Office for Nuclear Regulation

Chief Nuclear Inspector's annual report on Great Britain's nuclear industry

October 2021

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Any enquiries related to this publication should be sent to contact@onr.gov.uk

Version 2 published 20/10/21 to correct omission of Rosyth Royal Dockyard Ltd from Table 1.

Version 3 published 15/12/21 to correct minor typographical error on page 142.

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Chief Executive and Chief Nuclear Inspector's foreword

Welcome to my latest annual report on the safety, security, and safeguards performance of Great Britain's nuclear industry. Overall, I am confident that during the reporting period, the industry has performed well and that the required standards of safety and security have been maintained.

As a nation, we have faced unprecedented circumstances during the year that have challenged all areas of the United Kingdom (UK). The nuclear industry is no different; it has had to adapt to the challenges presented by the COVID-19 pandemic and the dynamic nature of the UK's response. The industry responded well to national and local pandemic conditions as part of a controlled and effectively managed response that has ensured the continued safety and security of its activities, including those associated with critical national infrastructure, high hazard legacy facilities, and the transport of radioactive materials.

ONR's primary mission is to protect society, accomplished by a regulatory regime of inspection, assessment, and engagement. The pandemic challenged our normal modes of operation and I was pleased with how my regulatory teams adapted, gaining assurance on the standards of safety and security achieved by licensees and other dutyholders in new and innovative ways.

I am proud of what we have accomplished through the year, establishing a firm evidence base of industry performance throughout the pandemic, enabling us to provide assurances to the public and other stakeholders on the safety and security of the nuclear industry.

I am pleased to note that, as of January 2021 we successfully assumed responsibility as the UK's domestic safeguards regulator, implementing the State System of Accounting for and Control of Nuclear Materials (SSAC). This was the culmination of a significant amount of work by ONR and other key stakeholders that enabled a seamless transition to our new domestic safeguards arrangements. We are working closely with International Atomic Energy Agency (IAEA) colleagues to support their independent verification work, providing assurance that the UK is abiding by its international non-proliferation obligations.

The UK government has stated its commitment to sustainable, carbon-free sources of energy as it seeks to achieve its 2050 net zero carbon emissions target and it has confirmed that nuclear has a significant role to play in the future energy mix of the country. We have begun to implement plans that will see us grow our capability and capacity to match the future ambition around large scale and small modular reactors, which will ensure we are ready to regulate new nuclear effectively, able to confirm the safety and security of new technologies and associated innovations.

I remain committed to continue the modernisation of ONR through the delivery of key projects that will improve what and how we do things. This will enable us to regulate dutyholders in a more effective and efficient manner and we will take opportunities to engage and update on these in due course.

My thanks to the professional and dedicated team at ONR. Our staff have applied themselves to great effect during these challenging times – their adaptability ensuring our continued effectiveness as the nuclear safety, security, and safeguards regulator.

Mark Foy
Chief Executive and
Chief Nuclear Inspector

Executive Director of Operation's foreword

My appointment to the newly-created post of Executive Director of Operations comes at a time when we are not only working to ensure the continued safe and secure operation of existing nuclear facilities and transport of radioactive materials, but are also preparing to regulate the start of transition of advanced gas cooled reactors (AGRs) to their defuelling lifecycle stage. This is in addition to the regulation of major defence infrastructure and capability projects, and the potential delivery of Generic Design Assessments (GDAs) for small modular reactors. We are also continuing to deliver high quality nuclear materials safeguards regulation following the UK's exit from the European Union.

Over recent years, we have enhanced our regulatory capability and capacity to ensure that we can deliver the robust and high-quality regulation that workers and the public rightly demand. However, our forward programme of work is such that we will need to continue to develop our capability and organisational resilience into the future, and this will remain a priority over the year ahead.

Given the importance of organisational culture and behaviours in securing high standards of safety and security, I intend to increase our focus on the quality of safety and security leadership across the organisations that we regulate, and on better understanding and influencing the resultant organisational cultures and behaviours.

Correspondingly, to reflect our organisational values, I will also look to develop our own culture of diversity and inclusion and, in the interests of efficiency, to maximise collaboration, co-operation and consistency in our regulation across our five statutory purposes.

