including the regional tier in England and where appropriate, the devolved administrations. The central government response to such an emergency would be coordinated from the Cabinet Office Briefing Rooms (COBR), under the leadership of the lead government department.
- Level 3 – Catastrophic Emergency (broadly equivalent of IAEA INES Rating 7): one that has an exceptionally high and potentially widespread impact and requires immediate central government direction and support. Characteristics might include a top-down response in circumstances where the local response had been overwhelmed, or the use of emergency powers were required.

16.11 The UK uses the INES for determining the scale of nuclear incidents. This scale is broadly equivalent to UK ConOps emergency levels.

16.12 In the event of an off-site nuclear emergency in England, Scotland or Wales, the central government Emergency Operation Centre (EOC) and COBR would be activated to coordinate the response and decision-making at the national level. Central government would be supported by the Scientific Advisory Group for Emergencies (SAGE). However, the lead for the response will always remain at the local level and usually under the control of a senior police officer at the Strategic Coordinating Group (SCG) in all but the most severe events.

16.13 The UK's Devolved Administrations have a key role in supporting a response, and DESNZ would work closely with the relevant administrations. In Scotland, the Scottish Government are responsible for consequence management and recovery of the emergency within its borders and would activate the Scottish Government Resilience Room (SGoRR). In Wales the equivalent is the Emergency Coordination Centre Wales (ECCW). Northern Ireland (NI) has no nuclear installations but would support any response that affected NI following a nearby radiation emergency.

16.14 The agencies that provide a local response are located at the off-site Strategic Coordination Centre (SCC) (see figure 16.1). At this facility, the SCG's prime function is to decide on and coordinate the appropriate public protective actions to be taken off-site. The SCG ensures that the protective actions are implemented, and that authoritative information and advice is provided to the public (the facility ordinarily includes media briefing centres).

16.15 Each organisation with responsibilities within the emergency plan is represented at the SCC. These would include the operator, police, local authority, national health authority, local water company and the fire and ambulance services. Government departments and agencies would also be represented, including DESNZ (or Scottish or Welsh administrations as

[1] The INES system is a commonly understood rating system that helps to facilitate communication of safety-significant information, in the case of nuclear accidents, to the technical community, media and public.

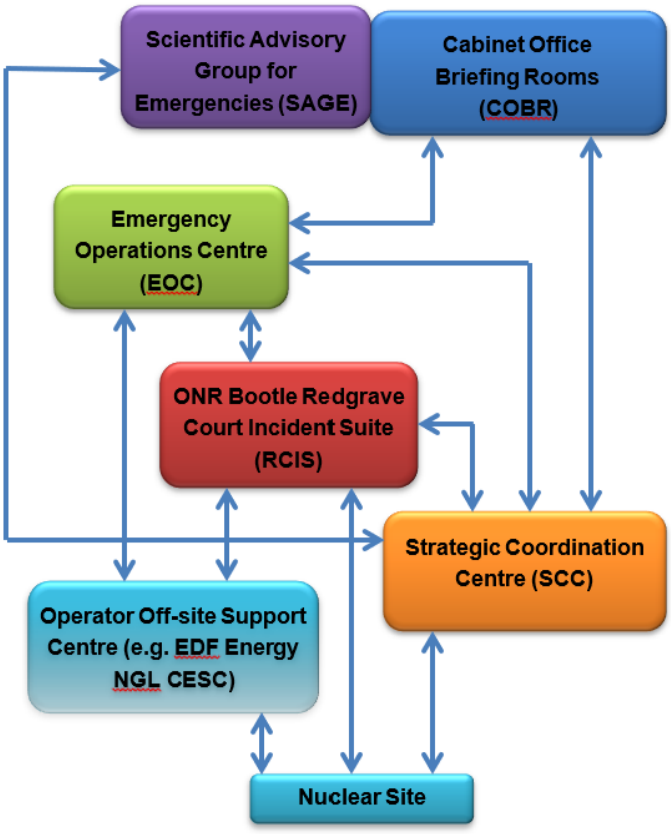
equivalents), the UK Health Security Agency (UKHSA), the relevant Food Standards Agency, the relevant environment agency and ONR.

16.16 The Scientific and Technical Advice Cell (STAC), brings together technical experts from those agencies involved in the response. The STAC provides authoritative and independent scientific and technical radiological and health protection advice for public protection to the SCG. The advice and recommendations will consider appropriate protective actions for different areas such as sheltering, evacuation, administration of stable iodine tablets, and any restrictions to be placed on food or water. In the early phases of an incident, prior to the formation of the STAC, the site operator will provide the SCG with advice on appropriate protective actions.

16.17 The operator has an important role in regaining plant control on-site and ensuring that any radiological release is minimised and terminated, whilst ensuring that personnel on the site are protected. The technical information regarding plant prognosis and radiological assessments by the licensee is an important aspect in the response to an emergency. The licensee has two roles directly related to the off-site response, to:

- Monitor the environment on and around the site for radioactivity and radiation levels.
- Provide advice to the off-site organisations on the emergency's prognosis and any protective actions that could be taken to protect the public (particularly in the early stages of an emergency). For example, sheltering, issue of stable iodine tablets, or evacuation.

Figure 16.1: UK's Emergency Arrangements Structure

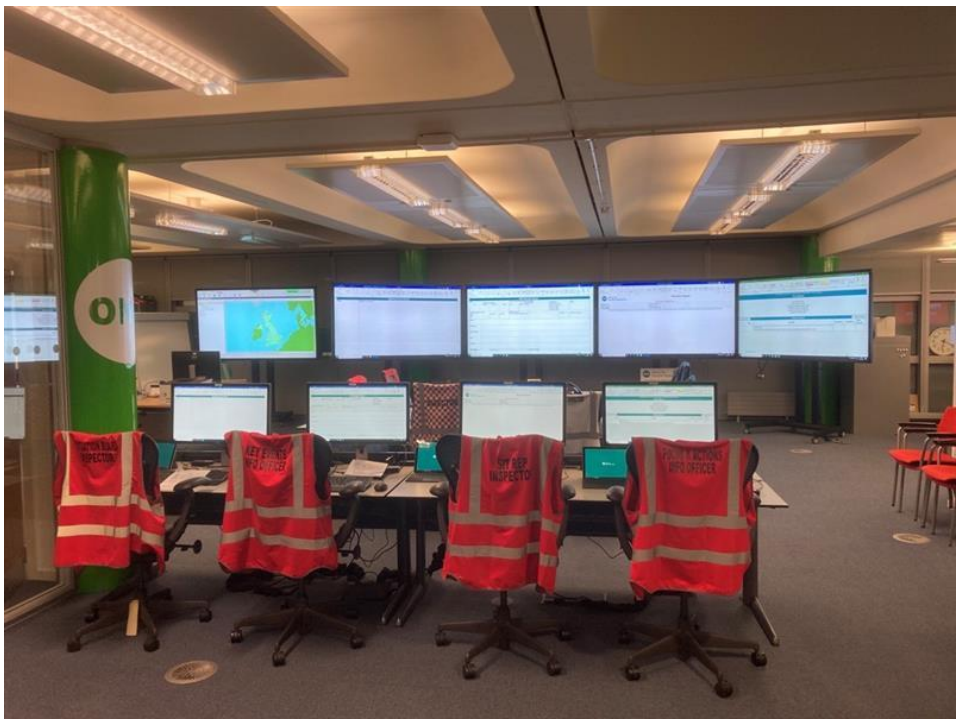


16.18 In response to the declaration of an off-site nuclear emergency at a nuclear site, ONR will independently monitor and record the operator's actions to be able to provide advice to Government and relevant authorities, and, if appropriate, undertake subsequent enforcement action. To achieve this, the Redgrave Court Incident Suite (RCIS) would be activated as ONR's

central information and communication hub, and 'away teams' will be dispatched as appropriate dependent on the nature and location of the emergency (See figure 16.2). The RCIS is maintained, exercised and ready to be activated at short notice, 24 hours a day and 365 days a year.

16.19 In the event of an overseas emergency that has implications for UK nationals, the UK has with various partner agencies developed Joint Agency Modelling (JAM). JAM is a national capability to estimate, forecast and provide expert advice on the scale and uncertainties associated with a radiological release arising from a nuclear emergency. It was developed following the Fukushima disaster and involves a range of expert bodies (ONR, UKHSA, Met Office, Environment Agency and FSA) to support and complement the decision making of SAGE for the Government. This capability may be used for various scenarios and has been used to postulate releases caused by the war in Ukraine.

Figure 16.2: ONR's emergency control room, the Redgrave Court Incident Suite



Emergency plan implementation by licence holders

16.20 All nuclear licensees are required to prepare, in consultation with local authorities, the emergency services and other organisations, emergency plans for any nuclear and non-nuclear emergency that may occur on the site. In parallel, local authorities prepare plans for the off-site response to a nuclear emergency for the protection of the public.

16.21 In the event of an emergency, trained station staff form a site emergency response organisation under the command of the Emergency Controller. This is based in emergency facilities located on the site. The Emergency Controller is responsible for initiating the emergency actions to be taken by EDF Energy NGL staff, and for ensuring the off-site organisations that have responsibility for initiating actions to protect the public are alerted. The station is permanently staffed in such a way that a site emergency response organisation can be set up immediately. Additional key station personnel are available on call.

16.22 The on-site response is supported by the EDF Energy NGL Central Emergency Support Centre (CESC). It provides for the off-site support for a Nuclear Power Plant (NPP) in an emergency. Command, technical and health physics support teams are available at short

notice during working hours and within an hour out of hours. The technical team helps to understand the situation on the site and provides advice on how to rectify the situation and on the release prognosis. The CESC also takes responsibility for the onward transmission of monitoring results and the outcome of radiological assessments to external agencies such as the SCC.

Deployable back-up equipment

16.23 EDF Energy NGL maintains a comprehensive array of deployable back-up equipment (DBUE) and a large fleet of emergency response vehicles for people and equipment transportation. Sets of DBUE have been situated at strategically selected locations in the UK.

Training and exercises

16.24 EDF Energy NGL performs a regular programme of emergency exercises to test its procedures, facilities, systems and equipment. This enables everyone to practise their role in an emergency and provides an opportunity for learning/continuous improvement of the emergency plan. Emergency exercises are also the main way that EDF Energy NGL demonstrates the effectiveness of its emergency arrangements to the regulator and external agencies.

16.25 There are three main types of regulatory exercises that have evolved in the UK nuclear industry: Level 1, Level 2 and Level 3. These regulatory exercises vary in the involvement of organisations locally and nationally.

- Level 1 – An exercise that involves all station staff, visitors and contractors and will take up to six hours to complete. This type of exercise takes place annually and demonstrates existing on-site emergency arrangements to ONR.
- Level 2 – An exercise that demonstrates how the SCC and the CESC deals with the off-site implications of an emergency. A Level 2 exercise involves the CESC, SCC, Media Briefing Centre, the emergency services, and other external organisations. It may also include some central Government involvement and will occupy at least a full working day. A desktop exercise in the site Emergency Control Centre (ECC) often drives a Level 2 exercise, and these take place every three years.
- Level 3 – An exercise that involves all the organisations in a Level 2 exercise, but also includes full central Government departmental involvement. These exercises may occur over several days and may seek to transition into the recovery phase of an emergency.

On-site exercises

16.26 Emergency response role training is an important part of these emergency exercises. It ensures each member is confident in their role and the tasks that they would be required to carry out in an emergency. Each site role has several key training modules to be completed. Each shift working team completes emergency response role training once a year as part of the training programme.

16.27 A key element in developing the emergency arrangements is through a learning culture of reviews and audits of both preparedness activities and response performance. Assessment arrangements for exercises are graded according to the scale and frequency of the exercise. For shift training exercises, assessment is completed in-house by umpires and assessors from the same station. Some training exercises are also assessed by a team of peers drawn from the fleet to observe, assess and critique the exercise performance. For the Level 1, 2 and 3 exercises EDF Energy NGL deploys an Emergency Arrangements Review Team led by the Independent Nuclear Assurance function. This allows actions to be prioritised, planned, tracked, and checked for effectiveness.

16.28 ONR oversees, makes judgements, and provides feedback on the adequacy of Level 1 exercises. As a minimum, each shift will take part in a site exercise every year when all the elements of the emergency organisation are practised. Over time the site exercises test all aspects of the approved site emergency plans, such as minimum personnel levels and common mode failure events with the potential to affect adjacent sites. The worst scenario that will be routinely exercised is based on an event that results in the loss of all on-site power and cooling to the reactors. The worst scenario exercise serves to demonstrate the severe accident management procedures for the site.

16.29 ONR oversees the exercise, the post-exercise debrief, reviews the report of the exercises, and ensures that any issues identified by the exercise are addressed. If ONR considers that aspects of the demonstration are inadequate, a repeat of all or part of the arrangements is required. Level 1 exercises undertaken during the reporting period are listed in figure 16.3.

Figure 16.3: Level 1 or LC11 exercises completed from April 2022 to 31 March 2025

Site	2022	2023	2024/2025
Hartlepool	30 November 2022	4 October 2023	11 December 2024
Heysham 1	8 August 2022	24 January 2023	7 February 2024 19 March 2025
Heysham 2	30 June 2022	8 February 2023	31 May 2024
Hinkley Point B	11 October 2022	21 June 2023	18 July 2024
Hunterston B	14 December 2022	26 July 2023	27 March 2024
Sizewell B	13 September 2022	26 June 2023	15 July 2024
Torness	4 October 2022	4 April 2023	28 February 2024
Dungeness B	25 May 2022	26 April 2023	1 May 2024

Off-site exercises

16.30 Level 2 exercises are delivered by the local authority and are aimed primarily at demonstrating the adequacy of the arrangements to deal with the off-site aspects of the emergency; particularly the functioning of the SCC, where organisations with responsibilities within the relevant off-site emergency plan exercise their functions. Level 2 exercises are performed for each nuclear site at least once every three years and can be performed as a series of modular tests rather than as a single test.

16.31 Training for the SCC participants is provided by their organisations to ensure they can carry out their role effectively. The local authorities are encouraged to perform challenging exercises that address a variety of scenarios at a national level.

16.32 ONR assesses all Level 2 emergency exercises and provides feedback on the adequacy of the implementation on the off-site plan. All organisations that participate in tests of emergency arrangements co-operate to identify improvements; these are recorded within a report of each exercise that is written either by the operator (for Level 1 exercises) or the relevant local authority (for Level 2 exercises). ONR ensures that any corrective actions are

implemented following the exercise through inspections or assessment of subsequent exercises. Figure 16.4 lists all the Level 2 Exercises that have taken place in the UK since the UK's ninth NR.

16.33 Level 3 exercises test not only the functioning of the SCC but also the wider involvement of central government. This includes the exercising of the various government departments and agencies attending the EOC and COBR in London, the SGoRR (for Scotland) in Edinburgh, and the ECCW (for Wales) in Cardiff. Aspects of DESNZ's international liaison arrangements including the process on notification of potentially affected neighbouring countries are also tested during the Level 3 exercises.

Figure 16.4: Level 2 Exercises from April 2022 to March 2025

NPP Site	Exercise Name	Date
Hartlepool	Hydra	08 May 2022
Torness	Centaurus	09 June 2022
Sizewell B	Eagle	20 July 2022
Hunterston B	Indus	11 October 2022
Heysham 1 & 2	Lupin	31 January 2023
Torness	Puma	19 June 2024
Hinkley Point B	Jaguar	10 September 2024
Dungeness B	Firecrest	26 September 2024

16.34 The national level Lessons Learned Working Group reviews feedback from Level 2/3 exercises and collates, prioritises, and oversees the implementation of a range of improvements that are relevant across the UK. In recent years, the following actions have been taken because of lessons learned reviews:

- A review of the process by which Scientific and Technical Advice is developed and shared.
- Inclusion of real or realistic weather patterns in exercise scenarios where possible.

16.35 Additionally, local authorities that have responsibility for planning for civil nuclear emergencies meet biannually to solve common issues and share best practice under the Local Authorities Nuclear Working Group.

Measures to Enhance Emergency Preparedness Programmes

16.36 The updated REPPIR regulations came into force in the UK in 2019 and ensure that:

- Arrangements are sufficiently flexible to respond to very low probability events
- Arrangements are commensurate with the range of hazards for each facility
- Methods for determining planning zones are consistent and transparent
- There is co-operation between all organisations involved in emergency planning throughout the planning and testing review cycle

- There is continuous improvement in the production and implementation of emergency plans by requiring on-going review and implementation of learning from exercises

16.37 In addition, the new regulations bring into use emergency reference levels, which optimise radiological protection for the public

16.38 An Approved Code of Practice and Guidance was published in 2019 that assists dutyholders in complying with the new regulations.

International engagement on emergency preparedness and response

16.39 The UK Government and agencies continue to take an active and collaborative role within both European and international emergency preparedness and response activities with the aims of learning, sharing and influencing best practice both within the UK and elsewhere.

16.40 UK agencies contribute to:

- The IAEA Commission on Safety Standards, including the IAEA's Radiation Safety Standards Committee (RASSC) and Emergency Planning and Response Standards Committee (EPReSC). The UK also participates in the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE), the Response and Assistance Network (EPR–RANET), and Modelling and Data for Radiological Impact Assessments (MODARIA).
- The Heads of European Radiological protection Competent Authority (HERCA) Board of Heads and the Working Group on Radiation Emergencies (HERCA -WGE).
- WENRA, the European Radiological Data Exchange Platform (EURDEP), the EU platform on preparedness for nuclear and radiological emergency response and recovery (NERIS) and the OECD NEA Working Party on Nuclear Energy Matters (WPNEM).
- Since the end of the UK EU exit transition period on 31 December 2020, the UK is no longer part of the European Community's European Nuclear Safety Regulators Group (ENSREG), Urgent Radiological Information Exchange (ECURIE) arrangements or Article 31 Advisory Group (who advises on radiation protection issues, including Basic Safety Standards and Emergency Preparedness and Response). On 12 May 2021, the UK government accepted the invitation for representatives of ONR to become an observer of the ENSREG [144] and the Article 31 Advisory Group.

16.41 Representatives of the UK have acted as the Chair for the HERCA-WGE Task Force Ukraine. This Task Force aided in the delivery of consolidated urgent protective actions information sheets for affected countries near to Ukraine where postulated radiological consequences could have cross-border public protection challenges. This was to enable common cross-border public protection decisions should a nuclear emergency propagated by the war in Ukraine affect multiple states.

Provision of prior information to the public

16.42 REPPIR provides a legal basis for the supply of information prior to a radiation emergency to members of the public who may be affected by such an event. The local authority must provide members of the public within a detailed emergency planning zone who would be at risk from a radiation emergency, with certain prescribed information at least every three years that explains what to do in the event of a radiation emergency. The local authority must also make the information available to the wider public, including people within any

outline planning zone. Each licensee also has local liaison arrangements that regularly provide links with the public in the vicinity of the site.

Information in the event of a radiation emergency

16.43 REPPIR requires local authorities to prepare and keep up-to-date arrangements that ensure that members of the public affected by a nuclear emergency receive prompt and appropriate information in the event of a radiation emergency. While the agencies involved in responding to the emergency would seek to deal with any queries they received, the main channel of communication with the public outside the immediate vicinity of the affected site would be through various media methods and channels.

16.44 In addition, the various information services of the local organisations involved, and of central government, together with the news media, are available to help inform the public of the facts and of the assessments being made during the nuclear emergency.

16.45 Government agencies will communicate by using an on-line real time platform to ensure that all organisations are aware of the latest developments so that standardised messages are issued to the public.

Recovery

16.46 The duration and extent of an emergency would primarily depend on the scale and nature of the radioactive release. Once the release had terminated, ground contamination would be monitored, and the police, following public health advice, would advise those who had been evacuated when they could return home. At this stage, the acute phase of the emergency condition would be officially terminated, but the return to completely normal conditions might take place over time. Following an emergency, the Recovery Working Group (RWG) is set up at the SCC to plan for, and oversee the actions taken to return to normal conditions in a safe way. The RWG works closely and in tandem with the SCG to ensure consistency of public protection in the days and weeks following an emergency.

International notifications

16.47 For an emergency at a nuclear installation in the UK, DESNZ is responsible for notifying other countries and initiate requests for international assistance. Under existing early notification conventions, DESNZ would inform the IAEA United System for Information Exchange in Incidents and Emergencies (USIE), and countries with which the UK has bilateral agreements and arrangements, providing information about the accident and its likely impact.

16.48 The UK has trained International Liaison Officers who support the notification and information sharing requirements under the Convention. These officers regularly take part in IAEA ConvEx exercises. The UK also uses the INES as the classification and notification system for safety significant events involving sources of radiation. DESNZ has appointed ONR as the UK INES National Officer.

16.49 The UK takes part in internationally coordinated emergency exercises with other countries to test the emergency arrangements, should there be a nuclear emergency in another country that has the potential to affect the UK.

Response to emergencies outside the UK

16.50 DESNZ is the LGD for coordinating the response to an overseas nuclear emergency and is the competent authority for international reporting to the IAEA. The UK is a signatory of the IAEA Convention on Early Notification of a Nuclear Accident and the IAEA Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. With reference to the Convention of Early Notification, the UK has signed several international agreements covering the exchange of information in the event of a nuclear emergency. The UK is a member of

IAEA's global assistance mechanism, the Response and Assistance Network (RANET) to support the provision of assistance in the event of a nuclear or radiological emergency.

16.51 The UK has national arrangements in place to respond to an overseas nuclear emergency, which will be implemented by DESNZ, with support from other agencies. The UK operates a 24-7 capability of contact arrangements and duty officers to ensure that the UK can be notified of an emergency at any time. DESNZ maintains its Emergency Operations Centre containing the equipment required for management of the response. DESNZ has established procedures including the notification and alert of organisations within the UK with responsibilities for dealing with an overseas nuclear accident. In an event, with direct impacts on the UK, DESNZ as the LGD will support COBR in delivering its response.

16.52 The UK's response is supported by the Radiological Response Emergency Management System (RREMS). RREMS is the UK's national radiation monitoring and information management platform. RREMS has a nationwide network of gamma dose rate monitors; this includes fixed and mobile monitoring capability. The RREMS database may also be used by approved data suppliers to hold and disseminate measurements of measured environmental concentrations. RREMS is a key part of the UK's emergency response capability and supports the UK's international obligations for monitoring, early warning and information sharing in the event of a nuclear emergency overseas.

Summary of responses to applicable challenges

16.53 Challenge 1 from the joint eighth and ninth review meeting invited that the UK to consider potential radiological consequences because of military action endangering nuclear installations. The implementation of JAM (see paragraph 16.19) has ensured that the UK can postulate radiological consequences, for a variety of scenarios, of nuclear installations across the world that could endanger UK citizens and the wider public.

16.54 As further part of Challenge 1, the UK was also asked how they would manage trans-border effects of these postulated radiological consequences. The UK acted as the Chair for the HERCA-WGE Task Force and enabled urgent protective action methodology sharing (see paragraph 16.41) so that an agreed public protection strategy could be reached for these cross-border situations.

Summary of other significant changes since previous report

16.55 During the reporting period, developments under this Article are as follows:

- In 2024 the UK completed a 5-yearly statutory post-implementation review of the REPPIR 2019 legislation [44]. This was conducted in order to review whether the legislation has met its primary objectives and not introduced unintended consequences or disproportionate regulatory burdens. The main conclusions from the review was that the current legislation fulfilled its primary purpose, that REPPIR19 remains fit for purpose and has identified some improvements that may be considered in the future.

Notable achievements

16.56 **UK Emergency Preparedness (Joint Agency Modelling) Capability development:** As discussed in paragraph 16.19, UK developed a modelling capability known as 'Joint Agency Modelling' (JAM). JAM postulates radiological consequences of events affecting nuclear facilities to enable guidance on appropriate urgent protective actions for the protection of UK citizens. The JAM capability supports the decision making at a national level by generating 24/7 impact modelling for nuclear accidents. It does this through estimating radiological release impacts on UK public health, the environment, food stuffs and water

sources, all against specified thresholds. This capability provides an agreed process through which subject matter experts can deliver a consensus of guidance for the governments Scientific Advisory Group for Emergencies (SAGE) for UK public or overseas citizen protection.