In previous reports, the Chief Nuclear Inspector highlighted key priorities (ageing management, conventional health and safety, and a more holistic approach to nuclear security) for which there is a need for wider industry improvement.

I am pleased to note progress across these areas over the last year but am mindful of the need for industry to sustain its focus in these areas. To that end, this will continue to be a focus for us in the year ahead, and we will work with and encourage dutyholders to do likewise.

Whilst the last year was challenging due to the impact of COVID-19, our inspections provided assurance that dutyholders have managed the risk to the safety of their workforces and the public effectively and have maintained safe and secure operations throughout the pandemic. I am also pleased to note that each of the nuclear licensed sites subject to 'enhanced regulatory attention', due to concerns about their historic safety or security performances, have continued to deliver improvements necessary to support their eventual return to 'routine regulatory attention'.

We continue to engage with other national and international regulatory bodies to benchmark the quality of our regulation and to inform our approach to key matters, such as our response to regulating the industry during the COVID-19 pandemic.
Finally, following the publication of our approach to regulating innovation, we will be considering opportunities to innovate in how we regulate, and how we can best support safe and secure innovations proposed by the industry.

Donald Urquhart
Executive Director of Operations and Deputy Chief Nuclear Inspector

1 Chief Nuclear Inspector's review

1.1 The COVID-19 pandemic has had a severe impact on the UK since early 2020, which has seen numerous control measures introduced by government to protect the public by restricting the spread of the virus. This has required us to do things differently and to be agile in our regulation; being able to adapt has ensured that have been able to continue to effectively deliver our mission, 'to protect society by securing safe nuclear operations'.

1.2 From the programme of inspections and assessments that my inspectors have undertaken during the year, I am satisfied that the nuclear industry has, overall, achieved the high standards of safety and security that are expected of it. In some instances, dutyholders have not fully achieved the high standards of safety or security that we expect and, where this has been the case, my inspectors have intervened to secure proportionate improvements to remediate shortfalls in a timely manner. In such cases, I am satisfied that our interventions have had, or are having, the desired effect.

1.3 I am pleased to report a smooth and effective transition as we assumed responsibility as the UK's domestic safeguards regulator in January 2021, successfully implementing our State System of Accountancy and Control (SSAC) for nuclear material. This is the culmination of a significant piece of work to develop a robust safeguards system that has involved ONR, government, industry, and international agencies.

1.4 We have continued to make improvements to our regulatory approach, enhancing the collaboration and co-operation between our statutory purposes. This has seen closer working between inspectors across some of our specialisms, where we have conducted more joint activities involving multidisciplinary teams of inspectors, successfully delivering a comprehensive and holistic view of the dutyholder's arrangements.

1.5 We made progress over the last year in establishing how we will support the adoption of innovative solutions by the nuclear industry and its supply chain, where this is in the interest of society and is consistent with our safety and security expectations. I recognise that further work in this area will be needed in the years ahead as new and novel solutions are considered but record our ongoing commitment to supporting this.

Industry progress against our key regulatory priorities

1.6 I have stated in my previous reports that key themes will be prioritised for our regulatory attention and will continue to be prominent until sustainable improvements have been delivered. I will continue to direct my inspectors to work with our licensees and other dutyholders to influence a collective response to address the issues which make up our regulatory priorities.

1.7 Where demonstrable progress has been made against a priority, it will be deprioritised, and the matter returned to routine regulatory scrutiny. To provide a focused forward look, this report will identify regulatory priorities that will be relevant in the coming reporting years.

1.8 Last year, I set out four overarching priorities requiring increased industry attention:

- Management of ageing facilities
- Conventional health and safety performance
- Delivering a holistic approach to nuclear security
- Ensuring adequate pandemic resilience arrangements

1.9 I highlighted the need for the industry to review, critically, its strategies and plans and reflect on how it can work more collectively to deliver better outcomes in each of these areas. All four priorities were features in our regulatory planning for 2020/21. We have seen progress against these priorities; however, we will continue to review progress against the identified priorities to ensure that focus remains on delivering sustainable outcomes in areas where further improvements are necessary. Our approach will be to influence and leverage the right outcomes, whilst continuing to engage with our nuclear site licensees, other dutyholders and relevant stakeholders.

Management of ageing facilities

1.10 The regulatory work that we have undertaken during the reporting year has highlighted and reinforced the continued importance of ensuring that adequate programmes for the management of ageing facilities are in place across the nuclear industry. It is evident from the age of many nuclear facilities, and from intelligence gained by my inspectors, that this remains a challenge for most, if not all, dutyholders across the nuclear sector.

1.11 Consequently, I commissioned a themed inspection to review a representative sample of industry dutyholders, to determine whether they have sustainable programmes in place for the management of ageing facilities. This will allow the identification and promulgation of good practices but will also inform our future regulatory priorities in cases where improvements are required to ensure the continued safety and security of Britain's nuclear estate.

1.12 Licensees and associated nuclear licensed sites subject to the themed inspection have been selected to provide a representative sample of the nuclear estate, specifically:

- Atomic Weapons Establishment (AWE Plc) – Aldermaston and Burghfield
- EDF Energy Nuclear Generation Limited – Sizewell B Power Station
- Devonport Royal Dockyard Limited (DRDL) – Devonport
- Magnox Limited – Hinkley Point A
- Sellafield Limited – Sellafield Site

1.13 My report on the findings of this themed inspection is expected to be published in spring 2022. It will identify challenges that are common across the selected licensees and, therefore, likely to be common across the wider sector, and will highlight the good practices identified. I expect dutyholders to establish appropriate and proportionate actions plans for the remediation of any significant shortfalls and the findings are anticipated to act as a catalyst for further cross-industry co-operation in this area.

1.14 Overall, I am satisfied that dutyholders have increased their focus on their performance related to the management of ageing facilities, but further work is required. The findings from my themed inspection will be used to inform subsequent regulatory intervention across the industry.

Conventional health and safety performance

1.15 During the year I commissioned a review of the conventional health and safety (CH&S) performance of the nuclear sector with that of other high hazard sectors in the UK, which has been completed (see case study in section 7). The outcome has indicated that, in general, CH&S performance in the nuclear industry is comparable with other high hazard sectors.

1.16 The impact of the pandemic on licensees' workplace activity patterns precludes a meaningful direct comparison with last year's incident numbers. However, our assessment of performance based on qualitative data from regulatory interventions supports the findings of the benchmarking project, indicating that the increased efforts by industry continue to take effect.

1.17 This is reassuring, and we have seen improvements, but it does not preclude the need for continued focus on delivering improvements in specific areas of CH&S performance across the nuclear sector, where performance remains variable. CH&S, including fire safety, will therefore remain a priority for us so that we are assured that industry initiatives continue to deliver sustainable improvements.

1.18 There is a considerable amount of work being undertaken by the nuclear industry associated with nuclear power plant construction, other major project construction, post operational clean out and decommissioning of existing facilities (including demolition), and other similar hazardous activities. These pose significant risks to workers, and potentially the public, if not properly controlled. We will maintain focused oversight of these operations over the coming year, with greater attention on construction and decommissioning activities that involve demolition.

1.19 In response to a recent rise in the number of electrical and working at height incidents and near misses reported across the industry, we will enhance our oversight of licensees' arrangements where these hazards exist, with specific iinterventions to influence improvements with electrical safety and working at height.

Delivering a holistic approach to security

1.20 I am pleased with the work that has been undertaken by the industry as it has sought to adopt a holistic approach to security. Most licensees and other dutyholders have now submitted security plans that we have assessed as meeting our Security Assessment Principles (SyAPs) expectations and have subsequently approved them. The plans cover all aspects of security and how it is ensured; they have been implemented satisfactorily and demonstrate a significant improvement in the understanding, ownership, and management of security across the industry.

1.21 We are continuing to support a small number of dutyholders in their adoption of SyAPs-aligned security plans, but the nature and number of these dutyholders does not warrant maintaining this topic as an overarching priority.

1.22 I am content to deprioritise this theme and return it to routine regulatory attention. Although progress has been made in developing this approach to security, such that it is no longer an industry-wide matter, work remains. We will maintain oversight of progress in this area to ensure that improvements are built upon and retained.