16.57 In response the conflict in Ukraine the JAM partners were able to produce postulated radiological release plumes for three variations of an emergency. These three variants reflected differing scenarios of containment at the Zaporizhzhia nuclear power plant were it to be struck by ordinance fired by the Russian military forces when still generating power. These modelling runs were produced to support the protection of both UK citizens in the region as the remit of the Foreign Commonwealth & Development Office (FCDO), but also to support the nearby countries in Europe who would also be affected by a radiological release.

Article 17 – Siting

Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

I. for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;

II. for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;

III. for re-evaluating as necessary all relevant factors referred to in sub-paragraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;

IV. for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.

Summary statement for article

17.1 The UK fulfils the obligations of Article 17. It has arrangements in place for evaluating (and re-evaluating as required) all relevant site-related factors likely to affect the safety of a nuclear installation, the safety impact of proposed nuclear installations and for consulting other Contracting Parties in the vicinity of a proposed nuclear installations.

Evaluation of site-related factors

17.2 Proposed Nuclear Power Plants (NPPs) with a capacity of more than 50 MWe (in England) or more than 350 MWe (in Wales) are required to obtain a development consent order from the Secretary of State for the Department for Energy Security and Net Zero (DESNZ), under the Planning Act 2008 [145]. The current National Policy Statement for Nuclear Power Generation (EN-6) [146] for England and Wales sets out the policy framework within which applications for development consent will be decided for sites capable of deployment by the end of 2025 (current Scottish Government policy opposes new-build with existing fission technologies) [147]. For other activities, such as site preparation for a new nuclear power station, or construction or alteration of buildings on an existing nuclear site, planning permission may also need to be obtained from the relevant local planning authority.

17.3 In addition, to construct and operate a nuclear power station in the UK, operators must obtain and comply with the conditions attached to a nuclear site licence as required by the Nuclear Installations Act 1965 (NIA65) and any necessary environmental authorisations as required by the Environmental Permitting (England and Wales) Regulations 2016 (EPR16 – England and Wales), Environmental Authorisations (Scotland) Regulations 2018 (EASR18 – Scotland)

17.4 In this way, site-related factors relevant to the safety of a proposed nuclear installation are considered in a staged and proportionate manner: at a strategic level during development of the National Policy Statement, as material considerations within the planning process, and in detail through the licensing and permitting regimes.

17.5 The revised overarching energy National Policy Statement (EN-1) states the need for nuclear, which could be met by gigawatt-scale or small modular reactors. The Government is

currently consulting on a new National Policy Statement for England and Wales for nuclear power stations deployable after 2025 [148] ('EN-7'), following the previous consultation on a proposed approach to siting new nuclear power stations beyond 2025, which ran from January to March 2024 [149].

17.6 The safety-related factors that are considered in assessing sites cover three main aspects:

- The location and characteristics of the population around the site, and the physical factors affecting the dispersion of released radioactivity that might have implications for the radiological risk to people.
- External hazards that might preclude the use of the site for its intended purpose.
- The suitability of the site for the engineering and infrastructure requirements of the facility.

17.7 The current National Policy Statement [146] for new nuclear identified eight sites in England and Wales as potentially suitable for deployment of a nuclear power station by the end of 2025 based on a strategic assessment of sites against siting criteria. The siting criteria included matters relevant to nuclear safety including flood risk, proximity to hazardous facilities and demographics. The policy framework set out in the National Policy Statement provides that new nuclear power stations may be sited in semi-urban areas, subject to detailed examination by ONR of any proposal and specifically of the demographic criteria. The demographic criteria defining semi-urban areas are set out in ONR's land use planning guidance [150].

17.8 Factors relating to the radiological risk to people, external hazards and engineering and infrastructure requirements are considered within the licensee's safety case. The safety case is required to demonstrate that the risks presented to persons both on and off the site are both below the risk targets specified within ONR's Safety Assessment Principles (SAPs) [28] and as low as reasonably practicable (ALARP).

17.9 To support the request for a site licence for a new site, the prospective licensee must provide a safety submission to justify, amongst other things, the suitability of the site for the nuclear installation. ONR assesses this as part of the process to determine whether to grant the site licence. As with all safety case assessments, ONR uses its SAPs for nuclear facilities and associated TAGs [47] as a framework for assessing the adequacy of the licensee's application.

17.10 IAEA safety requirements for siting, as set out in 'Site Evaluation for Nuclear Installations' (NS-R-3) [151] and a wide range of supporting guidance specific to nuclear power plants, are addressed within the regulatory assessment of siting and the subsequent assessment of licensees' safety case submissions.

17.11 SAP ST.1 requires ONR to provide development control planning advice that is aligned with the government siting policy. SAPs ST.3–ST.6 set out principles relating to how the physical location of a facility can affect its safety, including local physical aspects, site suitability, effect on other hazardous installations, and interactions between facilities on multi-facility sites.

17.12 When siting the UK's existing nuclear installations, account was taken at the time of natural and man-made hazards in the area in line with relevant good practice (RGP) at the time of construction. Many external hazards, particularly earthquakes, were not considered, or considered in a way that would not meet modern standards today. The periodic safety review (PSR) process has been used extensively to capture such shortfalls on existing nuclear sites and identify practicable enhancements implemented subsequently as modifications.

17.13 The siting of future installations will consider external hazards and RGP current at that time.

17.14 ONR's SAPs set out the principles for the design of a new nuclear installation, including the need for site-specific data. SAPs EHA.1 – EHA.7 and EHA.18 – EHA.19 address the general principles of hazard analysis including identification and screening, data sources, and inputs to fault analysis. SAPs EHA.8 – EHA.17 address individual site-specific hazards. Geo-hazards (including earthquake), extreme weather (drought, high winds, and extremes of ambient temperature) and coastal flooding are examples of natural hazards that need to be considered. Manmade hazards include the possibility of an accidental aircraft crash on the site and the storage and processing of nuclear materials in the vicinity. The methods of analysis are assessed against the SAPs and subordinate ONR guidance to confirm they meet RGP or otherwise support a demonstration that site risk is ALARP.

17.15 Licensees often monitor natural phenomena at their sites; typically, this would include tide height (for coastal sites), rainfall, wind speed and seismicity. Also, licensees receive advice from government agencies responsible for weather and flood forecasting, for advice on the occurrence and location of earthquakes and for longer-term considerations, on climate change predictions.

17.16 In addition to the analysis of external hazards as initiating events that could lead to accidents, the site selection process must consider other external factors that relate to geological suitability and susceptibility to extreme weather.

17.17 ONR's SAPs ECE.4 and ECE.5 state that investigations should be carried out to determine the suitability of the natural site materials to support the foundation loadings specified for normal operation and fault conditions. The design of foundations should utilise information derived from geo-technical site investigation. The information should include ground-water conditions, contamination conditions, soil dynamic properties and any potential for liquefaction or cyclic mobility. SAP ECE.10 also specifies that the design should be such that the facility remains stable against possible changes in groundwater conditions, with consideration given to potential uncertainties due to climate change.

17.18 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (EIA17) [152] provide that development consent for a new nuclear power station cannot be granted by the Secretary of State unless an Environmental Impact Assessment (EIA) has been carried out, which includes the preparation of an environmental statement. The environmental statement must include at least:

- A description of the proposed development comprising information on the site, design, size and other relevant features of the development.
- A description of the likely significant effects of the proposed development on the environment.
- A description of any features of the proposed development, or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment.
- A description of the reasonable alternatives studied by the applicant that are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, considering the effects of the development on the environment.
- A non-technical summary of the information listed above.

17.19 The environmental statement must also include any additional information specified in Schedule 4 to the regulations relevant to the specific characteristics of the development and to the environmental features likely to be significantly affected. The information specified in Schedule 4 includes, for example, a description of the expected significant adverse effects of

the development on the environment deriving from the vulnerability of the development to risks of major accidents and/or disasters that are relevant to the project concerned.

17.20 The EIA process involves public consultation, and consultation bodies, including ONR and the relevant environment agency may make representations regarding the reliability, accuracy and/or completeness of the information provided by the applicant. The regulations also require consultation with European Economic Area States regarding developments that are likely to have significant effects on the environment in those states.

17.21 Consultation zones around nuclear installations and installations (including pipelines) that present a major accident hazard potential are maintained by ONR and the Health and Safety Executive (HSE) respectively. Arrangements within the planning process ensure that ONR and/or HSE are consulted regarding any potential developments within such consultation zones. Therefore, if planning permission was sought for a nuclear installation where the site lay within a major accident hazard consultation zone, HSE would identify and raise this matter at the planning stage. Similarly, if planning permission was sought for a major accident hazard installation within a nuclear installation consultation zone, ONR would identify and consider the external hazard potential of the proposal at the planning stage and make an appropriate representation to the relevant planning authority.

Impact of a proposed nuclear installation on individuals, society and the environment

17.22 The initial design of a nuclear power plant should minimise, so far as is reasonably practicable (SFAIRP), the radiation exposure to workers and the public. This should be addressed in the pre-construction safety report. ONR SAPs NT.1 and targets 1–3 set out guidelines for radiation exposure during normal operation. The safety case prepared by the licensee must demonstrate to ONR that these guidelines will be met. As the nuclear installation design develops, the safety case must become more developed and provide the necessary verification of the initial calculations. The Pre-Operational Safety Report (POSR) will consider all the commissioning tests and the validation of any initial assumptions. This will be reviewed during the plant's life in the PSRs required by LC15 (periodic review).

17.23 On multi-facility sites, the safety case must consider the whole site to establish that hazards from interactions between facilities have been considered (SAP ST.6).

17.24 SAPs targets 4, 6 and 8 set out targets for radiation exposure in design base fault sequences for people on and off the site.

17.25 SAPs target 9, and the associated paragraphs 752-758, address societal risk from severe accidents. This target is a measure of the societal concerns that would result from a major accident. It is based on an accident leading to an immediate or eventual 100 or more fatalities, likely to be mainly from very low doses to very large populations (that is, stochastic deaths). The target does not in itself cover directly all the factors related to societal concerns (such as environmental damage and clean-up costs) but is intended instead to be a surrogate to reflect these aspects (in addition, dutyholders' ALARP demonstrations must also include all applicable societal effects directly attributable to the accident). The safety case for a nuclear installation should identify accidents that result in source terms that could cause 100 or more fatalities.

17.26 SAP ST.3 states that the licensee should consider the topography and geology for the area that might affect the dispersion of the radioactivity discharged from the site, both in normal operation and released in the event of an accident. In addition, aspects of the topography of the area around the site that may affect the movement of people and goods are identified, and their effect on the safety of the plant examined. This examination determines whether the topography and road and rail systems are likely to create difficulties if it became

necessary to evacuate people from the area around the plant. SAP ST.3 also expects the dispersion of radioactive releases via the atmosphere, surface water and ground water and the potential exposure pathways to be considered.

17.27 Assessment by ONR would consider:

- Fundamental Principles FP.7 (emergency preparedness and response) and AM.1 (accident management and emergency preparedness) requiring that a nuclear facility should be designed and operated to ensure that it meets the needs of accident management and emergency preparedness.
- Siting principles ST.1 and ST.3 – ST.6 for new facilities and ST.3 (local physical aspects), ST.5 (effect of other hazardous installations) and ST.6 (multi-facility sites) during subsequent reviews.
- The operator's use of probabilistic safety analysis (PSA) (FA.10 – FA.14), severe accident analysis (FA.15, FA.16, and FA.25) and the assurance of the validity of data and models (AV.1 – AV.8).
- Relevant TAGs [47] that inform such assessment include: PSA, validation of computer codes and calculation methods and radiological analysis – fault conditions.

Planning and demographic controls

17.28 The UK Government maintains a policy relating to the control of population around nuclear sites. The current National Policy Statement for Nuclear Power Generation (EN-6 Vol II page 266, July 2011) [146] states:

> *'The Government has a longstanding policy regarding local demographics which would limit the radiological consequences to the public in the unlikely event of an accident involving the spread of radioactive materials beyond the site boundary. This policy is a measure of prudence over and above the stringent regulatory requirements imposed on nuclear operators in order to prevent such accidents.*
> *The Office for Nuclear Regulation administers the Government's policy on the control of population around licensed nuclear sites. The Office for Nuclear Regulation fulfils this function throughout the entire life cycle of the installation through consultation with local authorities. This ensures that until the installation is delicensed, the basis for site licensing is preserved through constraints placed on the surrounding population by controls on future development.'*

17.29 The intent of this policy is maintained in the draft of new National Policy Statement ('EN-7'), which is currently subject to public consultation [148].

17.30 Local planning authorities consult ONR regarding proposed developments close to nuclear sites that may lead to an increase in residential or non-residential populations, thus potentially impacting the arrangements within the off-site emergency plan, and/or pose an external hazard to the site. ONR also provides advice regarding local plans and neighbourhood plans, in which local authorities set out the policies that will inform their long-term development aims and allocate sites for residential, commercial and industrial development. These plans are produced by local planning authorities to secure their planning objectives and communities have direct power to develop a shared vision for their neighbourhood and shape the residential and commercial development and growth of their local area. ONR will respond to local and neighbourhood plan consultation requests by outlining the process ONR will follow at the planning application stage, and it is for those producing the plans to satisfy themselves that ONR will not advise against any development in the plans at the planning application stage before including such developments within their plans.

17.31 The National Planning Policy Framework [153] and Planning Practice Guidance on Hazardous Substances [154] (in England), Planning Policy Wales supplemented by a series of Technical Advice Notes, Welsh Government Circulars, and policy clarification letters [155] (in Wales) and Scottish Planning Policy [156] and Planning Circular 3/2015 Planning Controls for Hazardous Substances (in Scotland) [157] provide guidance on the exercise of planning control over hazardous development and over development in the vicinity of hazardous installations including nuclear installations.

17.32 ONR is specified as a statutory consultee for types of development within COMAH 2015 [38] consultation zones around certain nuclear sites (within development management procedures covering England, Wales and Scotland) [158]) and has non-statutory arrangements in place to ensure it is consulted in the case of planning applications in the vicinity of all nuclear installations where there is the potential for a radiological emergency to arise [150].

17.33 ONR requires assurances from local authorities that proposed developments in the immediate vicinity of a nuclear installation can be accommodated within their existing (or modified) emergency preparedness arrangements to satisfy REPPIR requirements.

17.34 Local planning authorities normally follow ONR's advice, recognising ONR's acknowledged expertise in assessing the risks presented by nuclear installations. When local planning authorities propose to grant planning permission against ONR advice, ONR would consider whether the decision gave rise to a serious safety concern or challenge to government policy and, where appropriate, refer the matter to the relevant Secretary of State or Scottish Minister, recommending that the application be called in for their determination.

Re-evaluation of site related factors

17.35 The licensee monitors and assesses any natural phenomena that might affect safety (for example something that may change the assumptions concerning external hazards) around each nuclear site. The PSRs described under Article 14 – Assessment and Verification of Safety include requirements that the radiological risk from the nuclear installation under review will remain acceptable during the period covered by the reviews. In addition, ONR has committed to undertaking demographic reviews every 10 years around each nuclear power station site in its land use planning guidance, based upon up-to-date population data provided by a third-party supplier [150].

Consultation with other Contracting Parties likely to be affected by the installation

17.36 The UK Government, via the environmental regulators, considers whether planned disposal of radioactive waste could result in significant radioactive contamination from the point of view of health, of water, soil or airspace of notifiable countries (transboundary radioactive contamination). This assessment takes place before an environmental authorisation is granted. Notifiable countries are EU Member States and Norway. If there are transboundary considerations, then, as appropriate, the UK will notify these countries of the environmental authorisation application so that they may participate in the public consultation [159].

17.37 The UK undertakes a broad range of information exchange to fulfil safety obligations and to promote co-operation, see Section B – Summary for further details.

Summary of significant changes since previous report

17.38 During the reporting period, developments under this Article are as follows:

- In 2022, the UK completed a 5-yearly statutory post-implementation review of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. This was conducted in order to review whether the legislation has met its primary objectives and

not introduced unintended consequences or disproportionate regulatory burdens. The PIR resulted in a recommendation to consider replacing the regulations with new regulations and a streamlined system of environmental assessment.

Article 18 – Design and Construction

Each Contracting Party shall take the appropriate steps to ensure that:

I. the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence-in-depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;

II. the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;

III. the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.

Summary statement for article

18.1 The UK fulfils the obligations of Article 18. The UK applies the internationally endorsed principle of defence-in-depth to the design and operation of its Nuclear Power Plants (NPPs) and to reducing risks where reasonably practicable; these principles are firmly embedded in the ONR Safety Assessment Principles (SAPs).

18.2 The UK also has arrangements to ensure that the technologies incorporated in the design and construction of an NPP are proven by experience or qualified by testing or analysis and that the design of a nuclear installation allows for reliable, stable and easily manageable operation. Each of these aspects are presented in this article.

Consideration of defence-in-depth

18.3 Defence-in-depth is seen as a fundamental element of nuclear safety. It is one of ONR's key engineering principles (SAP EKP.3) [28] that nuclear facilities should be designed and operated so that defence-in-depth against potentially significant faults or failures is achieved by the provision of multiple independent barriers to fault progression. It has been an expectation for all nuclear installations since the beginning of the GB reactor programme and continues to be an expectation for new build.

18.4 Defence-in-depth is generally applied in five levels, which should be, as far as practicable, independent from one another (SAPs, para 152). The methodology should ensure that if one level fails, it will be compensated for, or corrected by, the subsequent level. The aims for each level are described in detail in IAEA Safety Requirements SSR-2/1 [29] on which the levels are based. The levels are also consistent with the definitions in IAEA publication INSAG-10. The levels defined in the SAPs are identified in figure 18.1 below.

Figure 18.1: Defence-in-depth levels defined in ONR SAPs

Level	Objective	Defence/Barrier
Level 1	Prevention of abnormal operation and failures by design.	Conservative design, construction, maintenance, and operation in accordance with appropriate safety margins, engineering practices and quality levels.

Level 2	Prevention and control of abnormal operation and detection of failures.	Control, indication, alarm systems or other systems and operating procedures to prevent or minimise damage from failures.
Level 3	Control of faults within the design basis to protect against escalation to an accident.	Engineered safety features, multiple barriers and accident or fault control procedures.
Level 4	Control of severe plant conditions in which the design basis may be exceeded, including protecting against further fault escalation and mitigation of the consequences of severe accidents.	Additional measures and procedures to protect against or mitigate fault progression and for accident management.
Level 5	Mitigation of radiological consequences of significant releases of radioactive material.	Emergency control and on and offsite emergency response.

18.5 Safety cases for UK NPPs need to demonstrate how the defence-in-depth principle has been applied. Even if a safety measure is not formally claimed in Design Basis Analysis (DBA), the law requires operators and designers to do everything that is reasonably practicable to ensure that risks are reduced to ALARP. This is expected to include consideration of the effectiveness and reliability of all levels of defence-in-depth.

18.6 Relevant good practice (RGP) for design basis measures (level 3) as established in the SAPs is consistent with international guidance. For example:

- Challenges to structures, systems and components delivering a safety function should be addressed by incorporation of redundancy, diversity, and segregation (SAP EDR.2), including consideration of common cause failures (SAP EDR.3).
- No single random failure, assumed to occur anywhere within the systems provided to secure a safety function, should prevent the performance of that safety function (the single failure criterion, SAP EDR.4).
- Structures, systems, and components that are important to safety should be designed, manufactured, constructed, installed, commissioned, quality assured, maintained, tested and inspected to the appropriate codes and standards (SAP ECS.3).

18.7 The requirement to physically contain radioactive material within a nuclear facility is well established. Fault sequence analysis (SAP FA.7) should be used to demonstrate, so far as is reasonably practicable, that the correct performance of the claimed passive and active safety systems ensures that:

- None of the physical barriers to prevent the escape or relocation of a significant quantity of radioactive material is breached or, if any are, then at least one barrier remains intact and without a threat to its integrity.
- There is no release of radioactivity.
- No person receives a significant dose of radiation.

18.8 ONR's SAP AM.1 on accident management and emergency preparedness was substantially revised in response to the Fukushima accident. Licensed nuclear sites in the UK all need to comply with the requirements of LC11 to make and implement adequate

arrangements for dealing with any accident or emergency arising on the site and their subsequent effects. This includes emergency control to mitigate the radiological consequences on and off-site (Defence-In-Depth Level 5) if other design features have failed or been ineffective. A new operator needs to demonstrate it is developing appropriate arrangements before a site licence is granted.

Application of the defence-in-depth concept by licence holders

18.9 Current operating reactors incorporate defence-in-depth measures to protect against a wide range of fault conditions, whether initiated by external natural and man-made hazards, internal hazards, other internal events, or consequential combinations of these.

18.10 The Advanced Gas-cooled Reactor (AGRs) employ CO_2 gas to take away heat from the fuel elements in the reactor core. With regards to defence-in-depth, the key features of the AGR design include:

- Reactor Shutdown: Provided by the control rod primary shutdown system, and a diverse system consisting of nitrogen injection for secondary shutdown and injection of boron beads to provide long-term holddown.
- Post-trip Cooling: If the gas circulators fail, the fuel can be cooled by natural circulation providing feed water can be supplied to one boiler quadrant and sufficient gas pressure in the primary circuit. All AGRs have at least two diverse and redundant post-trip feed water systems.
- AGRs do not have a containment building around the pressure vessel. None of the design basis accidents for AGRs result in large scale fuel failure and the plant is designed to be capable of retaining the bulk of any radioactive material that might be released from the fuel. The AGRs massive concrete pressure vessel together with the large mass of graphite in the core provide hours of heat sink in case of total loss of post-trip cooling.

18.11 The UK also operates a single Westinghouse-designed four-loop PWR, located at Sizewell B. This plant also incorporates defence-in-depth measures:

- Reactivity control is achieved by the rod cluster control assemblies, which in the event of a trip fall under gravity into the core. The emergency boration system provides a diverse means of achieving reactor shutdown.
- For intact primary circuit faults, post-trip cooling can be provided by main feed water systems, backed up by the diverse auxiliary system powered by emergency diesel generators and a turbine-driven system. For loss of coolant accident faults, the emergency core cooling system provides decay heat removal by way of high and low head safety injection pumps and pressurised accumulators. The heat sink for the post-trip cooling systems is provided by the seawater-cooled essential service water system or the air-cooled reserve ultimate heat sink, powered by the diesel generators.
- The containment building limits the release of radioactivity should a beyond design basis fault occur. Heat is removed and pressure reduced by fan coolers and reactor building spray systems. The licensee is also in the process of installing a Filtered Containment Venting (FCV) system, to mitigate containment overpressure in certain severe accident scenarios.

18.12 As part of the implementation of defence-in-depth, the potential for severe accidents is considered as part of the design of the UK EPR™. Dedicated safety functions and safety features are defined and implemented to mitigate a severe accident, along with a set of procedures requiring only a limited number of operator actions. The aim of this approach is to

collect and cool molten material from the core in a core catcher, while maintaining the integrity of the containment. The Hinkley Point C and Sizewell C safety case claims that:

- Severe accidents that lead to large and/or early releases due to containment failures are practically eliminated.
- The severe accident mitigation measures enable a Severe Accidence Safe State to be established and maintained indefinitely (with sufficient heat removal and maintenance of containment integrity).

Use of engineering design principles

18.13 The key design principles that are discussed in this section have long been established as RGP in the design of nuclear power plants built in the UK. They are based upon five key principles (of which defence-in-depth - discussed above - is one). They then set-out more specific principles across a range of engineering topics and disciplines. They are written to be largely technology-neutral, applying to both NPPs and other nuclear installations, though some principles are limited to a specific type of facility in some cases. They are essential to achieve the necessary high levels of nuclear safety expected in the UK, including under fault conditions. Given the long history of nuclear engineering in the UK, the formalisation and application of these principles has evolved over time. The latest revision of ONR's SAPs captures the current RGP for these principles. They are also set out in the procedures and manuals of the nuclear power plant operators.