1.23 We will continue to focus on the industry's resilience to the cyber security threat to ensure the adequacy of their arrangements. We will be looking to confirm that proactive leadership and ownership is in place at the highest levels, to provide assurance that robust arrangements exist in the face of an ever evolving cyber threat. Where shortfalls are identified we will seek proportionate improvements.

1.24 We have developed the first revision to our SyAPs, which is due for publication by the end of 2021, following a period of industry consultation. The main amendments are designed to ensure closer alignment between safety and security on the management of human performance and management of change. This will facilitate dutyholders in developing arrangements that satisfy similar regulatory expectations regulatory expectations in respect of both safety and security.

Ensuring adequate pandemic resilience arrangements

1.25 In last year's report I stated that, once the UK began to emerge from the current pandemic, I would be asking the nuclear industry to undertake a review of its pandemic preparedness and resilience if a more severe pandemic in the future conveyed even greater societal disruption than that experienced for COVID-19.

1.26 We have consulted with stakeholders and the nuclear industry and concluded that the priority should be ensuring the continued safety and security of the industry during the current pandemic, recognising that the UK is still to fully emerge from it.

1.27 We will not be undertaking the review of pandemic resilience plans in the 2021/22, to allow the industry to properly recover from and reflect on its COVID-19 pandemic experience. The future resilience of industry's pandemic response arrangements continues to be a regulatory priority for us but will now be a focus during 2022/23.

1.28 We have engaged extensively with fellow national regulators and international agencies over the course of the pandemic to balance our response and ensure effective nuclear regulation. The global impact and implications of COVID-19 are likely to lead to further international collaboration between national regulators and the nuclear industry, to capture emerging lessons and to appropriately characterise the resilience required to effectively respond to more severe pandemics.

Our Regulatory Priorities

Leadership for safety and security culture

1.29 For the remainder of the 2021/22 reporting year and for the subsequent reporting year, I have decided to increase the focus of my regulatory teams on the quality and effectiveness of licensees' safety and security culture and how leadership influences this.

1.30 The importance of a strong culture to an organisation's safety and security performance cannot be overstated. Intelligence gathered and events across the industry reveal, amongst other factors, shortfalls in leadership that led to deficiencies in organisations' safety and/or security culture and associated performance.

1.31 It is clear that we need to direct our attention to ensuring our licensees and other dutyholders have strong, visible safety and security leadership, that drives a strong, embedded culture through which positive behaviours are cultivated and promoted all the way through their organisation.

1.32 Consequently, I will be directing my inspectors to seek improvements in and support increased industry attention on:

- Management of ageing facilities
- Conventional health and safety performance
- Leadership for safety and security culture

1.33 Experience has shown that licensees and other dutyholders are responsible, demonstrating progress in areas against regulatory priorities that have been previously highlighted in my annual reports. However, there is sufficient regulatory intelligence to justify these as proportionate areas of focus over the year ahead.

COVID-19 pandemic

1.34 The reporting period has been dominated by the effects of, and disruption caused by, the COVID-19 pandemic. We have continued to regulate the nuclear industry effectively and support its programmes by remaining flexible and agile, which has required us to think and act differently. Our philosophy of enabling regulation played an important role in supporting the nuclear industry's ambitions to progressively restore operations, whilst continuing to ensure that hazards are controlled effectively.

1.35 At the outset of the pandemic, licensees and other dutyholders had established pandemic management/contingency plans available. These were implemented immediately to good effect, involving working in 'bubbles', site testing arrangements, reductions in the number of non-essential staff on-site, with many working from home, and the reconfiguration of many workplaces.

1.36 To remain assured of the continued safety and security of nuclear operations, I established a formal reporting requirement whereby each licensee provided daily statements on absence rates and the impact of these on the resilience of their operations, emergency plans, site security plans and supply chains.

1.37 These reports were provided to government to support its strategy for key national infrastructure during the pandemic.

1.38 With the changes to the working environment, it was necessary for the industry to develop, and for us to assess and approve, 52 temporary security plans (TSP) or temporary security arrangements (TSA). These TSPs/TSAs ensured that appropriate security was maintained in a sustainable and COVID-safe fashion throughout the period of lockdown.