ONR's engineering principles

18.14 ONR's SAPs set out engineering principles (Table 2 – Example Engineering Principles from the SAPs) that have been benchmarked against IAEA and other international guidance. ONR looks for evidence of these principles being applied in the arrangements, designs and safety cases of existing and new nuclear power plant operators so far as is reasonably practicable.

Examples of the application of design principles by licence holders

18.15 The following are examples of the application of the design principles for existing AGRs and the Sizewell B PWR:

- The AGRs and Sizewell B have primary and secondary control & instrumentation (C&I) protection systems to initiate key safety functions. Redundancy, separation, and segregation are widely applied within each system, and the two systems are independent of each other. They are fail-safe and tolerant of single failures.
- The control rods on the AGRs are fail-safe, falling under gravity if necessary. There are diverse secondary and tertiary systems for achieving reactivity control.
- The rod cluster control assemblies on Sizewell B are fail-safe, falling under gravity if necessary. The emergency boration system provides a diverse means to shutdown the reactor should there be a multiple failure of the assemblies.
- For the AGRs in the event of loss of post-trip-cooling, the high thermal inertia of the core and concrete pressure vessel means that the timescale to restore cooling is long, thereby providing increased tolerance to faults.
- For post-trip cooling the AGR boilers have segregated power supplies and feedwater systems and are capable of removing the decay heat from a tripped reactor by natural circulation of the CO_2 coolant (if pressurised).

- Sizewell B has multiple methods of cooling the reactor post shutdown in normal and fault conditions, including a high level of segregation and redundancy within the systems.
- The on-site emergency generation capacity at the AGRs (either diesels or gas turbines) available in the event of a loss of off-site power is distributed around the site.
- The four essential diesel generators at Sizewell B are segregated with each unit being in its own independent cell and with the cells being in pairs in two separate buildings.

18.16 The designs for the proposed new reactors have been assessed by the regulator against the latest SAPs and relevant international good practice.

Implementation of Beyond Design Basis Design (BDB) measures

18.17 As a result of a renewed consideration of modern safety case practice (and following the events at Fukushima), several areas for further safety improvements were identified and implemented by EDF Energy NGL. The aim was to improve defence-in-depth against beyond design basis events, and hence increase the robustness of sites, in the case of prolonged loss of electrical power, ultimate (and alternative) heat sinks and containment integrity. The improvements are similar for each station although some are station specific. In general terms, the key improvements include:

- Improving the robustness of re-seal and re-pressurisation arrangements for the AGRs.
- Improved training, planning and pre-engineering in order to improve mitigation measures.
- Increasing mission time (the period throughout which a safety system can perform its intended function during a postulated event) by increasing the capacity of water and fuel storage tanks on-site.
- Maintaining the provision of off-site back-up equipment with robust deployment support, including equipment to enable water injection for cooling and emergency power generation, for lighting and C&I with improvements in deployable communications systems.
- Improvements to the resilience of AGR decay store cooling against loss of ultimate heat sink in respect of improved guidance to operators, fault recovery and understanding of credible consequences.
- Improvements to the resilience of AGR storage pond cooling and make-up against the loss of ultimate heat sink in respect of improved guidance to operators, replenishment of lost pond water and standalone pond cooling facilities having no dependence on any other station supplies or systems.
- The progressing of design work to install filtered containment venting (FCV) at Sizewell B to improve containment protection.
- Update of the Sizewell B severe accident mitigation procedure, aligned with worldwide best practice as embodied in severe accident management guidelines, including supporting training for role holders.

18.18 Design enhancements have been added to the UK EPR™, such as measures to protect the Ultimate Diesel Generators and Severe Accident batteries against flooding and the provision of an extra water supply for containment heat removal. Additional mobile equipment such as a pump to assist with containment cooling and diesel generators with identified plant connection points were added to the emergency equipment inventory. Human Factors studies

were carried out to validate that operator actions could be carried out in the required timeframes and appropriate storage requirements identified.

Implementation of measures to maintain containment integrity by licence holders

Advanced gas-cooled reactors

18.19 AGRs do not have a containment building around the pressure vessel. However, there are longer timescales available in the event of loss of post-trip cooling and the pressure vessel is a massive reinforced concrete structure. The concrete pressure vessel together with the large mass of graphite in the core provide hours of heat sink in case of total loss of cooling.

18.20 In the 1990s, a major research programme was carried out by the industry to gain an improved understanding of severe accident phenomena for the AGRs. The research yielded a considerable body of experimental data, model development and severe accident analyses. The work was used to support severe accident management strategies for scenarios with longer term loss of post-trip cooling, including use of water injection, filtered venting and preservation of the containment.

18.21 The primary design provision to prevent over-pressurisation of the AGR pressure vessels is the safety relief valves. In addition, there are blowdown routes used in normal operation to provide a route for lowering the vessel pressure. All discharge routes are fitted with filters, including particulate filters on the safety relief valves. These operate to limit particulate discharge in design basis faults.

Sizewell B pressurised water reactor

18.22 Sizewell B has some design features that would limit the occurrence of over-pressurisation of the containment, namely the large volume, provision of containment fan coolers and water spray system and, as a last resort, the reactor building fire suppression system could be used for additional cooling. The main operational provisions for preventing overpressure of the PWR containment in accident conditions are the reactor building spray system cooling train or initiation of the fire suppression sprays.

18.23 EDF Energy NGL has made a decision to implement additional resilience enhancement in severe accident scenarios by installing a filtered containment ventilation (FCV) system at Sizewell B (See Annex 4 – Safety Related Issues and Safety Upgrade Programmes for more details).

18.24 In light water reactors, generation of hydrogen may occur during severe accidents due to oxidation of Zircaloy fuel cladding, by oxidation of other metals in the corium, and molten core concrete interaction. Sizewell B has active and passive hydrogen recombiners strategically placed within the containment structure.

18.25 Sizewell B has also minimised the use of fibrous material within the containment, thereby reducing the risk of clogging of filters or strainers by debris in the event of a high energy pipe break. This is further discussed in the example below for Hinkley Point C.

Hinkley Point C EPR™

18.26 Hinkley Point C has some design features that would limit the occurrence of over-pressurisation of the containment; these include the large volume, provision of the containment heat removal system, corium spreader, annulus ventilation system and catalytic hydrogen recombiners. The containment heat removal system is made up of building sprays, passive corium cooling and corium flooding systems.

18.27 An example of a design enhancement to improve the operation of severe accident safety systems is discussed below.

Containment building fibre removal programme at Hinkley Point C

18.28 The UK EPR™ design has safety systems for protecting the fuel in case of high energy line break in the primary or secondary circuit. These systems draw cooling water from storage facilities that are part of a closed loop between the system, the reactor vessel and pipework and the reactor building. Recirculation is an integral part of the process, so care needs to be taken to avoid the introduction of uncontrolled quantities of debris into the reactor vessel and the fuel assemblies. The debris is produced as a result of the explosive nature of the high energy line break. The amount and type of debris is controlled through a combination of reducing potential debris sources and the use of filters or strainers upstream of sensitive components.

18.29 NNB GenCo, its responsible designer and its suppliers have been working on the design of the filters and on the minimisation of the potential debris sources, with the aim of providing a justifiable design that takes recognition of RGP from the UK. Fibrous debris has been shown capable of creating conditions that can reduce cooling water flow both in the reactor core and in filters. RGP therefore implies that fibrous debris should be considered a hazard that should be minimised as a primary design objective. The source of fibrous debris can be from thermal insulation and fire protection materials.

18.30 In a severe accident, although the core will have undergone a managed melt-down, there is still a concern around ensuring adequate cooling of the resulting corium. Therefore, the severe accident safety systems must be capable of ensuring the supply of adequate cooling water in the face of all potential debris quantities and types.

18.31 For Hinkley Point C, a multi-legged development and assessment programme was launched covering topics such as pipework insulation systems, HVAC design, equipment qualification, filtration, and fire protection for cables. In many instances this work has had to analyse safety aspects in light of their impact on a substantially complete design. The project has had to reconsider the traditional design approach and the use of margins within the design sequence to allow a balance to be struck between pipe support loadings, non-fibrous insulation systems and HVAC loads and between cable tray loadings and cable protection systems. In addition, the project has continued to develop a filtration system commensurate with the likely debris loadings.

18.32 The development of the safety case has continued in parallel and there are several design changes being introduced to the design including the use of non-fibrous alternatives (for example, reflective metal insulation) and fire protection systems.

Improvements as a result of deterministic and probabilistic safety analyses

Overview of main improvements since commissioning

18.33 The most recent AGRs (Heysham 2 and Torness) were the first nuclear power plants in UK to be designed with a full system engineering approach, which included a more detailed consideration of hazards as a potential common cause, with redundancy, diversity and segregation as core design principles to ensure safety. The design approach also included the benefit of PSA as well as deterministic rules for safety. As a result of defence-in-depth improvements identified in the PSA, several safety features were back-fitted to the other selected reactors at the time of the first periodic safety review (PSR). The improvements for each station were identified on a case-by-case basis, considering the design differences between the stations. The scope of changes across the AGR fleet included:

- Tertiary feed systems (high pressure and/or low-pressure backup cooling)

- Diverse guard line tripping
- Increased segregation of gas circulators
- Steam release trip systems
- Seismically qualified CO2 supplies
- Pressure vessel reseal equipment for shutdown faults
- Electrical overlay systems (diverse electrical supplies)

18.34 Improvements as a result of deterministic and probabilistic safety assessments since the last National Report are discussed in Article 6 – Existing Nuclear Installations and Annex 4 – Safety Related Issues and Safety Upgrade Programmes.

Incorporation of proven technologies

Contracting Party's arrangements and regulatory requirements

18.35 ONR SAPs state that the reliability claimed for any Structure, System or Component (SSC) should consider its novelty, experience relevant to its proposed environment, and uncertainties in operating and fault conditions, physical data and design methods (SAP ERL.1). The use of proven technology is thus one aspect contributing to the demonstrating that SSCs are suitably reliable. The required reliability is clearly linked to the safety function that the SSCs are performing.

18.36 ONR SAPs ECS.1 and ECS.2 state that safety functions should be identified and categorised based on their safety significance, and the SSCs identified to deliver those safety functions, should be classified based upon the safety function category and the significance of that SSC in delivery of the function. ONR SAPs recommend a graded approach, with three-tiers (Categories A to C for safety functions, and Classes 1 to 3 for SSCs), in line with the international RGP.

18.37 In July 2019 ONR issued its updated TAG providing guidance and expectations on categorisation of safety functions and classification of the structures, systems, and components implemented to deliver those safety functions (NS-TAST-GD-094) [160] This guidance provides expected reliability ranges for each class of SSC. This reliability is expected to be achieved by ensuring that SSCs are designed, manufactured, constructed, installed, commissioned, quality assured, maintained, tested and inspected to codes and standards appropriate to the SSC class (SAP ECS.3). It is ONR's expectation that licensees ensure that:

- appropriate nuclear industry-specific, national and international codes and standards are adopted for Class 1 and Class 2 SSCs. For Class 3, if there is no appropriate nuclear industry-specific code or standard, appropriate non-nuclear-specific codes or standards are applied instead.
- codes and standards are evaluated to determine if they are suitable and sufficient, and supplemented as necessary to a level commensurate with the importance of the safety function(s) being performed.
- the amalgamation of different codes and standards for a single aspect of a SSC is either avoided or appropriately justified to demonstrate compatibility.
- where there are no appropriate established codes or standards, an approach derived from existing codes or standards for similar equipment in similar applications is used (SAP ECS.4).

- in the absence of applicable or relevant codes and standards, the results of experience, tests, analysis, or a combination thereof, is used to demonstrate that the SCC will perform its safety function(s) to a level commensurate with its classification (SAP ECS.5).

18.38 In addition to the general requirement to demonstrate adequate SSC reliability in accordance with the safety classification, ONR SAPs also outline further expectations for the use of proven techniques and design features in specific circumstances, as follows:

- SAP EMC.14 sets the expectation that manufacture and installation of metal components and structures should use proven techniques and approved procedures to minimise the occurrence of defects.
- SAPs EMC.3 and ECE.2 set out the expectation that for the highest reliability components and structures, evidence should be provided to demonstrate that the necessary level of integrity has been achieved for the most demanding situations identified in the safety case. This includes the use of sound design concepts and proven design features, consideration of potential in-service degradation mechanisms, use of proven materials, confirmatory testing, high standards of quality management, pre-service and in-service examination, in-service monitoring, and a process for review of experience from other facilities.
- In the case of the highest reliability steel pressure vessels and pipework, a further UK regulator-specific beyond design code demonstration is required. This needs to show that the components are as defect free as possible and that they are tolerant to defects (SAP EMC.1). The approach includes the use of verified material properties and qualified non-destructive testing and is applied to the design of existing and new plant.
- SAP EQU.1 expects that a qualification procedure should confirm that SSCs will perform their required safety function(s) under the relevant operational, fault and accident conditions throughout their operational life. This is expected to include type testing to conditions equal to, at least, the most onerous for which they are designed (SAP EMT.3).

Measures taken by the licence holders to implement proven technologies

18.39 The AGRs were developed from an earlier generation of gas-cooled reactors and a prototype Advanced Gas-cooled Reactor. The AGRs themselves were typically built in sister-station pairs, with each subsequent pair attempting to learn lessons and deploy improvements identified from the preceding designs.

18.40 An important requirement for an operating facility's site licence is a requirement to perform a PSR. As part of these reviews, typically undertaken on a ten-year cycle, the operators must review their designs against modern codes and standards. Where a gap exists, they are required to consider whether it is reasonably practicable to adopt the latest codes. Over the operating lifetime of the AGRs, some significant changes have been implemented as a result of these processes. See Article 14 – Assessment and Verification of Safety for further details on PSRs.

18.41 In addition to the need to comply with applicable deterministic expectations and codes, the AGRs and Sizewell B have PSAs that establish reliability claims for structures, systems, and components. Initial assumptions for reliability need to be substantiated and then monitored throughout the operational lifetime of the equipment.

18.42 Some of the features of the AGR fleet are unique to the UK, for instance in the design of the graphite core and the boiler units internal to the pre-stressed concrete reactor vessel. The licence holder has undertaken significant research to ensure that these components and

structures remain within the envelope assumed by the safety cases for these components, and that their reliability is not reduced below the values assumed in the safety case.

18.43 In the case of the Sizewell B PWR, the licensee monitors international developments to ensure that components and structures will remain within the envelope assumed in the safety case, supplemented by their own monitoring programmes. For example, irradiation ageing affecting the reactor pressure vessel is monitored by the licensee's own surveillance programme supplemented by review of worldwide knowledge in this area.

Methods for qualification of new technologies, such as digital control and instrumentation

18.44 Before any new design or feature with potentially significant safety implications is put into service, the licensee must submit a safety case to ONR that demonstrates relevant safety principles have been achieved.

18.45 The use of safety principles provides licensees with the freedom to develop new and innovative design approaches and analysis techniques where they are beneficial to safety, rather than a more prescriptive approach that may hold back innovation.

18.46 ONR actively encourages research into new technologies and analysis techniques. One such example is the C&I nuclear industry forum to which most UK licensees subscribe. Through this consortium, research in the C&I topic area is proposed, developed, prioritised, and managed. Research projects are undertaken by a range of leading consultancies, universities, and the licensees themselves, as appropriate. ONR inspectors provide guidance on regulatory considerations, and research outcome reports are stored in a library and made available to all consortium members. The research findings, such as an approach to qualify smart devices, are used by licensees and ONR to inform decision-making.

Design for reliable, stable, and manageable operation

Arrangements and regulatory requirements for human factors and human-machine interface

18.47 The specific arrangements by which ONR enforces, and UK licensees consider human factors and human machine interfaces is described in detail under Article 12 – Human Factors and Article 11 – Financial and Human Resources (in relation to training).

18.48 ONR expects that a robust, modern-standards human factors integration process has been followed (SAP EHF.1), so far as is reasonably practicable. For new plants, determining whether a requesting party meets this expectation is part of the formal GDA process. Underpinning this is the UK legal requirement for the safety case to demonstrate that the facility risks, including those arising from human action and inaction, have been reduced SFAIRP. Where actions important to safety are claimed, it is required that the credibility of the claim be substantiated. For example, it does not make unrealistic assumptions about human performance, there is sufficient time available, it is conducted in an environment using interfaces that support operability, and it is supported by effective administrative controls.

Implementation by the dutyholders

18.49 The operating AGR fleet was not designed in accordance with modern expectations for human factors integration. Nevertheless, human factors considerations are embedded within EDF Energy NGL's safety case and PSR processes. As such, the potential impacts on human performance from modifications (to equipment or operations) are assessed and arguments are made to demonstrate that the risks are ALARP. Furthermore, any claims made on human

actions within the PSA are underpinned by appropriate human factors validation and the PSA models can be interrogated to evaluate the importance of these actions during operations.

18.50 New designs assessed for suitability for deployment within the UK have all recognised how critical human factors are when designing for the safe generation of nuclear power. They follow the latest approaches to manage the integration of human factors into the design – for example, they use formal human factors integration tools, user centred design processes, improved systematic allocation of function analysis, and sophisticated prototyping and simulation technologies to optimise the human-technology interfaces. Evidence of this can be seen in the following design attributes, which feature in the reactor types currently being assessed:

- Increased passivity and automation to reduce the cognitive and physical burden on the operator
- Interactive computer-based procedures
- Automated diagnostic systems
- Advanced core monitoring systems
- Task-based displays, which co-locate C&I necessary to perform the task
- User configurable displays
- Symptom-based diagnosis to reduce the cognitive overhead of determining the correct fault recovery response
- Improved methods for defining alarms systems, and technologies that offer improved dynamic logical capability to reduce the logic burden on the operator

Regulatory review and control

18.51 Licensees' application of defence in depth, use of design principles, implementation of design basis measures and measures to maintain containment integrity are done through the assessment and verification of safety cases.

18.52 Article 14 – Assessment and Verification of Safety explains regulatory assessment of safety submissions and verification by ONR. Taken together, these activities describe in general terms how ONR implements oversight of the measures taken by the licensee on operational sites. ONR's SAPs are used as the basis for judging the adequacy of the safety submission, which as described previously in this section, consider aspects related to implementing technologies proven by experience and qualified by testing.

Regulatory review and control for construction

18.53 In the UK, once granted a site licence by ONR, the safety of a nuclear installation is regulated principally through the conditions attached to the nuclear site licence (see Article 7 – Legislative and Regulatory Framework and Table 5 – Licence Conditions). An inspector (or team of inspectors) is allocated to the nuclear installation site before the start of construction. This means that from the start of construction, through commissioning to normal operation, and finally decommissioning, there will always be an ONR inspector (or team of inspectors) with specific responsibilities for the regulation of the nuclear licensed site.

18.54 During the construction and commissioning phases the site inspector(s) will conduct frequent inspections and discussions with the licensee, witness key tests and sample the adequacy of test reports. In addition, ONR inspectors often visit the site and key manufacturers' works to monitor the construction of components important to safety and witness quality assurance procedures.

18.55 There is a requirement to produce adequate documentation to justify the safety of the proposed facility. This is provided in a collection of documents and other evidence that collectively form the safety case; usually termed a pre-construction safety report. The production and control of the safety analysis is undertaken in accordance with the relevant company procedures required under other LCs such as LC14 (Safety Documentation).

18.56 In accordance with these arrangements the safety case evolves through the lifecycle phases of design, construction, installation, and commissioning of the new plant, with a series of staged submissions that justify safety as the project proceeds. These are called hold–points, identified to ensure that the construction or installation work is undertaken in accordance with the design specification and associated safety case. ONR may use these hold-points to exercise powers granted under the nuclear site licence to permission certain activities such as the various stages of commissioning.

Summary of significant changes since previous report

18.57 The UK has no significant changes to highlight under Article 18 during the reporting period.

Article 19 – Operation

Each Contracting Party shall take the appropriate steps to ensure that:

I. the initial authorization to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;

II. operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;

III. operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

IV. procedures are established for responding to anticipated operational occurrences and to accidents;

V. necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;

VI. incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;

VII. programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies;

VIII. the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste, directly related to the operation and on the same site as that of the nuclear installation, takes into consideration conditioning and disposal.

Summary statement for article

19.1 The UK fulfils the obligations of Article 19. It has comprehensive arrangements to ensure the safe operation of nuclear installations from initial authorisation through to decommissioning. An overview of these arrangements and regulatory requirements is presented below.

Initial authorisation

19.2 In the UK, once granted a site licence by the ONR, the safety of a nuclear installation is regulated principally through the conditions attached to the nuclear site licence (see Article 7 – Legislative and Regulatory Framework and Table 5 – Licence Conditions). ONR, through its inspection and assessment activities (see Article 14 – Assessment and Verification of Safety) judges compliance with the Licence Conditions (LC) throughout all of the lifecycle phases.

19.3 The commissioning of a nuclear installation is regulated by ONR in accordance with the requirements of LC21 (commissioning). This condition requires the licensee to make and implement adequate arrangements for the commissioning of any new or modified plant or processes that may affect safety.

19.4 Using powers under the licence, ONR may specify that the licensee shall not progress from one stage to the next without its formal agreement. ONR's agreement is dependent upon the licensee demonstrating its readiness to proceed to the next stage and that it has justified the safety of the structures, systems, and components it intends to construct, install, or commission during the stage. The intended approach for new reactors in the UK, is that ONR shall require the licensee to seek consent to commence construction. Thereafter, ONR has the option to exercise powers requiring the licensee to seek its consent to proceed between subsequent stages of construction and commissioning. The licence also gives ONR the power to direct the licensee to stop construction at any point it may judge to be necessary.

19.5 Prior to commencing commissioning, ONR expects the licensee to update the Pre-Construction Safety Report (PCSR) that provided the basis for proceeding with construction, to reflect the plant as built – including modifications to the initial design, or those made during construction. This updated report, referred to as the Pre-Commissioning Safety Report (PCmSR), provides the basis for commencing commissioning. The commissioning programme required under LC21 is produced by the licensee to ensure that all systems important to safety are tested to demonstrate that the plant complies with the design intent and is ready for operation. A comprehensive test and commissioning programme also allows for the detection of any unintended or undesirable modes of operation that the initial design had not anticipated.

19.6 LC21 requires a suitably qualified person or persons to be appointed to control, witness, record and assess the result of the commissioning tests. Full and accurate records must be kept for the commissioning programme. In addition to plant hardware, key management functions are established prior to commissioning and are tested during the commissioning process. LC23 (operating rules) requires operating limits to be derived from the safety cases, and these in turn define the safe operating envelope of the plant and provide the basis for operating rules and operating procedures. These are tested as part of the commissioning programme. Any changes to the plant or procedures found to be necessary during the commissioning process are implemented under the arrangements established under LC21.

19.7 ONR targets its inspections and assessments to ensure that the licensee's arrangements are robust, with the objective of preventing accidents throughout the lifetime of the reactors, including all stages in the commissioning leading up to normal operation.

19.8 Two EPR™ reactors are currently under construction at Hinkley Point C. The next major safety report for Hinkley Point C will be the PCmSR, to support active commissioning. Two further EPR™ reactors are planned at Sizewell C, which will develop a PCSR prior to the start of construction.

Operational limits and conditions

19.9 The following sections discuss operational limits and conditions for the UK's fleet of operating reactors. (Operational limits and conditions are not yet applicable to Hinkley Point C and Sizewell C as these stations are still under construction).

19.10 LC23 requires the licensee to produce an adequate safety case to demonstrate the safety of a plant and to identify the conditions and limits that are necessary in the interests of safety. The safety case limits are the measurable plant parameters that define the envelope for safe operation, and the conditions (plant configurations, availability, and operator actions) necessary to keep the plant within this envelope. These limits and conditions are referred to as the operating rules.

19.11 EDF Energy NGL, through its safety cases, defines a safe operating envelope via a set of operational parameters, within which the power station is required to operate. This envelope represents a bounding condition from which fault transients can be assumed to start.

19.12 Technical specifications are used to ensure that the station is always operated within the safe operating envelope. The limiting conditions expressed in the technical specifications often contain additional margins over and above the bounding conditions that are assumed in the transient analysis. The basis of the justification for the limiting conditions is explained in technical specification commentaries, which outlines the requirement for the limit and reference the relevant safety case documentation.

19.13 In addition, the technical specifications also address pre-fault safety system and safety-related system availability and performance. These limits and conditions represent assumptions that are made in the safety case about the availability and reliability of lines of protection for each essential safety function. Technical specifications and comprehensive safety case documentation are available to all staff via the company's document management system. Controlled paper copies are maintained in control rooms.

19.14 EDF Energy NGL has an accredited training programme based on a systematic approach to the identification and fulfilment of training requirements. This ensures that all members of staff whose duties require an understanding of the technical specifications and the underlying safety case reasons behind the contained limits and conditions, receive appropriate training.

19.15 Revisions to the technical specifications are controlled through the company's 'Maintain Design Integrity' process, which includes specific authorisations for role holders and a risk-assessment based grading of the significance of changes. For the more significant changes, independent assessment by the company's internal regulator, the Nuclear Safety Committees and ONR is required.

Procedures for operation, maintenance, inspection, and testing

19.16 LC24 (operating instructions) requires the licensee to ensure that all safety related operations are undertaken in accordance with written instructions. These instructions include the implementation of the operational limits and conditions identified in the safety analysis or safety case.

19.17 The licensee has procedures and instructions for the operation and maintenance of the reactors that describe the process by which these essential activities are managed and executed on all reactor sites, outlining interactions and dependencies on other defined processes. The documents set out the standards and expectations that underpin the sustained delivery of safe, reliable generation based on identified best practices from WANO and INPO.

19.18 All operating, maintenance, inspection and testing procedures and associated documentation are available electronically to all power station staff. These procedures form an essential element of the overall management system at the site and within the broader arrangements within EDF Energy NGL's corporate centre. Comprehensive paper copies of the technical specifications, operating procedures and instructions are provided in the reactor control room and the emergency control centre. These are also supplemented by station operating instructions that cover all the reactor evolutions including start-up, de-loading, normal operation and fault conditions.

19.19 EDF Energy NGL's maintenance and inspection arrangements ensure that effective preventive maintenance tasks are performed in accordance with established procedures on the correct equipment at the appropriate time, to achieve high reliability and availability of the plant. The core elements of these procedures are the identification of important nuclear safety components that have a significant impact on safety, reliability and generation. These are subject to a preventive maintenance review, based upon reliability centred maintenance, to determine applicable and effective maintenance tasks.

19.20 EDF Energy NGL's arrangements ensure that all relevant staff at the power stations are fully involved in the development of procedures required for safe operation, maintenance, inspection, and testing. Through the use and implementation of all procedures, the station staff are also able to feedback any suggested improvements that will be considered as part of the regular review of all operating and maintenance procedures.

19.21 LC28 (examination, inspection, maintenance, and testing) requires licensees to make and implement arrangements for the regular and systematic examination, inspection, maintenance and testing of all plant that may affect safety.

19.22 This work is set out in a maintenance schedule that details the scope and frequency of maintenance. This schedule identifies those examinations, inspections, maintenance, and tests that are required to demonstrate the continued ability of the plant to meet claims in the safety case. The intervals between maintenance schedule activities are determined by the safety case, operational experience, engineering judgement and manufacturers' recommendations.

19.23 The work is carried out in accordance with procedures by suitably qualified and experienced persons, under the control and supervision of an appropriate person specifically appointed for that task, who must sign a full and accurate report on completion of the work. Any examination, inspection, maintenance, or test that indicates that the safety of the plant may be affected is reported to the licensee, who takes appropriate action. Any deferrals of the defined maintenance tasks are subject to the same rigorous process EDF Energy NGL has defined for modifications to plant and safety cases, as required under the LC for maintenance.

19.24 The licensees' overall EIMT strategies are to ensure that their nuclear installations are kept within the safety case and in accordance with overall requirements for their designs. Safety objectives of these overall strategies include:

- That the integrity of all safety-related plant meets plant operating conditions
- That the reliability of plant remains within safety case assumptions
- That plant operation within safety case assumptions can be demonstrated
- That sufficient safety-related plant is always available to comply with the safety case

19.25 As part of its on-site activities, ONR inspectors ensure that all operations, maintenance, and inspections are carried out in compliance with the station's procedures.

Other requirements for examination, inspection, maintenance, and testing

19.26 In addition to LC28, there are several regulations made under the Health and Safety at Work Act 1974 (HSWA74) that, while not specific to nuclear licensed sites, make an important contribution to safety on those sites.

19.27 The Pressure Systems Safety Regulations 2000 (PSSR) place duties on the owner/user of pressure systems (including nuclear site licensees) to have them examined at suitable intervals, as identified within a Written Scheme of Examination. The aim of such examinations is to assist in minimising the risk of danger to persons from the release of stored energy or the scalding effects of steam.

19.28 The regulations allow for the postponement of such an examination, provided certain conditions are met. However, the regulations do not allow for an extension to an existing postponement, otherwise referred to as a 2nd postponement.

19.29 The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER) place similar obligations on dutyholders with respect to the owners/users of lifting equipment. In addition, the Regulatory Reform (Fire Safety) Order 2005 and the Fire (Scotland) Act 2005 place obligations with respect to the management of fire risk assessments and maintenance of fire protection equipment in England/Wales and Scotland, respectively.

Periodic shutdown

19.30 All UK operating nuclear reactors are required to shutdown at specified intervals for inspection and testing. These periodic shutdowns required under LC30 (periodic shutdowns) occur every 18 months for Sizewell B and three years for the Advanced Gas-cooled Reactors (AGRs). Once shutdown, the reactor cannot be restarted without the formal consent of ONR. Prior to issuing a consent, ONR needs to be satisfied that all necessary maintenance, inspection, and testing has been completed, that the licensee has fully evaluated its findings and that the safety case remains valid. This evaluation may identify any necessary changes to the type and frequency of maintenance, inspection, and testing.

19.31 To justify operation until the next identified shutdown, the licensee is required to carry out analyses to predict that failures due to ageing processes, such as creep or fatigue, are unlikely in the defined next period of operation. Non-destructive testing, sample testing monitoring, plant inspection results and any modifications completed during the outage are used widely to support these analyses.

Procedures for responding to operational occurrences and accidents

19.32 The information in this Article is directly related to the major common issue on **strengthening emergency preparedness and response arrangements** from the joint eighth and ninth review meeting.

19.33 After an operational occurrence the plant protection system will ensure that the plant is brought back into a safe state. The safety case identifies a range of fault conditions that will generate plant alarms for operator action or automatic response. The operating instructions and emergency operating procedures, required by the LC for operating instructions, identify the necessary operator actions. Fault conditions are addressed by providing strategies and guidelines to help operators decide on their emergency response. The administrative process for development of emergency operating procedures is the same as the process for other operating procedures described above.

19.34 All the EDF Energy NGL reactors have procedures contained in the station operating instructions, for responding to alarms (actions on receipt of alarms) and reactor trips (known elsewhere as emergency operating procedures).

19.35 For the AGRs, if the reactor does not respond as per the operating instructions or the sequence progresses further, then the licensee must use a series of documents called Symptom-Based Emergency Response Guidelines (SBERGs), which are aimed at the prevention of an uncontrolled release. They are, therefore, concerned with shutting the reactor down and maintaining adequate post-trip cooling. If recovery actions within the guidelines are unsuccessful, or plant/core damage occurs for any other reason, further guidance is given in the AGR Severe Accident Guidelines (SAGs).

19.36 For Sizewell B, symptom-based procedures, and guidance to manage a severe accident (equivalent to severe accident management guidelines) are contained within the station operation instructions.

19.37 ONR's SAPs [28] outline the expectation that licensees should analyse those fault sequences beyond the design basis that have a potential to lead to severe accidents. These analyses should determine the magnitude and radiological consequences of such an accident and demonstrate that there is not a sudden escalation of consequences just beyond the design basis. These analyses should inform preparation of accident mitigation strategies and emergency plans.

19.38 Following Fukushima, EDF Energy NGL has undertaken an extensive work programme leading to a revision of both the severe accident guidelines and symptom-based emergency

response guidelines. This was informed by the development of a level 2 PSA for the AGRs. EDF Energy NGL continues to assess its ongoing emergency arrangements based on the AGR fleet moving from generation to defuelling.

19.39 Sizewell B has completed a similar exercise resulting in updated Living Probabilistic Safety Analyses and associated operating documentation. In addition, recognising the aspiration to extend the life of Sizewell B, EDF Energy NGL is progressing the installation of filtered containment venting (FCV) at Sizewell B to mitigate against potential containment overpressure in the event of a severe accident.

19.40 The arrangements for dealing with accidents and emergencies are set out under Article 16 – Emergency Preparedness.

Engineering and technical support

19.41 The nuclear site licence requires that the licensees have access to sufficient technical expertise for all stages of a plant's life. Article 11 – Financial and Human Resources provides further details on EDF Energy NGL's approach to human resources, including organisational capability, knowledge management/retention and training.

19.42 Although most of the licensee's technical resource is provided by its own staff resources, amounting to several hundred staff, use is also made of additional technical contractors and Nuclear Services (see paragraph 11.39) as appropriate. ONR considers this to be acceptable, providing that EDF Energy NGL retains sufficient expertise to be an 'intelligent customer' of such work.

19.43 EDF Energy NGL's design authority is a key element of its central technical organisation. The role of the design authority is to ensure fit for purpose design solutions to manage nuclear safety risks over the lifetimes of the power stations. Furthermore, the design authority is effectively the custodian of the relevant specialist part of the reactor's safety case to ensure that the integrity of the design and the safety case remain consistent.

19.44 Another of the central functions is that of engineering, which provides technical support to the stations using the additional resource, and capabilities of its technical support alliance partners to maximise the value of work delivered by the organisation.

End-of-generation

19.45 Since the UK's last National Report, a further two reactors at Hinkley Point B have shut down so the total shutdown AGR reactors is now six. Hunterston B completed defuelling in December 2024 and Hinkley Point B and Dungeness B continue to defuel.

19.46 End-of-generation (EoG) does not significantly alter the legislative requirements placed on a reactor. The 36 LCs remain applicable until the site is delicensed, and the requirement for operational limits and conditions and procedures for operation, maintenance, inspection, and testing, and responding to operational occurrences and accidents remains as described above. Safety assessment of shutdown and defuelling safety cases is discussed in Article 14 – Assessment and Verification of Safety.

19.47 As EDF Energy NGL defuels its shutdown reactors and declares that a site is fuel free, the transfer of the nuclear site licence to the Nuclear Decommissioning Authority for eventual decommissioning will be progressed. During this period, EDF Energy NGL is undergoing a significant change in its organisational structure, particularly (though not exclusively) at the corporate level, where much of the engineering and technical support for stations resides. This will allow it to manage the separate challenges of defuelling and preparing to decommission stations at the end of their life; continue to support operation of the remaining AGRs until their planned shutdown dates; and manage longer-term generation at Sizewell B (recognising the

challenges and opportunities that the potential new build reactors at Hinkley Point C and Sizewell C will bring).

19.48 In preparing for defuelling operations, EDF Energy NGL has created a 'Management of the Asset' programme to ensure that the lifetime management strategy for the AGR systems reflects the changes in operating requirements of the various plant systems.

19.49 EoG will lead to a change in plant requirements, with some systems no longer required for managing the reactor safely. The fuel route components, which will support defuelling will have an increased requirement. The Management of the Asset programme recognises this change and manages the transition between generating and defuelling phases of operation.

Reporting of incidents significant to safety

Overview of Contracting Party's arrangements and regulatory requirements

19.50 There are legal requirements outlined in various regulations and in some of the LCs (most significantly LC7 (incidents on site)) for dutyholders to notify ONR of significant events occurring on nuclear sites.

19.51 ONR has published guidance on notifying and reporting incidents and events in all its areas of responsibility, which now include security, safeguards, and transport in addition to nuclear safety [161].

19.52 ONR's guidance identifies the category of incidents that are required to be reported including nuclear safety, radiological safety, nuclear security, and nuclear safeguards. It also requires a description of each type of incident within the relevant category, together with the timings required to complete the notifications. Illustrative examples of each type of incident are provided for clarification.

Overview of established reporting criteria and reporting procedures

19.53 LC7 compliance arrangements made by each licensee cover a wide spectrum of events. Notifications to ONR contain preliminary information, and ONR expects the licensee to make a follow-up report within 60 days following an event notification. The licensees include the following information in follow-up reports for events:

- Confirmation of the factual details in the preliminary information
- Conclusions from the licensee's investigation of the event including the cause of the event
- Summary of the mitigation and corrective actions taken or to be taken
- An outline of learning from the event with any implications for related plant
- Confirmed International Nuclear and Radiological Event Scale (INES) level ascribed to the incident

19.54 EDF Energy NGL has implemented reporting arrangements to meet regulatory expectations. These arrangements set out what information should be included in an initial notification to ONR and on what timescales the notification should be made, ranging from immediate notification to within a week depending on the safety-significance of the incident.

19.55 The UK complies with the requirements of the IAEA's INES reporting arrangements. For most incidents reported to ONR (those of lesser significance and where the applicable INES level is clear), the INES level is determined by the originator of the report. In other cases, advice is sought from the UK INES national officer, who is the final arbiter in determining the INES rating for any incident. For relevant incidents the dutyholder is expected to assign a provisional INES rating, this is so that any onward international reporting commitments can be

made should the rating be at Level 2 or higher on INES. International reporting is made through the IAEA online reporting database by the national officer.

19.56 In practice, there are some incidents where further information is needed before finalising an INES rating; primarily where the use of additional factors set out in the INES user manual is applicable. Most of these incidents are at the boundary between levels 0, 1 and 2, where the verification of certain aspects can take some time and require a full root cause investigation. As a result, it is not uncommon for the INES rating to be revised after an investigation being carried out by the licensee or ONR.

Reported incidents significant to safety for the past three years

19.57 This report includes events that have occurred over the reporting period, from 01 June 2022 to 31 May 2025 . During the reporting period, there have been a total of six incidents rated at INES Level 1 and one event at INES Level 2 on the operating reactor fleet. The list of events and outcomes are presented in Table 3 – Summary of Incidents and associated INES Ratings .

Documentation and publication of reported events and incidents

19.58 ONR reports incidents to the public through two routes, both of which are available on its website. Nationally, it publishes a quarterly statement if there have been any incidents that meet specific reporting criteria. Locally, ONR includes incident reports in the quarterly reports that it makes to the local site stakeholder groups of each licensed nuclear site. These groups comprise members of local government, together with the emergency services and representatives of local communities. Meetings are also open to the public. Such incident reports indicate, as appropriate, the circumstances of the incident, the action taken or being taken by ONR together with any remedial actions being planned or taken by the relevant licensee. The stakeholder reports also cover ONR's wider regulation and activities on the site for the period.

19.59 Additionally, ONR publishes its annual Chief Nuclear Inspector's report on Great Britain's nuclear industry, which includes a summary of the nuclear safety and radiological safety events reported to ONR during the year. The latest of these reports covers the period April 2023 to March 2024 [100].

19.60 The UK is a signatory to the 1986 IAEA Convention on Early Notification of a Nuclear Accident, which requires notifying the IAEA when *'...a release of radioactive materials occurs or is likely to occur and which has resulted or may result in an international trans-boundary release that could be of radiological safety significance for another state'*. The Department for Energy Security and Net Zero (DESNZ) is the UK Competent Authority and provides contact points for issuing and receiving notification and information on any nuclear accidents arising from nuclear power plants. (See Article 16 – Emergency Preparedness for further details).

Operational experience feedback

19.61 Recognising that effective organisational learning is an important element of a strong nuclear safety culture, ONR's SAPs set out regulatory expectations for nuclear licenses' operational experience feedback programmes. One of the SAPs for leadership and management for safety (SAP MS.4) states that:

> *'Organisations should have effective processes for seeking out, analysing and acting upon lessons from a wide range of sources. A learning organisation should challenge established understanding and practice by reflecting on experiences to identify and understand the reasons for differences between actual and intended outcomes. An absence of major accidents and incidents does not necessarily indicate that risks are being adequately*

controlled and should not breed complacency. Near misses should be seen as opportunities to learn and a culture of open reporting should be fostered.'

19.62 The SAPs also state that information should also be actively sought from external sources, including those from beyond the nuclear sector to identify learning and improvement opportunities. Identified lessons should be embedded through a structured system for implementing corrective actions in a timely manner. The UK's regulatory regime requires the licensee to develop its own arrangements setting out how these principles will be achieved.

19.63 EDF Energy NGL's arrangements for organisational learning set out requirements for a corrective action programme to ensure that causes of non-conformances and other problems are determined, and corrective actions are taken to prevent their recurrence.

19.64 The corrective action programme establishes a process that enables anyone to identify potential deviation from the expected norm. Non-conformances collected by the programme are prioritised based on potential safety, security and environmental significance by suitably qualified and experienced personnel and used to inform the application of a graded approach to investigating the causes of the problem. A database is used to track identified corrective actions and ensure completeness of resolution. Effectiveness reviews are carried out to confirm that corrective actions have delivered the desired improvements.

19.65 Within the organisation, EDF Energy NGL routinely carries out self-assessments to evaluate the performance of work and identify areas for improvement. Self-assessments are supported by benchmarking, which seeks to identify opportunities for improvement from interactions with other EDF Energy NGL sites as well as external organisations, where good practices may be observed. The self-assessment process is also informed by the analysis of data and metrics from a variety of sources including from the corrective action programme to identify adverse trends, patterns, and incidences of re-occurrence. Corrective actions identified from the self-assessment process are monitored to ensure they are acted upon in a timely manner.

19.66 EDF Energy NGL's operational experience programme seeks to ensure that learning from other stations and from external organisations (including those outside the nuclear industry) is identified and acted upon to reduce the potential for recurring events. Sources of learning, which are typically screened and tracked by EDF Energy NGL's operational experience programme, include: the relevant IAEA databases, WANO, INPO documents, relevant learning from other UK licensees, learning from across the licensee's organisation and any other relevant material containing potential learning opportunities. Operational experience related information is screened and analysed to select and prioritise potential learning opportunities.

19.67 EDF Energy NGL has well developed mechanisms to distribute learning identified through its operational experience programmes including information shared through WANO and other relevant organisations, which also provide international experience relevant to UK operators. EDF Energy NGL has in recent years developed an Organisational Learning Portal (OLP) that provides all company employees (and contractors) access to shared learning from events. This has provided an opportunity to quickly share lessons from across the EDF Energy NGL fleet and ensure historic information is adequately stored and easily accessible.

19.68 As part of its international operational experience feedback processes, ONR routinely liaises with EDF Energy NGL to discuss information on incidents and to identify those that may be appropriate to share more widely through international reporting mechanisms. ONR is the UK's reporting authority, including for INES and the IAEA/NEA International Reporting System (IRS) for operational experience.

19.69 A number of examples of learning from experience can be found in Table 4 – Examples of Learning from Operating Experience.

19.70 At Hinkley Point C and Sizewell C, arrangements for incident reporting and operating experience feedback are considered as part of the organisational learning strategy. There is an internal learning element focussed on the reporting of incidents and observations that occur on the main site, across the associated development sites, and within direct elements of the supply chain. An external learning element focuses on the learning from incidents that occur within the wider UK nuclear industry, international power stations, UK and international large scale construction projects and from across the EPR™ fleet worldwide. The arrangements continue to evolve as the projects progress from design and construction stages through to commissioning and operation.

Regulatory review of licence holder

19.71 In determining its response to incidents notified to it, ONR applies the key principles underpinning its Enforcement Policy Statement [53] and related processes, which include the requirements that ONR acts proportionately and in a targeted and consistent manner. This means that the nature of ONR's response and subsequent enforcement are informed by and proportionate to the magnitude of any failure to comply with the law (including any failure to minimise risk to workers or the public so far as is reasonably practicable).

19.72 Consequently, when incidents of a minor nature occur (those that present minimal, if any, risk to workers or the public, and which represent most incidents reported to ONR), ONR's focus is to review the nature of the event and the dutyholder's response, to satisfy itself that the dutyholder has:

- Taken effective action to minimise, so far as is reasonably practicable, any risk to workers or members of the public.
- Competently and diligently investigated the event, and that appropriate learning opportunities and improvements have been identified.
- Been proactive in delivering appropriate improvements to an appropriate timescale (to minimise the potential for a recurrence).

19.73 In cases where the actual or potential consequences are judged to be more significant, ONR may elect to investigate the incident itself to establish the magnitude of any failure to comply with relevant law. If warranted, ONR will also take appropriate enforcement action in accordance with its Enforcement Policy Statement.

19.74 It is important to note that incidents are only one consideration in relation to enforcement decisions and, indeed, ONR may carry out enforcement action where it believes that there has been a breach of law but where no incident has occurred.

19.75 Additionally, and where appropriate, ONR will use the information it obtains to:

- Notify relevant Government departments if pre-agreed reporting criteria are met.
- Inform its future regulatory strategy and inspection programmes.
- Disseminate any generic learning points to the wider industry and, where appropriate, internationally.

19.76 Finally, in the highly unlikely event of a nuclear or radiological emergency, ONR has the capacity to coordinate its national safety regulatory activities to provide support and advice to local government, other government agencies, and in support of national emergency plans. ONR's arrangements are described in detail under Article 16 – Emergency Preparedness.

Management of spent fuel and radioactive waste on the site

19.77 Information on radioactive discharges, and on the disposal of solid radioactive waste, is provided in the UK's eighth national report for the Joint Convention [3].

19.78 LC34 (leakage and escape of radioactive material and radioactive waste) requires radioactive material or waste to be controlled and contained so that it does not leak or escape, except in compliance with discharges granted by the environmental regulators. Licensees must demonstrate that this is the case, to the satisfaction of the regulator. Any leak or escape must be notified, recorded, investigated, and reported, as required by the arrangements made under LC7. Each site has a discharge authorisation issued by the appropriate environment agency. The licensee must demonstrate how it complies with such authorisations.

19.79 LC32 (accumulation of radioactive waste) requires that, so far as is reasonably practicable, the rate of production and the total quantity of radioactive waste on the site at any one time is minimised. The quantity, type and form of the radioactive waste accumulated or stored may be subject to limitations specified by ONR. As part of its integrated intervention strategies, ONR requires EDF Energy NGL to make full use of the authorised disposal routes to reduce the volume of disposable radioactive waste stored on sites if it is judged that accumulations are excessive.

19.80 LC33 (disposal of radioactive waste) requires the disposal of radioactive waste to be in accordance with an authorisation granted under the Environmental Authorisations (Scotland) Regulations 2018 (EASR18) in Scotland and Environmental Permitting (England and Wales) Regulations 2016 (EPR16) in England and Wales. See Article 15 – Radiation Protection for more details).

19.81 The UK has a general policy of progressive and substantive reductions in radioactive discharges. In general, limits are set with minimum headroom above the level of actual discharges that would be consistent with 'normal operation'. In July 2009, the UK, Welsh, Scottish and Northern Ireland Governments jointly published a 'UK Strategy for Radioactive Discharges' to cover the period to 2030 [162], which was reviewed in 2018. In parallel, the UK Government published statutory guidance to the Environment Agency on the implementation of the strategy. The Scottish Government published separate Guidance to SEPA in 2008. The UK's strategy also forms its national plan for meeting its obligations under the OSPAR Convention [163].

19.82 For the AGRs, irradiated fuel assemblies are transferred by the fuelling machine to a buffer store and held for a suitable period, typically a few weeks, which allows the short-lived radioactive isotopes to decay. The assembly is then transferred, by the fuelling machine, to an irradiated fuel dismantling facility, where the individual elements are separated from the assembly and transferred to a storage pond. In the pond, the elements are stored below water in boron steel skips.

19.83 After a suitable further cooling period, skips are loaded into transport flasks and dispatched off-site for further storage at Sellafield, as reprocessing of AGR fuel ceased in 2018. As AGR stations reach the end of their operational life, the increased focus on defuelling, and the subsequent demonstration that sites are free from nuclear fuel, means there will be a corresponding increase in shipments of fuel sent off site for storage. The AGR Operating Programme, is specifically designed to ensure that as the number of AGRs that cease generation increases, AGR sites can continue to be defueled efficiently, safely, and securely.