1.39 Many licensees implemented test and trace arrangements to minimise the impact of the pandemic on their sites and safeguard the health of their people. This was successful, with most cases of COVID-19 identified in nuclear workforces being attributable to off-site social interaction as opposed to workplace transmission.

1.40 I am satisfied that licensees and other dutyholders acted responsibly and have continued to operate safely and securely throughout the pandemic, adopting a precautionary approach of suspending non-essential operations where this has been judged necessary.

1.41 We implemented our own business continuity plan at the outset of the pandemic, one of the first steps being the formation of our Incident Management Team (IMT), made up of the Chief Executive, the Chief Nuclear Inspector, and other senior staff. The IMT has managed our response throughout, protecting the health and wellbeing of staff and ensuring our continued effectiveness in delivering regulation and achieving our mission.

1.42 From the outset, the IMT established an agreed set of priorities and assumptions, which have guided its decision making and the work of ONR. These have evolved as the nature and impact of the pandemic has changed.

1.43 Specific priorities have focused on:

- Determining the safety, security, and safeguards impact of the pandemic on industry, taking action to influence improvements where necessary;
- Maintaining emergency preparedness and response capability (EP&R) to respond to a nuclear/radiological incident;
- Undertaking essential regulatory assessments with an appropriate on-site presence;
- Monitoring the effectiveness of dutyholder COVID-19 control measures; and
- Public and stakeholder confidence in ONR's regulation and the safety and security of the industry

1.44 Initially, we stopped routinely deploying inspectors to sites for the first two months of the pandemic – necessary in the short term to protect our inspectors and minimise the potential for them to be the source of an outbreak of the virus on a nuclear site. During this period, inspectors were only deployed to site if there was an essential need. We adopted remote inspections and made appropriate use of internal assurance arrangements as a means of gaining assurance in key areas of licensees' and other dutyholders' activities.

1.45 The level of on-site presence has subsequently varied, reflecting the prevalence and impact of COVID-19 during the year.

In March 2021 our on-site inspection activity was recovering and expected to return to near pre-pandemic levels by June 2021. I am pleased that our own home working arrangements proved effective and enabled our assessment of submissions, safety cases and other activities to continue through the year with minimal disruption.

1.46 During the pandemic, we pioneered new approaches to gathering evidence, taking enforcement action, and monitoring the discharging of certain statutory duties that place specific absolute requirements on licensees and other dutyholders. For example, we produced several regulatory position statements, which established our position on statutory duties that could not be reasonably achieved due to COVID-19 restrictions; in each instance any application was required to be underpinned by appropriate justifications demonstrating continued safety.

1.47 Regular engagement with licensees and other dutyholders, counterparts in domestic and international regulators, government ministers and departments, NGOs, and others was a key success factor in providing insight and being able to respond effectively to the challenges presented by the pandemic.

1.48 Good practices and new ways of working were established as we adapted our approaches during the pandemic, including frameworks for co-operation between ourselves, licensees/ dutyholders and government. This is highlighted, for example, by the remote facilitation of IAEA safeguards verification activities in the UK through our first three months of operating our domestic nuclear safeguards regime.

1.49 We will consolidate the learning from these into our incident management arrangements and wider management system.

Modernising regulation and new ways of working

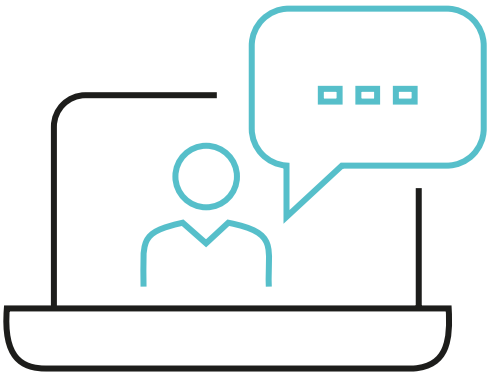
1.50 Modernising our organisation is a key element of continuously improving our regulation. We recognise the importance of improving our capability to regulate in a flexible, agile, and proportionate manner, and are committed to ensuring that we invest in modernising and improving our effectiveness and efficiency.