19.84 There are three classes of radioactive waste that are or have been produced because of operation of AGRs:

- High level waste is a by-product of past fuel reprocessing process at Sellafield. The waste is currently stored at Sellafield and will ultimately be vitrified for long term storage prior to disposal in a Geological Disposal Facility (GDF). There is no high level waste on power reactor sites in UK.
- Intermediate level waste comprises of sludges and resins used for water treatment, activated components from fuel stringer and plug unit disassembly and gas filter materials. This type of waste is stored at the power station site either in drums (in the case of liquid wastes) or in a shielded vault (in the case of solid fuel stringer and plug unit components).
- Low Level Waste from operational power stations is principally lightly contaminated miscellaneous waste arising from maintenance and monitoring, such as plastic, paper and metal.

19.85 For the PWR at Sizewell B the reactor is refuelled approximately every 18 months, and the spent fuel is then transferred to a fuel pond and stored under water in racks. After a suitable period of cooling in the pond, the fuel is transferred into casks, dried and then stored in the dry fuel store pending a future decision about whether to classify it as waste for disposal. The store will house spent fuel from Sizewell B until a GDF is available for the permanent disposal of spent fuel that has been classified as waste.

Summary of significant changes since previous report

19.86 The UK has no significant changes to highlight under Article 19 during the reporting period.

Tables

Table 1 – UK Civil Power Reactors' Key Parameters

Nuclear Installation	Dungeness B (1)	Hartlepool	Heysham 1 (2)	Heysham 2
Licensee	EDF Energy NGL	EDF Energy NGL	EDF Energy NGL	EDF Energy NGL
Reactor type	AGR	AGR	AGR	AGR
No. of reactors	2	2	2	2
1st Power Operation	1983	1983	1983	1988
End-of-generation date	(2021)	2027	2027	2030
Reactor Thermal Power (MWth/Reactor)	1550	1575	1575	1700
Electrical Gen. Power (MWe/Reactor)	585	640	630	670
Total exported (MWe/Reactor)	520	590	580	610
Nuclear fuel	UO_2	UO_2	UO_2	UO_2
Fuel cladding	Stainless Steel	Stainless Steel	Stainless Steel	Stainless Steel
Nuclear moderator	Graphite	Graphite	Graphite	Graphite
Reactor core: *Fuel channels* *Assemblies per channel* *Fuel pins /assembly*	 408 7 36	 324 8 36	 324 8 36	 332 8 36
Coolant	CO_2	CO_2	CO_2	CO_2
Coolant containment	Pre-stressed Concrete Pressure Vessel (PCPV)	PCPV	PCPV	PCPV
Coolant pressure (Bar)	30	42	42	42
Coolant max. temp. (°C)	650	660	660	660

Steam turbine inlet pressure (Bar)	163	159	159	159
Steam turbine inlet temp. (°C)	555	517	547	538
Gross electrical power (MWe)	1170	1280	1260	1340

Nuclear Installation	Hinkley Point B[1]	Hunterston B [3]	Torness	Sizewell B
Licensee	EDF Energy NGL	EDF Energy NGL	EDF Energy NGL	EDF Energy NGL
Reactor type	AGR	AGR	AGR	PWR
No. of reactors	2	2	2	1
1st Power Operation	1976	1976	1988	1995
End-of-generation Date	2022	2022	2030	2035
Reactor Thermal Power (MWth/Reactor)	1320	1320	1700	3425
Electrical Gen. Power (MWe/Reactor)	525	530	645	1260
Total exported (MWe/Reactor)	475	480	595	1198
Nuclear fuel	UO_2	UO_2	UO_2	UO_2
Fuel cladding	Stainless Steel	Stainless Steel	Stainless Steel	Zr-4
Nuclear moderator	Graphite	Graphite	Graphite	Water
Reactor core: *Fuel channels* *Assemblies per channel* *Fuel pins /assembly*	308 8 36	308 8 36	332 8 36	- 193 264
Coolant	CO_2	CO_2	CO_2	H_2O
Coolant containment	PCPV	PCPV	PCPV	Steel Pressure Vessel
Coolant pressure (Bar)	41	40	43	150
Coolant max. temp. (°C)	583	583	660	323
Steam turbine inlet temp. (°C)	435	435	538	283

Steam turbine inlet pressure (Bar)	126	126	159	67
Gross electrical power (MWe)	1050	1060	1290	1260

Note:
(1) Plant no longer generating and reactors are being defueled.
(2) Heysham 1 is currently limited to operating at 84 % power (only 7 out of 8 boilers are in service).
(3) Plant no longer generating and both reactors have been defueled. Fuel free verification to be completed in mid-2025.

Nuclear Installation	**Hinkley Point C (Under Construction)**
Licensee	NNB GenCo (HPC)
Reactor type	PWR
No. of reactors	2
Forecast Commercial Power Operation Date (Unit 1)	2029 - 2031
Forecast Commercial Power Operation Date (Unit 2)	12 months after Unit 1
Reactor Thermal Power (MWth/Reactor)	4500
Electrical Gen. Power (MWe/Reactor)	1780
Total exported (MWe/Reactor)	1650
Nuclear fuel	UO_2
Fuel cladding	Zirconium alloy
Nuclear moderator	Water
Reactor core: *Fuel Assemblies* *Fuel pins /assembly*	241 265
Coolant	Water
Coolant containment	Steel Pressure Vessel
Coolant pressure (Bar)	155
Coolant maximum temperature (°C)	312
Steam turbine inlet pressure (Bar)	76
Steam turbine inlet temp. (°C)	291
Gross electrical power (MWe)	3560

Table 2 – Example Engineering Principles from the SAPs

Principle	Details
Inherent safety (EKP.1)	The underpinning safety aim for any nuclear facility should be an inherently safe design, consistent with the operational purposes of the facility.
Fault tolerance (EKP.2)	The sensitivity of the facility to potential faults should be minimised.
Defence-in-depth (EKP.3)	Nuclear facilities should be designed and operated so that defence-in-depth against potentially significant faults or failures is achieved by the provision of multiple independent barriers to fault progression.
Safety measures (EKP.5)	Safety should be secured by characteristics as near as possible to the top of the list below: (a) Passive safety measures that do not rely on control systems, active safety systems or human intervention. (b) Automatically initiated active engineered safety measures. (c) Active engineered safety measures that need to be manually brought into service in response to a fault or accident. (d) Administrative safety measures. (e) Mitigation safety measures (for example, filtration or scrubbing).
Safety classification of structures, systems, and components (ECS.2)	Structures, systems, and components that must deliver safety functions should be identified and classified based on those functions and their significance to safety.
Failure to safety (EDR.1)	Due account should be taken of the need for structures, systems, and components to be designed to be inherently safe, or to fail in a safe manner, and potential failure modes should be identified, using a formal analysis where appropriate.
Redundancy, diversity, and segregation (EDR.2)	Redundancy, diversity, and segregation should be incorporated as appropriate within the designs of structures, systems, and components.
Common cause failure (EDR.3)	Common cause failure should be addressed explicitly where a structure, system or component employs redundant or diverse components, measurements, or actions to provide high reliability.
Single failure criterion (EDR.4)	During any normally permissible state of plant availability, no single random failure, assumed to occur anywhere within the systems provided to secure a safety function, should prevent the performance of that safety function.
Engineered safety measures (ERL.3)	Where reliable and rapid protective action is required, automatically initiated, engineered safety measures should be provided.

Automatic initiation (ESS.8)	For all fast-acting faults (typically less than 30 minutes) safety systems should be initiated automatically and no human intervention should then be necessary to deliver the safety function(s).
Allocation of safety actions (EHF.2)	When designing systems, dependence on human action to maintain and recover a stable, safe state should be minimised. The allocation of safety actions between humans and engineered structures, systems or components should be substantiated.

Table 3 – Summary of Incidents and associated INES Ratings

Hartlepool

Significant Events Reported to ONR: INES Rating 1 – Anomaly			
Date	**Event Description**	**Dutyholder Response**	**ONR Action**
10/12/2022 (INF-2603)	During phase 7 of Reactor 1 start-up following an off load refuelling outage, when raising load it was identified that reactor thermal power had been increased to a level above that which was allowable for the coarse lift 3 control rod position at the time (as specified in plant Technical Specification).	Following the identification of the error in the reactor power versus lift 3 rod position, the Central Control Room (CCR) took immediate action to reduce thermal power to below the maximum allowable limit. A follow-up investigation was undertaken.	ONR discussed the event with various station staff including the operations managers, nuclear safety group head and other senior staff. ONR was content that the station have investigated this incident and have identified suitable actions to prevent a repeat event. A previous event at station earlier in 2022 (INF-1796) (also rated at INES-1) and also occurred due to operator error in the control room. As such, ONR conducted an inspection during 2023 that covered control room standards and training as well as criticality management at Hartlepool.

27/07/2023 (INF-3172)	At 1445hrs on 27/07/2023, Hartlepool entered Operational Alert due to the loss of Nitrogen to gas circulator purge ring main on Reactor 2, with the Reactor in an air atmosphere.	Station technical advice group advised to shutdown gas circulator main motors due to lack of Nitrogen purge and high Oxygen purity. Gas circulator pony motors were put in service instead. Feed was increased to optimise cooling on decay heat loop, safety documents were recalled and plant contingency note for resealing was considered as a contingency. Nitrogen delivery was requested and delivered. The Operational Alert was stood down later on the same day (just after 2000hrs).	Following discussion with site, ONR was satisfied that this event has been investigated appropriately and actions have been assigned to prevent recurrence and to improve commodity management and order process at station. ONR continued to monitor the progress of the actions identified from the investigation as part of the routine engagement with the dutyholder.
26/09/2023 (INF-3334)	During return to service of 50% Boiler Feed Pump No. 2 for flushing of Reactor 2 boilers, Deaerator 2 was noted as decreasing, which is not unexpected. However, Deaerator 1 level was noted to rise. A few moments later, Unit 1 experienced numerous tube plate alarms and Deaerator temperature dropped by about 15 degrees Celsius. Linear drift power on Unit 1 was also noted to be rising. After diagnosis from the CCR team it was concluded that both Deaerator's were interconnected via the 50% Boiler Feed Pump No.2 leak off route.	The 50% Boiler Feed Pump was shut down promptly, Reactor 1 load was reduced from 105.4% to 103% to control the transient and Heypex Reactor Thermal Power calculation completed following the event. Operating parameters confirmed to be within limits by CCR team and verified by the Nuclear Safety Group. A walk down of plant found the 3 way valve BF2/WF/99 selected to Deaerator 1 when the valve alignment checks confirmed it was aligned to Deaerator 2.	ONR follow-up this event at a planned inspections at site in January 2024.

05/02/2024 (INF-3716)	On 3rd November 2023, the off-site Reverse Osmosis water supply became unavailable. Due to defects on the Water Treatment Plant (WTP), reserve feed water stocks could not be replenished and Reserve Feedwater Tank (RFT) levels were seen to fall rapidly. Usage of feedwater was significantly greater than expected. At the time duty holder entered the Safety Case Anomaly Process (SCAP), and confirmed availability of sufficient post trip cooling feed. In early January 2024, both units at Hartlepool were shut down as a result of the risk of failure of steam valves (due to incident on sister site Heysham-1). Rather than a reduction in total demineralised water usage, which was expected once the condensate loop was closed, water usage increased significantly to a level where the WTP was operating almost at capacity to maintain RFT levels. The extant safety case claim of 24 hour mission time is based on a limited leakage from the RFT system. Confidence that this leakage rate is bounding was significantly reduced.	A further SCAP meeting was held on 5th February, which confirmed an anomaly. With both units shutdown with decay heat at ~2.2 MW, cooling requirements are were significantly lower. The current risk was deemed to be as low as reasonably practicable (ALARP) given that the High-Pressure Back Up Cooling system remained a robust line of post trip cooling. Formal instruction via a Technical Advice Note remains in place that in the event of unavailability of the WTP (including loss of source feed to the WTP) that Operational Alert is entered. A Justification for Continued Operation (JCO) of the reactor and plan for longer term management was the issue was commenced.	ONR called in the JCO for review and consideration. Preliminary enquiries were carried out into the historic failure to monitoring of demineralised water onsite. ONR continued to follow up on the commitments made by the dutyholder in the JCO to reduce nuclear safety risk at station in the longer term. The longer term actions taken by the dutyholder and ONR for this event are discussed in Annex 4 – Safety Related Issues and Safety Upgrade Programmes
03/10/2024	The reactor has several protection settings designed for different phases of operation. The Low Log Protection is	Following discovery of the error, the Low Log trip settings were immediately actioned to be set back	ONR conducted preliminary enquiries on this event. This and a number of other control room training/and

(INF-4512)	designed for low power (start up) and shutdown modes. The protection is required to be set as per Technical Specification, which dictated that if vessel pressure is below 1 bar(g), the protection trip setting shall be ≤2.5kW, and at pressure above 1 bar(g) it shall be ≤900kW. During pressure cycling between 0.5bar(g) and 3.0bar(g) to purge the vessel from air to CO_2 following operation in air for Reactor 2 outage 580, the low log protection settings were set up to 900kW, the reactor vessel was subsequently blown down to <1bar(g) and so the trip settings were not correct for the prevailing reactor conditions.	to 2.5kW. Dutyholder commenced an investigation into the incident. The longer term corrective actions taken by the dutyholder are discussed in Table 4 – Examples of Learning from Operating Experience.	experience related issued will be followed up during the enhanced regulatory attention programme for Hartlepool.

Torness

Significant Events Reported to ONR: INES Rating 1 – Anomaly			
Date	**Event Description**	**Dutyholder Response**	**ONR Action**
11/01/2023 (INF-2663)	A planned shutdown of Reactor 2 for off load refuelling commenced at 23:00 on 04/01/2023. Post-shutdown three Gas Circulator Variable Frequency Converter units (VFCs) failed, preventing the associated Gas Circulators from continuing to run at reduced	The 3 failed VFC units were checked, with causes identified and addressed on 2 of the 3 units and no fault found on the 3rd. All 3 VFCs have subsequently been returned to service and used to drive the associated	ONR followed up the issue at pre-planned LC27/28 compliance inspection on these systems.

	speed as designed. Adequate post trip cooling of the reactor was maintained by the remaining five Gas Circulators running on VFC (1) and Variable Speed Drive (4). Failure of the 3 VFC units does not challenge the applicable safety case or operational limits, but represents an unexpected reduction in defence in depth.	Gas Circulators, restoring full post trip cooling capability.	The longer term actions taken by the dutyholder and ONR for this event is discussed are Annex 4 – Safety Related Issues and Safety Upgrade Programmes

Significant Events Reported to ONR: INES Rating 2 - Incident			
	Event Description	**Dutyholder Response**	**ONR Action**
24/11/2023 (INF-3471)	Reactor 2 was shutdown for a planned refuelling outage. Minimum post-trip cooling was established and reactor cooldown occurred at the normal rate. However, four of the eight gas circulators initially failed to run on variable speed drive. This placed the reactor in an immediate Technical Specification action condition.	Two of the gas circulators were started manually around six hours after the shutdown, improving cooling margins and changing the Technical Specification action timescale from immediate to 72 hours.	ONR followed up on the duty holder's initial follow up report, enforcement letter close out and Torness internal investigation findings. The longer term actions taken by the dutyholder and ONR for this event are discussed in Annex 4 – Safety Related Issues and Safety Upgrade Programmes

Note:
(1) More information on the events reported above, and other international events can be found on the IAEA Nucleus Portal: Sign In - NUCLEUS - IAEA.

Table 4 – Examples of Learning from Operating Experience

Event Description	Main Action Taken
Hinkley Point B: Two unplanned trips were experienced in March and May 2022, in both cases caused by turbine protection operating, and causing inter-trip of the reactor. Both turbine trips were the result of loss of hydraulic control fluid pressure from failed flexible hose connections. The investigation found that the hoses had been connected with incorrect fittings and had been installed with overly tight bends that increased the strain on the fittings.	Key corrective actions were focused on: • Improving the quality assurance and control at the parts manufacturers. • Reviewing on-site quality assurance for associated work packages.
Hunterston B: In May 2022, following permanent plant shutdown, the first channel of irradiated fuel was removed from the reactor using the fuelling machine. The empty fuel plug unit would not lower into the empty channel, delaying defuelling activities while recovery operations were carried out. Fault finding confirmed that the winch control logic would not allow the intended operation. The investigation found that modifications to the logic design in anticipation of defuelling activities had been completed, but not effectively tested for all operating conditions. Operating procedures had not been updated to include required 'Defect of Interlock' steps.	The fuelling machine control logic and operating procedures were revised to align with the requirements of the defuelling strategy. The changes were implemented at the 'sister' station in the fleet as part of their preparations for defuelling. Site arrangements for the control of plant modifications were revised to provide additional quality checks based on the learning from this event.
Sizewell B: In April 2023, during the plant refuelling outage, a reactor coolant system recirculating valve was maintained. Due to plant conditions, the leakage rate for the valve could not be tested. Later in the outage, as the plant moved toward return to service, the valve was tested – it failed the leakage criteria. As a result, plant conditions had to be returned to a lower state, and rework carried out – this added approximately 16 days to the outage. The investigation found that the potential risk/impact of inadequate	Outage preparation arrangements have been modified to highlight activities that have a significant risk of impacting safety/outage delivery due to the inability to prove successful completion at the time of work. Corrective actions also included: • Deep dives into the associated work packages. • Engaging with contract partners and original equipment manufacturers. • Identifying new/refresher training for key personnel.

maintenance to outage critical path activities was not fully recognised or mitigated.	
Torness: In November 2023 during a planned shutdown, 4 of the 8 gas circulators failed to engage/remain on variable frequency convertor/variable speed drive supplies, leading to reduced defence in depth for post trip heat removal. The investigation found that corrective actions from an event earlier in the year had not been carried out in a timely manner, and the bridging strategy was not effective in preventing a repeat. This event was rated INES 2. Also see Table 3 – Summary of Incidents and associated INES Ratings.	A full through-life management review was carried out, and a wide-ranging equipment replacement strategy in being implemented. This is focused on replacing obsolete equipment with modern equivalents. The actions taken by the dutyholder and ONR for this event are discussed in Annex 4 – Safety Related Issues and Safety Upgrade Programmes
Heysham 1: In December 2023, during the early stages of reactor start-up, failure of a main stop valve on the clean steam system led to a significant steam release in the boiler house. A site incident was declared, and the unit shut down. The cause of the failure was high temperature assisted corrosion of a threaded component, leading to the valve spindle being ejected.	Extent of condition reviews led to the shutdown of the other reactor at the affected plant, and extended outages on two reactors at another plant in the fleet. A programme of valve refurbishment/replacement has been implemented on all affected reactors. The longer term actions taken by the dutyholder and ONR for this event are discussed in Annex 4 – Safety Related Issues and Safety Upgrade Programmes
Hartlepool: In October 2024, during reactor activities prior to return to service, low pressure cycling was in progress to improve reactor gas conditions. In parallel, changes were made to flux protection settings to prepare for start-up. During cycling, the reactor pressure was reduced below the minimum allowed for the new flux protection settings. Although the issue was recognised by the control room personnel, the associated Tech Spec Limiting Condition of Operation (LCO) was not entered, and the associated action to put all protection channels into the 'tripped' state was not taken. The event was rated as INES 1. Also see Table 3 – Summary of Incidents and associated INES Ratings.	Key corrective actions from the event were: • Review of control arrangements for carrying out changes to safety circuit protection settings. • Review of outage plans/operating procedure to de-conflict activities involving pressure cycling. • Develop training for key personnel based on the INPO 'Line of Sight to the Reactor Core' document. • Benchmarking other sites to determine best practice for Tech Spec tracking arrangements.

Table 5 – Licence Conditions

LC	Title	Description
LC1	Interpretation	Defines the expressions used in the Licence Conditions
LC2	Marking of the site boundary	The licensee shall make and implement adequate arrangements to prevent unauthorised persons from entering the site or, if so directed by ONR, from entering such part or parts thereof as ONR may specify.
LC3	Control of property transactions	The licensee shall make and implement adequate arrangements to control all property transactions affecting the site or any part of the site to ensure that the licensee remains in overall control of the site. The arrangements shall include provision for the classification of property transactions according to their safety significance and their impact on the licensee's control of the site.
LC4	Restrictions on nuclear matter on the site	The licensee shall ensure that no nuclear matter is brought onto the site except in accordance with adequate arrangements made by the licensee for this purpose. The licensee shall ensure that no nuclear matter is stored on the site except in accordance with adequate arrangements made by the licensee for this purpose.
LC5	Consignment of nuclear matter	The licensee shall not consign nuclear matter (other than excepted matter and radioactive waste) to any place in the UK other than a relevant site except with the consent of ONR.
LC6	Documents, records, authorities, and certificates	The licensee shall make adequate records to demonstrate compliance with any of the conditions attached to this licence.
LC7	Incidents on the site	The licensee shall make and implement adequate arrangements for the notification, recording, investigation and reporting of such incidents occurring on the site.
LC8	Warning notices	The licensee shall ensure that suitable and sufficient notices are kept on site for the purposes of informing persons thereon of each of the following matters, that is to say; warning signals, the location of emergency exits, and the measures to be taken by such persons in the event of an emergency.
LC9	Instructions to persons on the site	The licensee shall ensure that every person authorised to be on the site receives adequate instructions as regards to risks and hazards associated with the plant and its operation, the

		precautions to be observed, and the action to be taken in the event of an accident or emergency on site.
LC10	Training	The licensee shall make and implement adequate arrangements for suitable training for all those on site who have responsibility for any operations which may affect safety.
LC11	Emergency arrangements	The licensee shall make and implement adequate arrangements for dealing with any accident or emergency arising on the site and their effects.
LC12	Duly authorised and other suitably qualified and experienced persons	The licensee shall make and implement adequate arrangements to ensure that only suitably qualified and experienced persons perform any duties which may affect the safety of operations on the site, or any other duties assigned by or under these conditions or any arrangements required under these conditions. The aforesaid arrangements shall also provide for the appointment, in appropriate cases, of duly authorised persons to control and supervise operations that may affect plant safety.
LC13	Nuclear safety committee	The licensee shall establish a nuclear safety committee or committees to which it shall refer for consideration and advice the following: all matters required by or under these conditions to be referred to a nuclear safety committee; such arrangements or documents required by these conditions as ONR may specify; any matters on the site affecting safety or off the site which ONR may specify; any other matters that the licensee considers should be referred to the nuclear safety committee.
LC14	Safety documentation	The licensee shall make and implement adequate arrangements for the production and assessment of safety cases consisting of documentation to justify safety during the design, construction, manufacture, commissioning, operation, and decommissioning phases of the installation.
LC15	Periodic review	The licensee shall make and implement adequate arrangements for the periodic and systematic review and reassessment of safety cases.
LC16	Site plans, designs and specifications	The licensee shall submit to ONR an adequate plan of the site showing the location of the boundary of the licensed site and every building or plant on the site which might affect safety.
LC17	Management systems	The licensee shall establish and implement management systems which give due priority to safety.

LC18	Radiological protection	The licensee shall make and implement adequate arrangements for the assessment of the average effective dose to such class or classes of persons specified in the aforesaid arrangements and the licensee shall notify ONR if the average effective dose to such class or classes of persons exceeds such level as ONR may specify.
LC19	Construction or installation of new plant	Where the licensee proposes to construct or install any new plant which may affect the safety the licensee shall make and implement adequate arrangements to control the construction or installation.
LC20	Modification to design of plant under construction	The licensee shall ensure that no modification of the design which may affect safety is made to any plant during the period of construction except in accordance with adequate arrangements made and implemented by the licensee for that purpose.
LC21	Commissioning	The licensee shall make and implement adequate arrangements for the commissioning of any plant or process which may affect safety.
LC22	Modification or experiment on existing plant	The licensee shall make and implement adequate arrangements to control any modification or experiment carried out on any part of the existing plant or processes which may affect safety.
LC23	Operating rules	The licensee shall, in respect of any operation that may affect safety, produce an adequate safety case to demonstrate the safety of that operation and to identify the conditions and limits necessary in the interests of safety. Such conditions and limits shall hereinafter be referred to as operating rules.
LC24	Operating instructions	The licensee shall ensure that all operations which may affect safety are carried out in accordance with written instructions hereinafter referred to as operating instructions.
LC25	Operational records	The licensee shall ensure that adequate records are made of the operation, inspection and maintenance of any plant which may affect safety. The aforesaid records shall include records of the amount and location of all radioactive material, including nuclear fuel and radioactive waste, used, processed, stored, or accumulated upon the site at any time.
LC26	Control and supervision of operations	The licensee shall ensure that no operations are carried out which may affect safety except under the control and supervision of suitably qualified and experienced persons appointed for that purpose by the licensee.

LC27	Safety mechanisms, devices, and circuits	The licensee shall ensure that a plant is not operated, inspected, maintained, or tested unless suitable and sufficient safety mechanisms, devices and circuits are properly connected and in good working order.
LC28	Examination, inspection, maintenance, and testing	The licensee shall make and implement adequate arrangements for the regular and systematic examination, inspection, maintenance and testing of all plant which may affect safety.
LC29	Duty to carry out tests, inspections, and examinations	The licensee shall carry out such tests, inspections, and examinations in connection with any plant as ONR may, after consultation with the licensee, specify.
LC30	Periodic shutdown	Where necessary for the purpose of enabling any examination, inspection, maintenance or testing of any plant or process to take place, the licensee shall ensure that any such plant or process shall be shut down in accordance with the requirements of its plant maintenance schedule referred to in Condition 28.
LC31	Shutdown of specified operations	The licensee shall, if so directed by ONR, shutdown any plant, operation, or process on the site within such a period as ONR may specify.
LC32	Accumulation of radioactive waste	The licensee shall make and implement adequate arrangements for minimising SFAIRP the rate of production and total quantity of radioactive waste accumulated on the site at any time and for recording the waste so accumulated.
LC33	Disposal of radioactive waste	The licensee shall, if so directed by ONR, ensure that radioactive waste accumulated or stored on the site is disposed of as ONR may specify and in accordance with an environmental permit granted under the Environmental Permitting (England and Wales) Regulations 2010, or the Radioactive Substances Act 1993 (for licensed sites in Scotland).
LC34	Leakage and escape of radioactive material and radioactive waste	The licensee shall ensure, SFAIRP, that radioactive material and radioactive waste on site is always adequately controlled and contained, so that it cannot leak or otherwise escape from such control or containment. The licensee shall ensure, SFAIRP, that no such leak or escape of radioactive material or radioactive waste shall occur without being detected, and that such leak or escape is then notified, recorded, investigated, and reported in accordance with arrangements made under Condition 7.

LC35	Decommissioning	The licensee shall make and implement adequate arrangements for the decommissioning of any plant or process which may affect safety.
LC36	Organisational capability	The licensee shall provide and maintain adequate financial and human resources to ensure the safe operation of the licensed site. The licensee shall make and implement adequate arrangements to control any change to its organisational structure or resources which may affect safety.

Annexes

Annex 1 – Extracts from Legislation Relevant to the Convention

Extracts from the Nuclear Installations Act 65 (NIA65) relevant to the convention

NIA65 Section 1 – Restriction of certain nuclear installations to licensed sites

(1) No person may use a site for the purpose of installing or operating—
(a) any nuclear reactor (other than a nuclear reactor comprised in a means of transport, whether by land, water or air), or
(b) any other installation of a prescribed kind,
unless a licence to do so has been granted in respect of the site by the appropriate national authority and is in force.

(2) Such a licence is referred to in this Act as a 'nuclear site licence'.

(3) The only kinds of installation that may be prescribed under subsection (1)(b) are installations (other than nuclear reactors) designed or adapted for—
(a) producing or using atomic energy,
(b) any process which—
(i) is preparatory or ancillary to producing or using atomic energy, and
(ii) involves, or is capable of causing, the emission of ionising radiations, or
(c) storing, processing or disposing of—
(i) nuclear fuel, or
(ii) bulk quantities of other radioactive matter which has been produced or irradiated in the course of the production or use of nuclear fuel.

(4) Regulations under subsection (1)(b) may make provision for exempting an installation from subsection (1).

(5) Regulations made by virtue of subsection (4)—
(a) may provide for any exemption to be conditional;
(b) may not result in an installation being exempt from subsection (1) unless the Secretary of State is satisfied that it is not a relevant installation (or, in the case of a conditional exemption, would not be a relevant installation if the prescribed conditions were satisfied).

(6) Before exercising any function under subsection (1)(b), (4) or (5) in or as regards Scotland, the Secretary of State must consult the Scottish Ministers.

(7) Any person who contravenes subsection (1) is guilty of an offence.

(8) A person convicted of an offence under subsection (7) in England and Wales or Scotland is liable—
(a) on conviction on indictment to imprisonment for a term not exceeding 2 years, or a fine, or both;
(b) on summary conviction to imprisonment for a term not exceeding 12 months, or a fine (in England and Wales) or a fine not exceeding £20,000 (in Scotland), or both.

(9) A person convicted of an offence under subsection (7) in Northern Ireland is liable—

(a) on conviction on indictment to imprisonment for a term not exceeding 5 years, or a fine, or both;
(b) on summary conviction to imprisonment for a term not exceeding 3 months, or a fine not exceeding the prescribed sum, or both.

(10) In relation to an offence committed before the commencement of [paragraph 24(2) of Schedule 22 to the Sentencing Act 2020] (general limit on magistrates' court's power to imprison), the reference to 12 months in subsection (8)(b), as it has effect in England and Wales, is to be read as a reference to 6 months.

(11) Subsection (1) is subject to section 47 of the Energy Act 2008 (prohibition in England and Wales and Northern Ireland on use of site in absence of approved funded decommissioning programme).

NIA65 Section 7 – Duty of licensee of licensed site

Subject to subsection (4), where a nuclear site licence has been granted in respect of a site, the licensee has the duties set out in subsections (1A), (1C) and (1E).

(1A) It is the duty of the licensee to secure that no occurrence involving nuclear matter falling within subsection (1B) causes—

(a) injury to any person,
(b) damage to any property of any person other than the licensee, or
(c) significant impairment of the environment, being injury, damage or impairment that arises out of or results from the radioactive properties, or a combination of those and any toxic, explosive or other hazardous properties, of that nuclear matter.

(1B) The occurrences referred to in subsection (1A) are—

(a) any occurrence on the licensed site involving nuclear matter during the period of the licensee's responsibility;
(b) any occurrence elsewhere than on the licensed site involving nuclear matter that is not excepted matter and which, at the time of the occurrence, satisfies the requirement mentioned in section 7A(1).

(1C) It is the duty of the licensee to secure that no occurrence involving the emission of ionising radiations falling within subsection (1D) causes–

(a) injury to any person,
(b) damage to any property of any person other than the licensee, or
(c) significant impairment of the environment, being injury, damage or impairment that arises out of or results from the radioactive properties, or a combination of those and any toxic, explosive or other hazardous properties, of the source of the emissions.

(1D) The occurrences referred to in subsection (1C) are—

(a) an emission of ionising radiations during the period of the licensee's responsibility from anything caused or suffered by the licensee to be on the site which is not nuclear matter;
(b) a discharge on or from the site of waste, being waste (of any form) that emits ionising radiations but is not nuclear matter, during the period of the licensee's responsibility.

(1E) It is the duty of the licensee to secure that no event happens that creates a grave and imminent threat of a breach of the duty under subsection (1A) or (1C)

Extracts from the Health and Safety at Work etc. Act 74 (HSWA74) relevant to the Convention

Section 2 General duties on employers to their employees

(1) It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees.

(2) Without prejudice to the generality of an employer's duty under the preceding subsection, the matters to which that duty extends include in particular–

(a) the provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safe and without risks to health;
(b) arrangements for ensuring, so far as is reasonably practicable, safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances;
(c) the provision of such information, instruction, training and supervision as is necessary to ensure, so far as is reasonably practicable, the health and safety at work of his employees;
(d) as far as is reasonably practicable as regards any place of work under the employer's control, the maintenance of it in a condition that is safe and without risks to health and the provision and maintenance of means of access to and egress from it that are safe and without such risks;
(e) the provision and maintenance of a working environment for his employees that is, so far as is reasonably practicable, safe, without risks to health, and adequate as regards facilities and arrangements for their welfare at work.

Section 3 places the following duties on employers and the self-employed to persons other than their employees

(1) It shall be the duty of every employer to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that persons not in his employment who may be affected thereby are not thereby exposed to risks to their health or safety.

(2) It shall be the duty of every self-employed person to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that he and other persons (not being his employees) who may be affected thereby are not thereby exposed to risks to their health or safety.

(3) In such cases as may be prescribed, it shall be the duty of every employer and every self-employed person, in the prescribed circumstances and in the prescribed manner, to give to persons (not being his employees) who may be affected by the way in which he conducts his undertaking the prescribed information about such aspects of the way in which he conducts his undertaking as might affect their health or safety.

Annex 2 – The Environmental Regulatory Bodies

A2.1 This Annex provides further information to that supplied under Articles 7 and 8 on the regulators that enforce environmental regulation in the UK.

Environment Agency

Mandate and Duties

A2.2 The Environment Agency was created by the Environment Act 1995 (EA95) with the aim of providing a more integrated approach to protecting and improving the environment of England as a whole – land, air and water. It is an executive 'non-departmental public body', sponsored largely by the Department for Environment, Food and Rural Affairs (DEFRA). Within England the Environment Agency is responsible for regulating major industry (including the nuclear industry) and waste, treatment of contaminated land, water quality and resources, fisheries, inland river, estuary and harbour navigations, and conservation and ecology. The Environment Agency is also responsible for managing the risk of flooding from main rivers, reservoirs, estuaries and the sea. The Environment Act sets out the principal aim of the Environment Agency 'in discharging its functions so to protect or enhance the environment, taken as a whole, as to make the contribution towards attaining the objective of sustainable development'.

A2.3 The Environment Agency applies the regulatory framework set by government. It works with businesses to make sure they operate in a way that avoids harming people or the environment, without imposing unnecessary administrative burdens on them.

Structure

A2.4 The Environment Agency has a board of 8 to 14 non-executive members and is led by the Environment Agency's Chair. Board members are appointed by the Secretary of State for the Environment and are drawn from, but do not represent, a wide variety of interests including industry, local government and various environmental fields. They are accountable to Parliament through the Secretary of State for the Environment. The Chief Executive attends the Board meetings and its Committees but is not a member of the Board and therefore does not vote on decisions. The Board delegates the Environment Agency's day-to-day management to its Chief Executive and staff.

A2.5 The Environment Agency's regulation of the nuclear sector is delivered through its two specialist groups (North and South). These groups carry out the regulation of radioactive waste disposals, including discharges of liquid and gaseous wastes on and off nuclear licensed sites, and support the wider Environment Agency radioactive substances regulation of radioactive waste management on other sites.

A2.6 Since 1 April 2013 these groups have provided support to Natural Resources Wales regulation of nuclear sites in Wales. The Environment Agency's nuclear groups also support and ensure co-ordination of the non-radioactive aspects of Environment Agency regulation of activities at nuclear sites (for example, permitting of chemical and combustion processes, and Control of Major Accident Hazards (COMAH, where the Environment Agency is joint Competent Authority with ONR on licensed sites in England)). Within these groups are several assessment teams which provide national support on solid waste disposal, generic designs of potential new nuclear reactors, radiation incident management and independent checking, monitoring and assessment of discharges to the environment. The Environment Agency and the Food Standards Agency (FSA) liaise closely to ensure that their environmental monitoring is appropriate. Annual results from the environmental monitoring programme in the UK are published jointly by the environment agencies, the FSA and the Environment and Heritage

Service for Northern Ireland in a report entitled 'Radioactivity in Food and the Environment' (RIFE). The latest assessment of radioactivity in food and the environment and the public's exposure to radiation reports on the results of sampling and analysis carried out for 2023 [139].

A2.7 Both groups are supported by the Radioactive Substances Regulation Group, which works from the Environment Agency's national office, linking nuclear regulation to the development and implementation of national strategies (for example, nuclear decommissioning and clean-up and efforts to reach net zero) and providing advice to UK Government's policy development work, working internationally in support of a range of UK commitments and obligations (including participation in the OECD's Nuclear Energy Agency (NEA) and IAEA programmes). The national team also supports the wider Environment Agency regulation of radioactive substances (including support to the collection of disused radioactive sources and responsibility for security regulation of high activity sealed sources).

Financial Resources

A2.8 The Environment Agency's annual expenditure for the financial year ended 31 March 2024 was £2.2 billion. Defra provides most of the funding, although approximately one quarter comes from other parties including charge payers. Income is derived chiefly from three sources:

- income raised from charging for regulation
- flood defence levies
- government grants, which help to finance amongst other things, pollution prevention and control activities

A2.9 Section 41 of EA95 provides the Environment Agency with the power to impose financial charges for regulatory activities in order to recover the expenses incurred through regulation. Such expenses include those incurred in respect of a programme of waste and environmental monitoring carried out by the Environment Agency. The Environment Agency uses a work-recording system to identify the effort and expenses of its staff attributable to each licensee.

A2.10 The Environment Agency charges operators for its nuclear regulatory activities on the basis of a daily rate for inspectors. This rate is reviewed annually. The Environment Agency also recharges operators for the monitoring it carries out. Annual charges for radioactive substances and associated monitoring activities in the financial year 2023/24 were approximately £21m.

Human Resources

A2.11 The average number of full-time equivalent staff in the Environment Agency in 2023-24, was 13,070, although only a small proportion of these are involved in nuclear regulation. The nuclear regulatory groups have a total of around 90 technical staff, with additional programme support.

Inspectors' Qualifications

A2.12 Nuclear regulatory staff recruited by the Environment Agency are required to have a good honours degree in science or engineering, and several years' experience in a technical or management role in the nuclear industry. As part of its Strategic Workforce Planning and to build various career pathways, the Environment Agency also sponsors nuclear graduates on a cross-industry programme and in 2023 employed nuclear engineering degree apprentices for the first time.

Inspectors' Training

A2.13 The Environment Agency has established standards of competency for its staff involved with the regulation of radioactive substances. Competence standards for nuclear regulation are separately identified within the overall framework.

A2.14 The standards are used as a benchmark for all staff, but the need to undergo a structured programme depends on the individual's experience. For more experienced staff, the standards are used informally to better target professional development. For new inspectors, attainment of the competency standards is mandatory and these are used in a formal manner.

A2.15 Developing the competences of staff is achieved by combination of structured training (for example on legal requirements) and developmental experience (for example onsite inspection or issuing Enforcement Notices). The system adopted by the Environment Agency allows for competences to be demonstrated and the standards achieved to be recorded. More experienced staff act as mentors for new staff going through the competences programme.

Scottish Environment Protection Agency (SEPA)

Mandate and Duties

A2.16 The Scottish Environment Protection Agency (SEPA) was established by the Environment Act 1995 and is Scotland's principal environmental regulator. SEPA is responsible for regulating a wide range of activities including waste, water, contaminated land and industrial emissions as well as radioactive substances activities relating to public exposures in Scotland.

A2.17 SEPA's statutory purpose is set out in the Regulatory Reform (Scotland) Act 2014, which requires it to carry out its functions for the purpose of protecting and improving the environment, including managing natural resources in a sustainable way. In carrying out these functions, SEPA must contribute to improving the health and well-being of people in Scotland and achieving sustainable economic growth insofar as this is not inconsistent with its regulatory functions.

A2.18 SEPA independently regulates the management of radioactive waste at nuclear and non-nuclear facilities and the management of radioactive material, including radioactive source security, at non-nuclear facilities in Scotland. Radioactive substances activities are regulated under the Environmental Authorisations (Scotland) Regulations 2018 (EASR18).

A2.19 SEPA works with Food Standards Scotland (FSS) on a joint environmental monitoring programme that measures levels of radioactivity in food and the environment in Scotland. The results of environmental monitoring are used to assess public exposures from the consumption of food and doses arising from radioactive waste disposals.

Organisational Structure

A2.20 SEPA is constituted by a Board that is appointed by, and responsible to, the Scottish Ministers, who in turn are accountable to the Scottish Parliament for the policy and actions of the Scottish Government. The Board has responsibility for ensuring that SEPA fulfils the aims and objectives set by Scottish Ministers, and membership of the Board includes a Chief Executive to whom is delegated the day-to-day management of SEPA.

A2.21 SEPA's Radioactive Substances Unit is a specialist team of around 30 people whose time is focussed on specialising in all aspects of radioactive substances. The Unit is divided into four teams which cover nuclear regulation, non-nuclear regulation, and the policy and science functions.

Financial and Human Resources

A2.22 SEPA has legal powers that allow it to recover costs for the regulation of operators. It also receives finance from the Scottish Government in the form of grant-in-aid for work that is not cost recoverable and from other sources such as a financial agreement with the NDA.

A2.23 In the financial year 2023/24, SEPA's total income was £96.9m, of which £45.5m was grant-in-aid from the Scottish Government.

A2.24 SEPA has approximately 1200 staff working together to protect and improve the Scottish environment by using a combination of legislation and good practice measures.

A2.25 SEPA has established a capability assessment matrix for staff in the Radioactive Substances Unit that is based on IAEA good practice, the requirements of 'National Occupational Standards for Nuclear Regulators' and the core syllabus for radioactive waste advisers. The capability assessment matrix defines the range of competences and skills that staff in the Radioactive Substances Unit are expected to have to deliver their role effectively and competently.

A2.26 All radioactive substances specialists have academic qualifications and experience relevant to their function on entry into SEPA and will receive any additional training needed for them to carry out their function. Additional training needs are identified based on the capability assessment matrix.

A2.27 The performance and development of staff is continuously monitored and is formally reviewed annually.

Natural Resources Wales[2]

Mandate and Duties

A2.28 NRW is a Welsh Government Sponsored Body and came into existence in April 2013. Its core purpose is to pursue the sustainable management of natural resources as set out in the Environment (Wales) Act 2016. From April 2013, Natural Resources Wales (NRW) became responsible for the enforcement of environmental protection in Wales. As the competent authority in Wales, NRW acts as the independent environmental regulator of Wales's civil nuclear industry and regulates the management and disposal of radioactive waste and other hazardous waste types on or from specific civil nuclear sites through radioactive substances activity environmental permits issued in accordance with the provisions of the Environmental Permitting (England and Wales) Regulations 2016. NRW also regulates other environmental matters on civil nuclear sites under EPR 2016 and other relevant legislation.

A2.29 NRW is the largest Welsh government Sponsored Body, largely taking over the functions of the Countryside Council for Wales, Forestry Commission Wales and the Environment Agency in Wales, as well as certain Welsh government delegated functions (such as Marine Licensing).

A2.30 NRW are responsible for delivering compliance, permitting, and enforcement for conventional environmental permits at licensed sites and permitting and enforcement for nuclear regulation matters. Nuclear compliance activities in Wales continue to be delivered by the Environment Agency on behalf of NRW and will do for the foreseeable future. The decision making accountability remains with NRW. NRW are also a statutory advisor and designator of protected sites such as Sites of Special Scientific Interest.

[2] Currently there are no nuclear installations in Wales that falls within the scope of the Convention. Information about Natural Resources Wales is included in this annex for completeness.

A2.31 Using its statutory functions, NRW issues various permits, licences, consents and registrations, ranging from major industrial operations, such as a licence to operate large combustion plant, down to domestic matters such as septic tank licensing.

A2.32 NRW's statutory functions include administering the Environmental Permitting Regulations 2016 (EPR16) in Wales. The provisions of EPR16 fall within the competence of the devolved administrations in the UK, including the Welsh government.

A2.33 Through a standing Service Level Agreement (SLA) the Environment Agency delivers nuclear compliance activities on behalf of NRW. This covers day to day regulation of the nuclear permit, detailed technical site audits and inspections applying a high level of scrutiny to the nuclear site operations. Each site has a nominated Environment Agency Nuclear Site Inspector who acts as an agent for NRW, maintaining an NRW warrant to do so. They make recommendations but NRW retain the final decision-making capacity for all aspects of site regulation.

A2.34 As part of the SLA, The Environment Agency undertakes radiological monitoring of the environment in Wales on behalf of NRW in addition to the conventional environmental monitoring that NRW conducts. The results of the radiological environmental monitoring programme is published annually in the RIFE jointly produced by the environment agencies FSA and FSS.

Structure

A2.35 Members of NRW's board are collectively responsible to the Welsh government for ensuring that the environment and natural resources of Wales are: sustainably maintained, sustainably enhanced and sustainably used. They are responsible for developing and approving the long-term strategy for NRW in order to meet its responsibilities and duties under the Natural Resources Body for Wales (functions) Order 2013.

A2.36 The Board of NRW consists of a Chair and not fewer than 5 and no more than 11 other members appointed by the Welsh Ministers, the Chief Executive and not fewer than 2 and no more than 4 other members appointed by the body.

A2.37 Day to day running of the organisation is delegated to the Executive team.

A2.38 The delivery of nuclear and non-nuclear radioactive substances policy, strategy and regulation is delivered by several functions within the organisation including engagement with UK and Welsh government, regulatory partners, operators and stakeholders.

Financial Resources

A2.39 NRW's income is derived chiefly from three sources:

- Government grant-in-aid, which helps to finance, amongst other things, flood and coastal risk management
- Income raised from charging for regulation
- Commercial activities, such as income from timber

A2.40 Through the SLA, NRW pay the Environment Agency a fee to undertake regulatory activity within Wales.

Human Resources

A2.41 NRW has approximately 2000 staff following an internal restructuring programme. In terms of nuclear regulation, there is a team of 6 in the Radioactivity and Nuclear team working on nuclear policy, strategy and regulation, including aspects related to advanced nuclear technologies and nuclear new build (Generic Design Assessment (GDA)), environmental permitting and decommissioning of the existing nuclear sites in Wales, and environmental

permitting and regulation for non-nuclear sites subject to non-nuclear radioactive substances regulation. This team includes a specialist nuclear compliance officer who works on compliance activities at the 2 existing nuclear licensed sites in Wales (Trawsfynydd and Wylfa). NRW belong to several nuclear policy and strategy regulatory working groups, working closely with partner regulators (specifically ONR, Environment Agency and SEPA) as well as government departments, nuclear operators, designers and developers.

A2.42 Within the wider operational functions, 7 specialist non-nuclear compliance officers work within 4 area teams (North, South East, South Central and South West Wales) delivering compliance of non-nuclear radioactive substances regulation. In addition, several specialists from other operational teams work closely with Environment Agency staff delivering the compliance activity for NRW at the nuclear sites within their area. This includes matters such as conventional waste issues, non-radiological discharges, conservation, habitats, planning and flooding issues.

Inspectors' Qualifications and Training

A2.43 NRW do not directly employ nuclear site inspectors but rather contract the services of the Environment Agency to deliver the day-to-day compliance activity of the nuclear environmental permits for the 2 nuclear licensed sites alongside the NRW specialist nuclear compliance officer.

Openness and transparency of regulatory activities

A2.44 The environmental regulators the Food Standards Agency (FSA) and Food Standards Scotland (FSS) publish a joint report annually on Radioactivity in Food and the Environment (RIFE) in the UK, which also includes estimated doses to the public. The Environment Agency also publishes an annual report 'Regulating for people, the environment and growth' that reports on its regulation work and the environmental performance of regulated businesses in England.

A2.45 The environmental regulators also have well-established mechanisms for communicating and engaging with the public and interested groups including attendance at quarterly Site Stakeholder Groups and Local Liaison Committees. Non-routine site matters (e.g. enforcement letters, incidents) are reported at these meetings. The Environment Agency also has an extensive programme of engagement meetings with non-governmental organisations (NGO) and communities around high public interest nuclear sites. These are both face-to-face and online. Public and stakeholder enquiries are also responded to through the Customer Contact Centre and via email. Regular eBulletins about nuclear regulation are issued to stakeholder lists – both national and local to sites and via social media.

A2.46 The environmental regulators attend events and conferences organised by others to engage with the public and stakeholders and promote understanding of their work. This includes science fairs for children, STEM events, parliamentary receptions, industry conferences and international events.