1.51 Our successful IT Separation project marked a milestone in our journey towards modernising our organisation, achieved during the pandemic. The project ensured that all our people received IT hardware, along with major software systems updates, to support modern ways of working and regulating the industry.

1.52 We have invested in, and have commenced the delivery of, the initial releases of our Well-Informed Regulatory Decisions (WIReD) project. This will modernise the way in which we regulate the industry by making our processes more efficient, more consistent, and easier to follow.

1.53 WIReD will improve the knowledge, connectivity, and mobility of our inspectors as they discharge their duties to ensure the safety and security of the industry. The system will enhance our existing arrangements for capturing, accessing, and retaining information, improving our knowledge and information management capability.

1.54 WIReD will support our commitment to being transparent through the provision of a digital-first interface with dutyholders, which will provide portal access between ourselves, licensees and other dutyholders.



1.55 I have also initiated work to develop a risk management maturity model that will apply to the nuclear industry and will cover all of our statutory purposes. This will build on existing processes to determine regulatory attention levels and will allow us to form, systematically, a holistic view on the maturity with which dutyholders manage the risks associated with their activities.

1.56 Adopting the maturity model will improve our perspective on the management of safety and security across the industry and presents us with the opportunity to improve cooperation across our statutory purposes. Ultimately, cooperation across our statutory purposes will enhance our proportionality, prioritisation and targeting of effort to drive the required improvements and associated outcomes more effectively across the industry.

1.57 We are also modernising to increase our capability to regulate new and novel reactor designs, which would be assessed through our GDA process. These could include new or novel large-scale reactor designs or SMRs. Providing our inspectors with the tools and capability to undertake this work is another major aspect of our modernisation effort.

1.58 As well as modernising to regulate the reactors of tomorrow, I am also conscious that we must evolve our capacity and regulatory approach in preparation for the changes the current fleet of reactors will undergo in the coming years. To support reactors as they come to the end of their operational lives, we are now in the process of revising our strategy to oversee the safe transition of the AGR stations into defuelling and beyond. This is expanded upon later in the Operating Facilities Division section of this report.

Innovation

1.59 We continue to seek opportunities to support innovation in the industry and have committed to be openminded and responsive to inventive solutions. I am pleased to announce the commencement of a project to ensure that regulatory expectations are considered when realising the potential benefits to safety and security that innovation may present.

1.60 The project will establish a clear plan for innovation, with defined milestones and a clear governance structure. The delivery plan intent would be to enable and support existing innovation work, to provide a clear entry route for innovation ideas and proposals, and to ensure efficiency and effectiveness of our engagements with a wide range of stakeholders and working groups. It will develop the proposal for an innovation hub, under which all innovation initiatives will reside. Finally, it will develop a communications and stakeholder engagement plan to address the concern raised in stakeholder engagements that we are not open to innovation.

1.61 We will also be seeking ways in which we can be more innovative as a regulator, through better use of technology and alternative, smarter ways of doing things. We will be making use of our regulatory and industry networks to explore these opportunities and how we can benefit from them in the future.

A set of good practices

1.62 In line with my previous reports, I have taken the opportunity to highlight good practices in the industry that have been identified by my inspectors as part of their regulatory activities during the year. These are included here for wider consideration by the industry:

1.63 **Continued effective and agile response to the COVID-19 pandemic from the industry.** The industry has continued to show an effective and measured response during the COVID-19 pandemic. When the pandemic first began to cause widespread disruption, the industry was quick to respond, placing appropriate facilities into quiescent safe states which allowed for on-site workforces to be reduced.

Many sites have since adopted on-site testing arrangements which has supported safe working arrangement and safeguarded against widespread transmission on sites. Overall, the industry has continued to maintain COVID-safe working arrangements, whilst also maintaining arrangements for overall safety and security.

1.64 **Intelligent replication of reactor design at Sizewell C (SZC).** In the SZC project, NNB Generation Company Ltd (NNB GenCo) (SZC) is adopting a strategy of 'intelligent' replication of the design and arrangements from Hinkley Point C (HPC). NNB GenCo's aim is to de-risk the project, enabling a true second of a kind (fleet approach), which has potential benefits from both a construction and nuclear safety perspective.

1.65 **Innovative training facility to support Pile Fuel Cladding Silo (PFCS) at Sellafield Ltd.** Sellafield Ltd has constructed a test and training facility at Rosyth which is used to train operators for PFCS early waste retrievals. The facility comprises a series of modules which are designed to be near exact replicas of the facilities on the Sellafield site. The facility provides the means to support the testing of engineering and the development of operating and maintenance procedures. This will support safe and secure operations when waste retrievals begin.

1.66 **Significant shift in risk profile across Magnox Ltd.** Magnox Ltd have undertaken work to identify and assess the changing risk profile of its sites as it has transitioned from energy generation to decommissioning. This has resulted in a significant shift in risk profile from nuclear safety to conventional safety and required a commensurate significant shift in the cultural mindset of Magnox Ltd across all levels of the organisation. One example of the success of this cultural shift relates to the significant improvements that Magnox Ltd has made in its management of asbestos risks by developing flexible and adaptable strategies and risk control measures to reflect the differing risk profile presented by asbestos across its sites.

1.67 **Effective industry collaboration for the development of best practice in commissioning for nuclear projects in the UK.** The industry has anticipated the challenges and risk associated with commissioning activities and a number of major licensees have been instrumental in establishing the Nuclear Commissioning Excellence Forum (NCEF). The core objective of the NCEF is to find best practice within the field of nuclear commissioning, and ways to roll-out best practice through internal and external education. Sharing of best practice between licensees in the industry will reduce the risks associated with commissioning and improve safety and security.

1.68 **Intelligent management of specialist resource across EDF.** Centralising the technical capability across EDF to support water reactor technology, high end technology skills and new reactors, the Technical Client Organisation (TCO) will directly support HPC, SZC and Sizewell B (SZB), while continuing to provide specialist niche skills in support of AGR reactor operations and defuelling via the Central Technical Organisation (CTO) within nuclear generation.

This centralised capability was launched in June 2020, the major benefit is the increased resilience within the organisation, enabling specialist technical staff to be retained and developed to support current and future projects, in a model that could support multiple licensees with different shareholder mixes.

2 Overview of safety, security, and safeguards performance

Regulatory attention levels

2.1 The regulatory attention that we are applying to licensed nuclear sites during 2021/22 is summarised in Table 1, 2 & 3. The attention level assigned for each site is based on our assessment of its performance over the past 12 months, considering a broad range of safety and security considerations, and the operational issues being addressed by each site. It also reflects an overall judgement across nuclear safety, conventional health and safety, security, and transport purposes. Attention levels may differ between safety and security for the same licensed site and may be allocated to specific parts of the larger sites.

2.2 We have not yet assigned safeguards attention levels to individual sites, as our regulatory regime for safeguards began from 1 January 2021 and all sites are therefore considered to be in a routine regulatory attention level until there is any evidence to indicate the contrary. This will be continuously reviewed and reported upon in future publications.

Table 1: Regulatory attention levels for licensed sites from 31 March 2020

Regulatory attention	Licensed site	Change in attention over 2020/21
Significantly enhanced	Sellafield (Sellafield Ltd), First Generation Magnox Storage Pond, Magnox Swarf Storage Silo, Pile Fuel Cladding Silo and Special Nuclear Materials Facilities	No change
Enhanced	Atomic Weapons Establishment (AWE Plc), Aldermaston	No change
	Atomic Weapons Establishment (AWE Plc), Burghfield	No change
	Devonport (Devonport Royal Dockyard Ltd)	No change
	Sellafield (Sellafield Ltd), remainder of estate	No change
	Dungeness B (EDF Energy Nuclear Generation Ltd)	No change