A2.47 The environmental regulators work with broadcast, print and digital media outlets, using a variety of channels to promote their work, responding in an open and prompt manner wherever possible. They publish news stories and blogs where appropriate to promote publications, announcements and consultations. They publish information and guidance about regulation of nuclear sites and radioactive substances on their websites and use social media channels to engage with stakeholders. All the environmental regulators have press offices that are accessible 24 hours – during working hours for 'routine' enquiries and out of hours for urgent issues and emergencies.

A2.48 The environmental regulators also communicate with government and the devolved administrations through working and senior level contacts within Defra, DESNZ, Scottish Government, Welsh Government, and with the Ministry of Defence (MoD).

A2.49 The environmental regulators want their decisions to be better informed through good engagement. They use consultations to allow anyone who wishes to the chance to take part in their decision making. Relevant comments and information are taken into account and used to help inform determination of permit applications and improve decision making.

A2.50 The environmental regulators also consult the public and relevant organisations on any other application if they consider it appropriate, for example applications of high public interest (HPI). They may carry out additional consultation if:

- any significant changes are made to an application, for example a change to the proposed activity or operator
- they receive new information about the application
- High public interest applications (this is decided on a case-by-case basis).

A2.51 To reach their decision, the environmental regulators consider all the relevant information, including:

- whether the interest relates to issues regulated under an environmental permit
- the breadth and scale of interest – for example, the number of different sources such as individuals, interest groups, businesses, local councillors, media and whether there is ongoing engagement from the local MP
- whether the interest is, or is likely to be, sustained for a period of time

A2.52 Consultation processes differ slightly between the environment agencies, but both Environment Agency and SEPA use on-line platforms, supplemented by information in traditional media and social media to reach their target audiences.

Annex 3 – SFAIRP, ALARP and ALARA

A3.1 The SAPs are consistent with 'Reducing Risks, Protecting People: HSE's Decision-Making Process' (R2P2) [164], which provides an overall framework for decision-making to aid consistency and coherence across the full range of risks falling within the scope of HSWA74. This extended the framework in The Tolerability of Risks from Nuclear Power Stations (TOR) [165]. In R2P2, 'hazard' is defined as the potential for an intrinsic property or disposition of something to cause a detriment, and 'risk' is the chance that someone or something is adversely affected by the hazard. In these SAPs, anything that is capable of causing harm is termed a 'hazard'. The relative importance of hazard and risk in determining the acceptability of control measures will vary according to the circumstances. In some cases, particularly where the hazard is particularly high, or knowledge of the risk is very uncertain, ONR may choose to concentrate primarily on the hazard.

A3.2 R2P2 describes risks that are unacceptably high and the associated activities would be ruled out unless there are exceptional reasons, and also the risks that are so low that they may be considered broadly acceptable and so no further regulatory pressure to reduce risks further need be applied. However, the legal duty to reduce risk so far as is reasonably practicable (SFAIRP) applies at all levels of risk and also extends below the broadly acceptable level. The overall risk levels set out in R2P2 and TOR have been translated into specific numerical targets within the SAPs. The derivation and basis for the SAPs numerical targets are described in Annex 2 of the SAPs.

A3.3 Though R2P2, TOR and the SAPs , meeting relevant good practice in engineering and operational safety management is of prime importance. In general, ONR has found that meeting relevant good practice in engineering, operation and safety management leads to risks that are reduced SFAIRP and numerical risk levels that are at least tolerable, and in many cases broadly acceptable.

A3.4 HSE and ONR guidance generally uses the term 'as low as reasonably practicable' (ALARP) as a convenient means to express the legal duty to reduce risks SFAIRP. For assessment purposes the terms ALARP and SFAIRP are interchangeable and require the same tests to be applied. ALARP is also equivalent to the phrase 'as low as reasonably achievable' (ALARA) used in relation to ionising radiations exposure by environmental regulators and other bodies nationally and internationally.

A3.5 The SAPs assist inspectors in the judgement of whether, in their opinion, the designers or dutyholder's safety case has satisfactorily demonstrated that the requirements of the law have been met. The guidance associated with each principle gives further interpretation on their application.

A3.6 The starting point for demonstrating that risks are ALARP and safety is adequate is that the normal requirements of good practice in engineering, operation and safety management are met. This is a fundamental expectation for safety cases. The demonstration should also set out how risk assessments have been used to identify any weaknesses in the proposed facility design and operation, identify where improvements were considered and show that safety is not unduly reliant on a small set of particular safety features.

A3.7 The development of standards defining relevant good practice often includes ALARP considerations, so in many cases meeting these standards will be sufficient to demonstrate that legal requirements have been satisfied. In other cases, for example where standards and relevant good practice are less evident or not fully applicable, or the demonstration of safety is complex, the onus is on the dutyholder to implement measures to the point where it can demonstrate that the costs of any further measures would be grossly disproportionate to the reduction in risks achieved by their adoption.

A3.8 The principles (SAPs) are used in helping to judge whether reducing risks to ALARP is achieved and that is why they are written using 'should' or similar language. Priority should be given to achieving an overall balance of safety rather than satisfying each principle, or making an ALARP judgement against each principle. The principles themselves should be met so far as is reasonably practicable. This has not been stated in each case to avoid excessive repetition. ONR's inspectors need to apply judgement on the adequacy of safety in accordance with HSE guidance on ALARP and ONR's more detailed guidance written specifically for the nuclear context.

A3.9 In many instances it will be possible for dutyholders to demonstrate that the magnitude of the radiological hazard will result in doses that will be so low (for example in relation to legal limits) that detailed consideration of off-site effects and/or worker risks is unnecessary.

A3.10 The application of the ALARP process should be carried out comprehensively and consider all applicable principles, with all relevant risks considered as a combined set. When judging whether risks have been reduced to ALARP, it may be necessary to take account of conventional risks in addition to nuclear risks and justify that an appropriate balance has been achieved.

Annex 4 – Safety Related Issues and Safety Upgrade Programmes

Overview of safety related issues

A4.1 Overview of some of the key Nuclear Safety related issues in the UK's operating fleet of NPPs during the reporting period is given below.

Heysham 1: Steam valve event and recovery

A4.2 On the 23rd of December 2023, with Reactor 1 in start-up, Heysham 1 declared a site incident in response to a major clean steam leak in the reactor building. This was subsequently identified as being due to a leak from a main steam supply route main isolating valve. A main steam stop valve was found to have failed and the tail spindle ejected from the lower part of the valve resulting in a significant steam leak (high pressure, 140 Bar, and temperature, 480°C).

A4.3 The failure was caused by high temperature assisted corrosion, leading to significant oxidation of the threaded components driving a reduction in strength and thread integrity. The significant steam release and consequential damage led to the controlled shutdown of Reactor 1. Due to the timing of the start-up and the time of the failure there were no personnel located near the steam valve, therefore, no injuries occurred because of this event.

A4.4 Assessment of the extent of condition identified the potential for similar events on other valves of this type. A decision was made to proactively shutdown Unit 2 at Heysham 1 and Units 1 and 2 at Hartlepool as part of a fleet event recovery to ensure safety and a fleet event recovery organisation was established. Sixteen main steam stop valves were replaced with newly forged valve spindles across 4 reactors at Heysham 1 and Hartlepool. The root cause investigation into the event reviewed a timeline of over 50 years from 1971 to 2023.

A4.5 Two key opportunities to prevent this failure were identified, with a main steam valve tail spindle ejection failure at Cockenzie power station in 1995 (the same valve design) and a Weir (the original equipment manufacturer) Company Instruction issued in 2008. OPEX from the Cockenzie event and the follow up safety instruction were both received by the company and stations at the time they were issued as OPEX and placed into EDF Energy NGL's organisational learning processes.

A4.6 Company processes to address the OPEX were initiated including lab investigations and reports following the 1995 event and a series of recommendations agreed. However not all of these recommendations were completed, and Catalogue IDs were not changed on the tail spindles that were modified from 12 Threads per Inch (TPI) to a coarser 8 TPI, meaning it was not possible to identify which spindles had and had not been replaced. On investigation it was found only some were replaced but there were no work order cards to drive this to completion.

A4.7 There remains a fleetwide decision to be made in relation to the remaining population of valves, of the same design, in feed systems across both operating and defuelling NPPs. This thread form remains inconsistent with the Original Equipment Manufacturer (OEM) advice of 8 TPI. As such, an AGR feed valve replacement and forensics programme was established. This programme underpins the medium-term management of remnant risk across the fleetwide feed system valve populations, in addition to ongoing assessment of risk to other similar valves of the same design as the Heysham 1 valve failure.

A4.8 There is active sharing of progress and understanding with Bureau Veritas (discharging the Pressure Systems Safety Regulations (PSSR) Competent Person role) and Trillium (OEM), including engagement at Programme Board.

A4.9 Following preliminary enquiries, ONR issued an improvement notice to EDF under the PSSR 2000 (PSSR) Regulation 12 (Maintenance) and the Health and Safety at Work etc. Act 1974 Section 2(1). EDF Energy NGL has complied with this improvement notice.

A4.10 EDF Energy NGL continues to engage with ONR through formal and informal interactions, to openly discuss the fleetwide position with respect to the learning and committed work programmes post Heysham 1 valve failure.

Torness: Variable Frequency Converters (VFCs) and Variable Speed Drives (VSDs)

A4.11 Advanced Gas-cooled Reactors (AGRs) at Torness NPP use Gas Coolant Circulators, powered by 11kV switchgear or a 3.3kV variable supply for different operational conditions. Following a planned shutdown of Reactor 2 in January 2023, some circulators failed, prompting a review and updates to maintenance procedures. (This incident was given an INES-1 Rating. See Table 3 – Summary of Incidents and associated INES Ratings).

A4.12 Another shutdown in November 2023 saw further circulator failures, leading to detailed investigations and a Safety Case to justify continued operation (This incident was given an INES-2 Rating. See Table 3 – Summary of Incidents and associated INES Ratings).

A4.13 Following the second failure, additional measures were taken to enhance the robustness of the VFC/VSD systems, including the improvements to processes and management systems and no further failures have been recorded since November 2023. Ongoing through life support for remaining life of the stations is and will be managed as follows:

- For VSDs, ongoing through life support is provided by the OEM and station/centre based SQEPs.
- For VFCs specialist maintenance resource will supplement station/centre based SQEPs, together with the manufacture and refurbishment of components/circuit boards by alternative well established sub-contractors.

A4.14 A number of interventions have taken place between EDF Energy NGL and ONR to provide updates on the improvements being undertaken, this also includes OPEX sharing with Heysham 2 who have the same equipment. ONR also issued an enforcement letter to both Torness and Heysham 2 following the incident in November 2023 to which EDF Energy NGL has responded. ONR also followed up with scheduled interventions at Torness and Heysham 2 to sample the adequacy of the improvements implemented at both stations and for stations to provide an update on future improvement programme.

Heysham 2 & Torness: Seal Ring Groove Wall (SRGW) debris mitigation programme

A4.15 Heysham 2 and Torness reactors have a slightly different design of graphite bricks compared to the other AGRs. Consequently, there is a possibility that subsequent operation after the bricks have developed a Keyway Root Crack (KWRC) could lead to a further degradation where fragments of the graphite brick break off in the fuel channel annulus. This could potentially challenge the free movement of fuel during fuel discharge although, by design, there are safety systems in place to prevent damage to fuel stringers in the event of high loads when removing fuel.

A4.16 To address this risk, an inspection programme has been developed to find and follow the first keyway root cracked bricks and to see the subsequent development of graphite fragments and debris.

A4.17 Keyway root cracking has been observed at Heysham 2 and Torness. Two types of fragment development have been seen:

- small fragments at brick end due to brick cracking in axially adjacent cracked bricks
- circumferential cracks at the Seal Ring Groove Wall (SRGW), which could lead to much larger fragments, but no cracks have yet developed to full length

A4.18 Experimental support from a test rig has demonstrated that small fragments will more readily entrain but present little challenge to fuel movement and large (SRGW) fragments are very unlikely to entrain but would present more of a challenge to fuel movement. There is work underway to put this evidence into a revised safety case to support operation up to the EoG as well as continued monitoring of the core.

Safety Upgrade Programmes

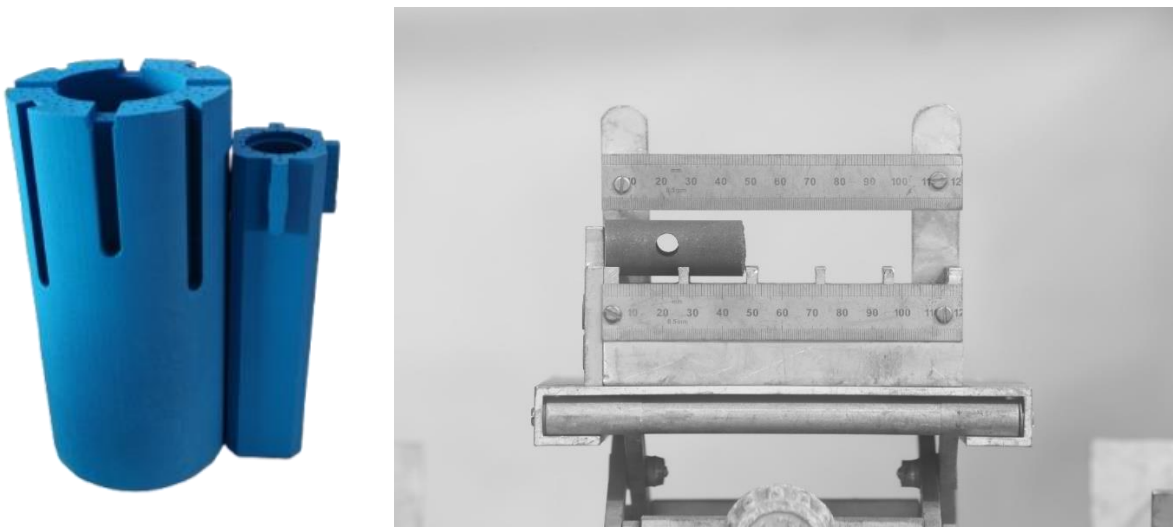
A4.19 Some examples of safety upgrades (that have progressed during the reporting period) to support safe operation of the UK's NPPs are illustrated below.

Hartlepool and Heysham 1: Control Rod Channel Trepanning Equipment (CRCTE)

A4.20 Trepanning the fuel channels of the AGRs is a mature process, with extant inspection equipment and a sizable data set. Trepanning enables material analysis of the graphite reactor cores of the AGRs, enabling forecasting of graphite core degradation. In Q4 2022, a project was enacted to develop tooling to retrieve trepanned samples from within the control rod channels at Hartlepool and Heysham 1 NPPs.

A4.21 Figure A4.1 (left) shows a fuel and control rod channel at Hartlepool and Heysham 1. The aim of this new equipment was to retrieve samples from unsampled parts of the graphite reactor core, to provide new material information and ultimately reduce the uncertainty in graphite core models. Samples are approximately 19mm in diameter and 45-47mm in length. An example is shown in figure A4.1 (right)

Figure A4.1: Model extract of fuel and control rod channels from an AGR (left); Trepanned sample (right)



A4.22 Due to the difference in diameter between fuel channels and control channels, new trepanning equipment was needed.

A4.23 The equipment was successfully deployed at the Hartlepool Reactor 2 outage in September 2024 (see figure A4.2). The equipment retrieved the intended 72 samples (8 channels and 9 samples per channel) within the planned outage timescales. The samples were processed at National Nuclear Laboratories (NNL), and slice density data was obtained for these samples at the start of April 2025 with full property measurements due in September 2025. The second deployment of Control Rod Channel Trepanning was completed at Heysham 1 in February 2025 and retrieved the target of 72 samples (8 channels and 9 samples per channel). Initial sample photography and whole core density data is due in mid-2025. The third deployment of Control Rod Channel Trepanning is expected to complete at Hartlepool in mid-2025 with a target of 72 samples.

Figure A4.2: Deployment of the CRCTE at Hartlepool R2, September 2024

Hartlepool and Heysham-1: Improvements to the diversity of boiler feedwater routes

A4.24 Recent updates to the probabilistic safety assessment of the Hartlepool and Heysham 1 stations identified the need to focus on the provision of adequate diverse boiler feed routes, in particular regarding the use of untreated townswater. Concurrently, degradation of plant systems at Hartlepool and Heysham 1 has increased cooling water losses, which led to an INES-1 rated event at Hartlepool. (See Table 3 – Summary of Incidents and associated INES Ratings)

A4.25 Measures taken so far to address these issues, and reduce the nuclear safety risk include: provision of on-site water treatment trailers, on-site deployment of an additional back-up pump, and strengthening of existing claims around the availability and use of outage cooling systems as risk mitigation.

A4.26 Work is ongoing to consider further plant enhancements, and to produce a consolidated safety case to manage station risk until end-of-life.

Hartlepool and Heysham 1: Water hammer in pressure systems

A4.27 Following dynamic loading events at Hunterston B in 2018, a fleet event recovery delivered a long-term safety case strategy for managing the nuclear and industrial safety risks resulting from hydraulic shock (also known as water hammer) in pressure systems. Following a subsequent event in December 2023, line stops were installed as a further mitigation. There are several outstanding dynamic loading actions for Heysham 1/Hartlepool relating to the event recovery and a dynamic loading programme board was established by EDF Energy NGL in Q2 2024 to provide oversight of these outstanding actions.

Hartlepool: Replacement of bulk fuel oil tanks

A4.28 The Hartlepool Bulk Fuel Oil Tanks (BFOTs) are a part of the Gas Turbine fuel oil system, which ultimately helps to provide electrical supplies to essential plant in the event of loss of grid. Initial inspections in 2021, and subsequently in 2023, revealed several areas of corrosion degradation on the shell of BFOT 2. To mitigate the potential for further degradation, a decision was then taken to replace the existing BFOTs instead of carrying out repairs. The new tanks are designed to the same dimensions of the existing tanks but with increased wall thickness to meet seismic qualification requirements, allowing them to meet the original 1110m^3 design capacity and an overall increase in the usable fuel volume. The new BFOT 2 has been fully constructed and was filled in April 2025; the completion of BFOT 1 will follow.

Heysham 1: Corrosion management

A4.29 At Heysham 1, over the past 7 years, a dedicated team have been ring-fenced to proactively manage corrosion risk. A suitable risk-based inspection programme is in place with the resources to implement any associated remediation. This work is often in areas that are challenging to access. As this risk-based inspection programme has matured, the corrosion risk has steadily reduced but as is expected with an ageing asset, corrosion remains an ongoing threat and failures have still occurred.

A4.30 Recognition that corrosion of the plant needs to be managed throughout all phases of station life and well beyond end of generation is key to underpinning fit for purpose plant that meets the requirements of relevant legislation. Hence the Heysham 1 strategy is for no environmental corrosion failures that would impact nuclear, industrial, or environmental safety until 2040. This is also supported through mandatory protective coating standards, confirming adequate surface preparation and coating application to ensure a 'right first time' approach.

Heysham 1: Improvements in pressure vessel cooling for an Extended Loss of Grid (ELoG) scenario

A4.31 In 2016, through interaction with National Grid, NGL identified that a nationwide loss of grid could extend for a significant duration (leading to depleted water stocks for post trip cooling). Since then a significant programme of work has been undertaken to ensure post trip cooling provisions at all NPPs sites in the UK. This work has been outlined in the UK's previous national reports.

A4.32 At Heysham 1, there is ongoing activity related to improving the second line of protection for pressure vessel cooling in the event of an ELoG. A seawater to townswater back up system was installed and completed in 2023 but the requirements for further work related to the seawater take off point was identified in late 2023/early 2024 that affected full availability of the system to meet the ELoG safety case requirements. After initial mitigations were put in place during 2024 further modifications are being pursued during 2025 on both this seawater system and the wider second line of protection fault sequence to ensure risks are reduced to as low as reasonably practicable (ALARP).

Heysham 2/Torness: Leak termination system

A4.33 In response to the 2008 Periodic Safety Review 2, it was recognised that while the water ingress safety case for Heysham 2 and Torness was robust, some updates were required. Water ingress faults in AGRs pose significant risks, and actions were taken to address these in the safety case. In 2023, the decision was made to install an automatic Leak Termination System (LTS) to mitigate water ingress and reactor overpressure faults, ensuring that risks remain tolerable and ALARP. Work on the safety case update and the LTS implementation is ongoing through 2025/2026.

Heysham 2/Torness: Offload Depressurised Refuelling

A4.34 The Heysham 2 and Torness AGRs, which were historically refuelled at reduced power (Low Power Refuelling or LPR), have been using Offload Depressurised Refuelling (ODR) since late 2020 due to equipment issues and graphite core ageing. In June 2022, it was decided not to return to LPR. A review is underway to understand the impact of a permanent shift to ODR on reactor safety, using a systematic approach to identify operational changes and assess safety impacts.

Sizewell B: Core Barrel Cracking – Response to International OPEX

A4.35 Five defects were found in the core barrel of Robinson Unit 2 (3-loop PWR) in the US during routine inspection in December 2022. Investigations to determine the root cause(s) are ongoing, and as such, the applicability of the OPEX to Sizewell B has not yet been determined.

A4.36 The core barrel forms part of the reactor internal structures and plays an important role in maintaining the fuel assemblies in a coolable geometry. The consequences of core barrel failure have not been assessed (this is consistent with all other similar PWRs), and consequently there is a very high integrity claim placed on the core barrel structure. The onerous integrity requirements are unique to Sizewell B.

A4.37 A review of the manufacturing records for the Sizewell B core barrel has confirmed that it was built to high standards, however a conservative decision was made that the Sizewell B core barrel could be subject to the same degradation mechanism as Robinson Unit 2. Inspection of key welds with the Sizewell B core barrel in-situ was therefore carried out in November 2024, and it was confirmed that there were no defects present.

A4.38 Work is ongoing to provide confidence that Sizewell B would be resilient to the types of defects detailed in the Robinson OPEX. This could involve additional inspections, updating structural integrity analysis to accommodate additional degradation mechanisms, and fault studies analysis to understand the consequences of core barrel failure.

Sizewell B: Stress Corrosion Cracking Programme - Response to International OPEX

A4.39 In 2021/2022, inspections found defects in the welds of safety injection system lines and residual heat removal system lines on five plants operated by EDF-SA in France. Investigations fleet-wide found further cracking and determined the cause to be Inter-Granular Stress Corrosion Cracking (SCC). Widespread replacement of affected lines was implemented by EDF-SA, along with a specific Ultrasonic Testing (UT) technique and investigation into the root cause of the SCC defects remains ongoing.

A4.40 Prior to Refuelling Outage (RO) 18, Sizewell B undertook a review of welds on all susceptible lines based on EDF-SA guidance. This included a review of failure consequence, pipe size, spatial configuration, weld process and procedures and the location of any weld

repairs and produced a list of most at-risk locations for consideration for UT inspection. This list was further developed prior to RO19, utilising the latest OPEX from EDF-SA and worldwide.
A4.41 An SCC specific UT technique was developed for deployment at Sizewell B by two vendors, as well as acceptance criteria developed for sentencing of the UT inspection results.
A4.42 During RO18, 23 weld locations were inspected using UT and a further 10 visual inspections were completed. No recordable indications were found. During RO19 a further two welds were inspected with no recordable indications.
A4.43 Long-term, a total list of SCC-UT inspections covering all at-risk locations has been included as part of the augmented inspections in the In-service inspection programme.

Sizewell B: Filtered Containment Venting - Response to International OPEX

A4.44 The events at Fukushima in 2011 led EDF Energy NGL to review the resilience of its nuclear power plants to severe accident fault situations, in particular station blackout scenarios. The review at Sizewell B suggested a number of potential modifications to mitigate against beyond design basis severe accidents, including the potential installation of a Filtered Containment Venting (FCV) system. Following a subsequent period of further optioneering it was decided that an FCV system would be installed.
A4.45 Following a core melt, within a few hours the molten core may exit the reactor pressure vessel and enter the reactor cavity. It will continually generate both heat and a large volume of gases (predominantly steam), which causes the containment pressure to increase rapidly. The proposed system will include a filter and a series of isolation valves leading to a dedicated stack which would provide a filtered release path for the containment atmosphere under severe accident conditions, in preference to conceding primary containment failure and a large uncontrolled release.
A4.46 The FCV system represents the first of a kind in the UK, which is specifically designed for the most onerous of PWR severe accidents. The site activities have commenced, and the implementation of the proposed system is expected to be completed in the second half of this decade, also supporting the planned life extension of Sizewell B. ONR has regular engagement with EDF Energy NGL to monitor the progress of the project.

Grid Stability Work

A4.47 The UK aims to achieve net-zero carbon emissions by 2050, necessitating significant changes to the transmission system to support a low-carbon energy system. Historically optimised for large synchronous generators, the system must now adapt to the closure of thermal power stations and the rise of non-synchronous generators, energy storage, and interconnectors. This adaptation must ensure the reliability and quality of power supplies to EDF's nuclear power stations. Recent grid instability events, particularly sub-synchronous oscillations in Scotland affecting Torness, have highlighted challenges. The National Energy System Operator struggled to identify the source of these oscillations and is now implementing defensive measures. Expected grid code changes will require EDF and other generators to provide electro magnetic transient models for system-wide simulations. Additionally, the transmission system continues to experience faults impacting some stations, prompting close collaboration with Transmission Owners to minimise risks and enhance resilience.

Fleetwide ageing management programmes

A4.48 In addition to the safety upgrade programmes discussed above, EDF Energy NGL continues to focus on the maintenance of suitable arrangements, with underpinning technical standards, competency and behaviours, to effectively manage the ongoing challenge presented by ageing related issues such as corrosion and PSSR across both the operational

and the defuelling sites. Such arrangements are required by LC28 for the regular and systematic examination, inspection, maintenance and testing of all plant that may affect safety.

A4.49 EDF Energy NGL continues to engage with ONR through formal and informal interactions, to openly discuss the fleetwide position with respect to corrosion management, PSSR and any particular OPEX of note, to share organisational learning.

A4.50 Sizewell B benefits from the availability of international OPEX from other PWRs worldwide, and engagement is being maintained with relevant sources of this OPEX, to facilitate the intelligent assessment and impact to the safety case. Of note are OPEX in relation to reactor pressure vessel core barrel in-service degradation (US OPEX) and stress corrosion cracking (EDF France OPEX), discussed above, which have led to additional inspection scope for the last two refuelling outages, increasing the robustness of the safety case, and maintaining a proactive stance.

A4.51 The Heysham 1 steam valve event also led to the establishment of an AGR Feed Valve Replacement and Forensics Programme as discussed above.

A4.52 A wide range of control and instrumentation (C&I) equipment and systems can be affected by ageing and obsolescence; recent examples of which include

- Neutron flux detectors
- Computer-based data processing and control systems
- Reactor protection systems equipment such as relays and in-core thermocouples

A4.53 Inadequate management of ageing and obsolescence of C&I equipment and systems can have a significant detrimental impact on nuclear safety. It is ONR's expectation that licensees have robust and proactive arrangements to enable ageing mechanisms and equipment obsolescence issues to be identified and mitigated before associated failures occur. These arrangements should include periodic equipment condition inspections, trending of test results and active engagement with the supply chain. ONR continues to actively engage with licensees to encourage them to develop such arrangements.

A4.54 ONR has recently seen good examples of cross-system and fleetwide guidance that has been produced by licensees for issues such as printed circuit board tin whiskers and dendrite growth, tantalum capacitor ageing and neoprene insulation degradation and breakdown. ONR has also reviewed EDF's ageing and obsolescence management strategies, which have ranged from reinforcing existing systems to replacing all items of vulnerable equipment on an OPEX-informed periodic basis.

Annex 5 – Safety Analysis of UK Nuclear Power Plants

Consideration of fault and accident conditions

A5.1 Nuclear facilities in the UK require safety cases that assess the risks from both normal operation and from fault and accident conditions. Fault analysis is required comprising of suitable and sufficient Design Basis Analysis (DBA), Probabilistic Safety Analysis (PSA) and Severe Accidence Analysis (SAA) to demonstrate that the risks are as low as reasonably practicable (ALARP). It is ONR's expectation that these three complementary techniques are applied to nuclear power generating facilities to demonstrate the adequacy of the design and activities being undertaken, whether this is for an existing facility or a new design.

A5.2 The deterministic approach is used in the analysis of design basis accidents to demonstrate the capability of the safety systems. As part of this approach, the dutyholders are expected to ensure that a small change in design basis parameters does not lead to a disproportionate increase in radiological consequences (cliff-edge effects). Analyses are also undertaken for more severe faults outside the design basis, and of severe accidents that could lead to large releases of radioactivity. These severe accident analyses include study of the potential failures of the physical barriers to the release of radioactivity, analysis of the magnitude and characteristics of the releases, identification of the accident management strategies to reduce the risk, together with the necessary equipment, instrumentation, and accident management procedures.

A5.3 It is ONR's expectation that dutyholders carry out DBA to provide a robust demonstration of the fault tolerance of the engineering design and the effectiveness of the safety measures. Relevant good practice in the UK is that the design basis should include internal faults in the facility that have an initiating frequency down to 1×10^{-5} per annum (p.a.) and natural hazards that conservatively have a predicted frequency of down to 1×10^{-4} p.a.

A5.4 The PSA provides a comprehensive, systematic analysis of the plant response to a fault condition and the numerical analysis of the risk from the plant, to support the demonstration of safety. ONR's SAPs [28] expect PSA to be performed as part of the fault analysis and design development and analysis, and to be used to inform the design process and help ensure the safe operation of the site and its facilities. The PSAs for all operating reactors within the UK are 'living PSAs', which are updated periodically, and to incorporate significant changes to plant or operations. The updates include revisions to initiating event frequencies, plant reliability data, hazards analysis and other modelling aspects.

A5.5 The PWR at Sizewell B has a full scope Level 1, 2 and 3 PSA. The Level 1 PSA is updated to provide an estimate of the core damage frequency as part of the living PSA programme, and this is used to provide revised Level 2 and 3 dose/risk information.

A5.6 The PSAs for the AGR fleet are hybrid PSAs. They include a Level 1 PSA and elements of a Level 3 PSA in the form of off-site dose estimates to a person in five dose bands (the dose bands are those shown in Target 8 of ONR's SAPs). As a result of the UK response to the Fukushima accident, a Level 2 PSA was produced for one AGR that is representative of the fleet. EDF Energy NGL took the lessons from that study and carried them through to the other UK AGRs via an ownership report. Significantly, this study provided EDF Energy NGL with further evidence that for AGRs, the available grace time for accident response is much longer than that possible for PWR designs (of the order of hours rather than minutes). Each AGR station also has a specific fuel route PSA.

A5.7 Through the rigorous application of DBA, PSA and SAA techniques, it is ONR's expectation that a modern safety case will consider the full scope of operational occurrences, design basis events, low frequency fault sequences beyond the design basis and severe

accident damage states. In all cases, the requirement is to demonstrate that risks have been reduced to ALARP.

18.58 The SAPs also include an expectation that SAA should form part of a demonstration that potential severe accident states be 'practically eliminated'. ONR's Severe Accident Analysis Technical Assessment Guide [166], provides further guidance on this topic, explaining that the SAPs reference to 'severe accident states' should be taken to encompass plant states and conditions that could lead to an early release or large release. The demonstration of practically eliminating early or large radioactive releases is considered a validation or check of the ultimate design (drawing on existing DBA, PSA and SAA, and engineering substantiation elsewhere in the safety case), and not an extra layer of defence-in-depth or additional accident analysis technique

Consideration of external and internal hazards

A5.8 External hazards are defined for use in plant design and DBA in terms of design bases, as described in SAPs EHA.3 and EHA.4. Design bases are defined by characterising the site and identifying all credible external hazards events that could affect the site. Hazards that could pose a significant risk, normally those that cannot be screened out on low frequency or low consequence grounds, are considered in the DBA and PSA analyses (SAP EHA.19). So far as plant design and assessment is concerned, external hazard design bases are simply additional 'loads' that the plant has to appropriately withstand.

A5.9 Most external hazards, especially natural hazards, are significant common cause fault initiators, meaning that several (for example, seismically initiated) faults may be initiated at the same time by the same event. This can place additional burdens on post-event operator recovery actions and emergency arrangements response.

18.59 Natural hazards, for example, earthquakes, extreme weather, external flood, etc. are characterised by hazard curves describing a range of frequency/hazard severity possibilities. The design bases are defined conservatively at 1×10^{-4} p.a. Beyond Design Basis Analysis is also performed to consider more severe hazard events at frequencies below 1×10^{-4} p.a. to ensure the avoidance of cliff-edge effects. This is described in detail in ONR TAG on external hazards [167], which was last reviewed and re-issued in October 2023. There is substantial relevant good practice worldwide that ONR inspectors would expect licensees to have made use of in supporting claims that the plant can meet the design basis, and has margin above this to account for the substantial uncertainties in all aspects of the hazard and plant analysis.

A5.10 For extreme weather and flood hazards, it is usual for several hazards to affect the plant simultaneously, for example, storm weather creates an environment for high wind and high rates of precipitation at the same time. In the case of seismic events there may be possible consequential effects, for example, a tsunami. ONR inspectors look for licensees to have accounted for credible combinations of external hazards in their safety analyses (SAP EHA.6).

A5.11 It is also the case that external hazards may cause internal faults (for example, plant failures) or internal hazards (for example, seismic and consequential fire, seismic and consequential internal flooding). ONR expects the hazards identification and characterisations process should include reasonably foreseeable combinations of hazards and consequential events (SAP EHA.1).

A5.12 ONR's SAPs also set the expectation for the identification of potential internal hazards and consideration of hazard effects in safety assessments. Internal hazards are defined as hazards that originate within the site boundary, and where the licensee has control over the initiating event in some way. The term is usually limited to apply to hazards external to the process, in the case of nuclear chemical plant, or external to the primary circuit in the case of power reactors. Internal hazards include internal flooding, fire, toxic gas release, collapses,

dropped loads, impacts from vehicular transport and explosion/missiles. It is recognised that internal hazards may originate from plant failures, mal-operation of the plant, or from other hazards, including external hazards (as discussed earlier).

A5.13 Detailed knowledge of the plant and site layout is required for internal hazards assessment. Hazard identification and impact assessment typically involves a facility and site review together with event tree analysis. Multi-facility sites would be expected to develop appropriate interface arrangements to deal with the potential effects of internal hazards.

A5.14 A key element of the site-specific parts of the Hinkley Point C/Sizewell C safety cases relates to internal and external hazards. The Generic Design Assessment (GDA) only included generic aspects in relation to hazards as it was not written for a specific UK site. Therefore, the licensees have to develop the site-specific aspects of the safety case as part of their safety justifications, taking account of the local geology, meteorology, and general site characteristics. This has included major programmes of site data collection and historical record analysis. In addition, UK specific methodologies have had to be developed using the French reference hazards as a starting point but adding UK specific expectations. In some areas, such as internal flooding, this has led to different methodological approaches between the UK and France. In turn, this has led to further design differences between Hinkley Point C/Sizewell C and FA3. External hazard protection is also expected to result in significant differences between Hinkley Point C and Sizewell C due to site specific differences.

A5.15 The SAPs set the expectation that the risk from internal hazards be minimised by attention to plant layout, by adopting good engineering standards and design, keeping inventories of hazardous (for example, combustible and toxic) materials to a minimum, and thereafter through good safety management practices.

18.60 More information on the regulatory expectations in relation to internal hazards can be found in ONR's Internal Hazards TAG [168].

Mapping of IAEA standards

A5.16 ONR's inspectors use the SAPs, together with supporting TAGs, to guide their regulatory judgements and recommendations when undertaking technical assessments.

A5.20 The UK is a Member State of the IAEA and contributes actively to the development of the IAEA's published Safety Standards. The UK applies the IAEA Safety Standards and ensures that its own regulations, regulatory requirements, and guidance for UK nuclear facilities are consistent with them. This includes the SAPs, which were benchmarked for the 2006 issue against IAEA's Safety Standards and were updated in 2014 to reflect subsequent changes in these standards since 2006. This exercise took account of recent work by the IAEA in the development of the Design Standard on the Safety of Nuclear Power Plants (SSR-2/1) [29]. ONR has carried out a systematic, comprehensive review of the SAPs against each of the specific requirements of SSR-2/1. This was carried out by a multi-disciplinary team of experienced inspectors, subject to robust challenge by a review panel acting under the direction of a deputy chief nuclear inspector. As with the previous version of the SAPs, ONR considers that the current SAPs are fully in line with IAEA guidance and standards. ONR acknowledges that these SAPs cannot reflect the breadth and depth of the entire suite of IAEA publications and so, as guidance is updated, ONR explicitly identifies those documents as relevant good practices within the TAGs.

Abbreviations and acronyms

A	ACoP	Approved Code of Practice
	A&D	Ageing and Degradation
	AGR	Advanced Gas-cooled Reactor
	AI	Artificial Intelligence
	ALARA	As Low As is Reasonably Achievable
	ALARP	As Low As is Reasonably Practicable
	AMBS	Alliance Manchester Business School
	AMR	Advanced Modular Reactor
	ANT	Advanced Nuclear Technology
	ANVS	Nuclear Safety and Radiation Protection (Netherlands)
	ARP	Adaptation Reporting Power
	ASN	French Nuclear Safety Authority
	ASME	American Society for Mechanical Engineers
B	BAT	Best Available Techniques
	BPEO	Best Practical Environmental Option
	BPM	Best Practicable Means
	BSL	Basic Safety Level
	BSO	Basic Safety Objective
C	CCR	Central Control Room
	CDG	Carriage of Dangerous Goods
	CE	Chief Executive
	CESC	Central Emergency Support Centre
	CFSI	Counterfeit, Fraudulent and Suspect Items
	CGN	China General Nuclear Power Corporation
	CIEHF	Chartered Institute of Ergonomics and Human Factors
	Climate ADAPT	EDF Nuclear Services' Climate Change Adaptation Programme
	CNI	Chief Nuclear Inspector
	CNRA	Committee on Nuclear Regulatory Activities
	CNS	Convention on Nuclear Safety
	CNSC	Canadian Nuclear Safety Commission
	COBR	Cabinet Office Briefing Rooms
	COMAH	The Control of Major Accident Hazard Regulations 2015
	CP	Contracting Party
	C&I	Control and Instrumentation
D	DAC	Design Acceptance Confirmation
	DAP	Duly Authorised Person
	DAERA	Department of Agriculture, Environment and Rural Affairs
	DBA	Design Basis Analysis
	DBUE	Deployable Back-up Equipment
	DEFRA	Department for Environment, Food and Rural Affairs
	DESNZ	Department for Energy Security and Net Zero
	DFW	Decommissioning, Fuel and Waste
	DWP	Department for Work and Pensions

	DWMP	Decommissioning and Waste Management Plan
E	EASR18	Environmental Authorisations (Scotland) Regulations 2018
	EA95	Environment Act 1995
	EC	European Council
	ECC	Emergency Control Centre
	ECURIE	Urgent Radiological Information Exchange
	ECCW	Emergency Coordination Centre Wales
	EDF Energy NGL	Électricité de France Energy Nuclear Generation Ltd
	EDF SA	Électricité de France SA
	EIA17	Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
	EIMT	Examination, Inspection, Maintenance, and Testing
	ELoG	Extended Loss of Grid
	EMM	Enforcement Management Model
	ENSREG	European Nuclear Safety Regulators Group
	EOC	Emergency Operation Centre
	EoG	End-of-generation
	EPD	Electronic Personal Dosimeters
	EPR™	European/Evolutionary Power Reactor
	EPReSC	Emergency Planning and Response Standards Committee
	EPR–RANET	Response and Assistance Network
	EPR16	Environmental Permitting (England and Wales) Regulations 2016
	EPS	Enforcement Policy Statement
	EU	European Union
	Euratom	European Atomic Energy Community
	EURDEP	European Radiological Data Exchange Platform
F	FAP	Funding Arrangements Plan
	FA3	Flamanville 3
	FANC	Belgium's Federal Agency for Nuclear Control
	FCDO	Foreign, Commonwealth & Development Office
	FCV	Filtered Containment Venting
	FDP	Funded Decommissioning Programme
	FFV	Fuel Free Verification
	FID	Final Investment Decision
	FMP	Fixed Monetary Penalties
	FSA	Food Standards Agency
	FSS	Food Standards Scotland
G	GB	Great Britain (England, Scotland and Wales)
	GDA	Generic Design Assessment
	GDF	Geological Disposal Facility
	GSR	General Safety Requirements
	GTGA	Government-to-Government Agreements
	G7	Group of Seven
H	HASS	High Activity Sealed Sources
	HERCA-WGE	Heads of the European Radiological Protection Competent Authority - Working Group for Emergencies
	HPC	Hinkley Point C

	HPI	High public Interest
	HSE	Health and Safety Executive
	HSWA74	Health and Safety at Work Act 1974
	HUET	Human Performance Evaluation Tool
	HVAC	Heating Ventilating and Air Conditioning
I	IAEA	International Atomic Energy Agency
	IACRNE	Inter-Agency Committee on Radiological and Nuclear Emergencies
	IAP	Independent Advisory Panel
	ICRP	International Commission on Radiological Protection
	IEA	Information Exchange Arrangement
	IIS	Integrated Intervention Strategy
	IMT	Incident Management Team
	IN	Improvement notice
	INA	Independent Nuclear Assurance
	INES	International Nuclear and Radiological Event Scale
	INPO	Institute of Nuclear Power Operations
	IRRS	Integrated Regulatory Review Service
	IRR	Ionising Radiations Regulations
	IRR17	Ionising Radiations Regulations 2017
	IRR99	Ionising Radiations Regulations 1999
	IRS	International Reporting System
	ISO	International Standards Organisation
J	JAM	Joint Agency Modelling
	JCO	Justification for Continued Operation
	JIT	Just-In-Time
L	LC	Licence Condition
	LCO	Limits and Conditions for Operation
	LGD	Lead Government Department
	LI	Licence Instrument
	LLW	Low Level Waste
	LMfS	Leadership and Management for Safety
	LoC	Letter of Compliance
	LOLER	Lifting Operations and Lifting Equipment Regulations 1998
	LPR	Low Power Refuelling
	LRQA	Lloyd's Register Quality Assurance
	LTS	Leak Termination System
M	MHSWR99	Management of Health and Safety at Work Regulations 1999
	MoD	Ministry of Defence
	MODARIA	Modelling and Data for Radiological Impact Assessments
	MoU	Memoranda of Understanding
N	NAR	National Assessment Report
	NCA	Nuclear Cooperation Agreement
	NDA	Nuclear Decommissioning Authority
	NEA	Nuclear Energy Agency
	NERIS	nuclear and radiological emergency response and recovery
	NES	Nuclear Energy Series
	NGO	Non-Governmental Organisation

	NHSI	Nuclear Harmonization and Standardization Initiative
	NIA	Nuclear Industry Association
	NIA65	Nuclear Installations Act 1965
	NIEA	Northern Ireland Environment Agency
	NISCI	Nuclear Industry Safety Culture Inventory
	NLF	Nuclear Liabilities Fund
	NNB GenCo	Électricité de France Energy Nuclear New Build
	UKNNL	United Kingdom's National Nuclear Laboratory
	NPP	Nuclear Power Plant
	NR	National Report
	NRS	Nuclear Restoration Services (NRS)
	NRW	Natural Resources Wales
	NSA	Nuclear Skills Alliance
	NSC	Nuclear Safety Committee
	NSDB	Nuclear Skills Delivery Board
	NSEC	Nuclear Skills Executive Council
	NSRB	Nuclear Safety Review Board
	NSSG	Nuclear Skills Strategy Group
	NSST	Nuclear Sector Skills Team
	NWA	Nuclear Workforce Assessment
O	ODR	Offload Depressurised Refuelling
	OECD	Organisation for Economic Co-operation and Development
	OEI	Organisational Effective Indicator
	OEM	Original Equipment Manufacturer
	OLP	Organisational Learning Portal
	ONR	Office for Nuclear Regulation
	OPEX	Operational Experience
	OSART	IAEA Operational Safety Review Team
P	p.a.	Per Annum (per year)
	PAR	Project Assessment Report
	PCmSR	Pre-Commissioning Safety Report
	PCPV	Pre-stressed Concrete Pressure Vessel
	PCSR	Pre-Construction Safety Report
	PIR	Post Implementation Review
	PN	Prohibition Notice
	POSR	Pre-Operational Safety Report
	PR	Peer Review
	PSA	Probabilistic Safety Analysis
	PSD	Primary Shutdown System
	PSR	Periodic Safety Review
	PSSR	Pressure Systems Safety Regulations 2000
	PWR	Pressurised Water Reactor
	PWSCC	Primary Water Stress Corrosion Cracking
R	RANET	Response and Assistance Network
	RASSC	IAEA's Radiation Safety Standards Committee
	RCF	Regulatory Competence Framework
	RCS	Reactor Coolant System

	RCIS	Redgrave Court Incident Suite
	REPPIR	Radiation Emergency Preparedness and Public Information Regulations 2019
	RFT	Reserve Feedwater Tanks
	RGP	Relevant Good Practice
	RIFE	Radioactivity in Food and the Environment
	RIDM	Risk Informed Decision Makie
	RIP	Radioactivity and Industry Policy
	RITE	Risk Informed Targeted Engagements
	RO	Refuelling Outage
	RP	Requesting Party
	RPA	Radiation Protection Advisor
	RPS	Radiation Protection Supervisor
	RPV	Reactor Pressure Vessel
	RREMS	Radioactive Incident Monitoring Network
	RSR	Radioactive Substances Regulation
	RWA	Radioactive Waste Adviser
	RWG	Recovery Working Group
	RWM	Radioactive Waste Management
	R2P2	Reducing Risk Protecting People
S	SAA	Severe Accident Analysis
	SAG	Severe Accident Guidelines
	SAGE	Scientific Advice Group for Emergencies
	SAPs	Safety Assessment Principles
	SAT	Systematic Approach to Training
	SBI	System Based Inspections
	SBERGs	Symptom-Based Emergency Response Guidelines
	SCC	Stress Corrosion Cracking
	SCG	Strategic Coordinating Group
	SCQWG	Supply Chain Quality Working Group
	SDF	Safety Director's Forum
	SDoR	Senior Director of Regulation
	SEPA	Scottish Environment Protection Agency
	SFAIRP	So Far As Is Reasonably Practicable
	SGoRR	Scottish Government Resilience Room
	SLA	Service Level Agreement
	SMP	Safety Management Prospectus
	SMR	Small Modular Reactor
	SoDA	Statement of Design Acceptability
	SPI	Safety Performance Indicator
	SPRINT	Strategic Prioritisation Regulatory Intelligence Tool
	SQEP	Suitable Qualified and Experienced Personnel
	SRGW	Seal Ring Groove Wall
	SSC	Structures, Systems and Components
	STAC	Scientific and Technical Advice Cell
	STEM	Science, Technology, Engineering and Mathematics
	STUK	Radiation and Nuclear Safety Authority of Finland

	SZC	Sizewell C Limited
T	TAG	Technical Assessment Guide
	TEA13	The Energy Act 2013
	TIG	Technical Inspection Guide
	TOR	Tolerability of Risk
	TPR	Topical Peer Review
	TSAB	Training Standards and Accreditation Board
	TSC	Technical Support Contractors
	TSD	Tertiary Shutdown System
	TSO	Technical Services Organisation
U	UK	United Kingdom
	UKAS	United Kingdom Accreditation Service
	UKHSA	United Kingdom Health Security Agency
	US-NRC	United States Nuclear Regulatory Commission
	USIE	IAEA United System for Information Exchange in Incidents and Emergencies
V	VDNS	Vienna Declaration on Nuclear Safety
	VFC	Variable Frequency Converter
	VSD	Variable Speed Drive
	VMP	Variable Monetary Penalties
W	WANO	World Association of Nuclear Operators
	WENRA	Western European Nuclear Regulators Association
	WGSUP	Working Group on Supply Chain
	WIReD	Well Informed Regulatory Decisions
	WPNEM	NEA Working Party on Nuclear Energy Matters
	WTP	Water Treatment Plant

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