Regulatory attention	Licensed site	Change in attention over 2020/21
Routine	Bradwell (Magnox Ltd)	No change
	Berkeley (Magnox Ltd)	No change
	Barrow (BAE Systems Marine Ltd)	No change
	Capenhurst (Urenco UK Ltd)	No change
	Chapelcross (Magnox Ltd)	No change
	Consort Reactor, Ascot (Imperial College of Science, Technology and Medicine)	No change
	Derby (Rolls-Royce Marine Power Operations Ltd), 2 sites	No change
	Dounreay Site Restoration Limited (DSRL)	No change
	Dungeness A (Magnox Ltd)	No change
	GE Healthcare Amersham (GE Healthcare Ltd)	No change
	Hartlepool (EDF Energy Nuclear Generation Ltd)	No change
	Harwell (Magnox Ltd)	No change
	Heysham 1 (EDF Energy Nuclear Generation Ltd)	No change
	Heysham 2 (EDF Energy Nuclear Generation Ltd)	No change
	Hinkley Point A (Magnox Ltd)	No change
	Hinkley Point B (EDF Energy Nuclear Generation Ltd)	No change
	Hinkley Point C (NNB Generation Company (HPC) Ltd)	No change
	Hunterston A (Magnox Ltd)	No change

Regulatory attention	Licensed site	Change in attention over 2020/21
Routine (continued)	Hunterston B (EDF Energy Nuclear Generation Ltd)	↓ Return to routine attention driven by safety case improvements and the resolution of issues on site.
	Low Level Waste Repository (LLWR)	No change
	Metals Recycling Facility, Lillyhall (Cyclife UK Ltd)	No change
	National Nuclear Laboratory (Sellafield Central Labs)	No change
	National Nuclear Laboratory (Preston)	No change
	National Nuclear Laboratory (Windscale)	No change
	Oldbury (Magnox Ltd)	No change
	Pacific Nuclear Transport Ltd (PNTL)	No change
	Rosyth (Rosyth Royal Dockyard Ltd)	No change
	Sizewell A (Magnox Ltd)	No change
	Springfields (Springfields Fuel Ltd)	No change
	Sizewell B (EDF Energy Nuclear Generation Ltd)	No change
	Synergy Health (Harwell)	No change
	TN International Orano	No change
	Torness (EDF Energy Nuclear Generation Ltd)	No change
	Tradebe Inutec (Inutec Ltd)	No change
	Trawsfynydd (Magnox Ltd)	No change
	Winfrith (Magnox Ltd)	No change
	Wylfa (Magnox Ltd)	No change

Table 2: Regulatory attention levels for civil nuclear security performance from 31 March 2020

Regulatory attention	Licensed site/premises/new build	Change in attention over 2020/21
Significantly enhanced	Sellafield Ltd	No change
Enhanced	Harwell (Magnox Ltd)	No change
	Magnox Ltd Corporate	No change
Routine	Berkeley (Magnox Ltd)	No change
	Bradwell (Magnox Ltd)	No change
	Bradwell Power Generation Company Ltd (BRB)	No change
	Canberra (Harwell)	No change
	Cavendish Nuclear	No change
	Capenhurst (Urenco UK Ltd)	↓ Return to routine attention driven by improvements in security arrangements.
	Centronic	No change
	Chapelcross (Magnox Ltd)	No change
	Consort Reactor, Ascot (Imperial College of Science, Technology and Medicine)	No change
	Direct Rail Services Ltd	No change
	Dounreay Site Restoration Ltd (DSRL)	↓ Return to routine attention driven by site's completion of security action plan and further improvements to security on-site.

Regulatory attention	Licensed site/premises/new build	Change in attention over 2020/21
Routine (continued)	Dungeness A (Magnox Ltd)	No change
	Dungeness B (EDF Energy Nuclear Generation Ltd)	No change
	EDF Energy Nuclear Generation Ltd (Corporate)	No change
	EDF Energy (Hinkley Point C)	No change
	EDF Energy (Sizewell C)	No change
	GE Healthcare (The Grove Centre)	No change
	GE Healthcare (Cardiff Nuclear Licensed Site)	No change
	General Nuclear System Limited (GNSL)	No change
	Geodis UK Ltd	No change
	Hartlepool (EDF Energy Nuclear Generation Ltd)	No change
	Heysham 1 (EDF Energy Nuclear Generation Ltd)	No change
	Heysham 2 (EDF Energy Nuclear Generation Ltd)	No change
	Hinkley Point A (Magnox Ltd)	No change
	Hinkley Point B (EDF Energy Nuclear Generation Ltd)	No change
	Hunterston A (Magnox Ltd)	No change
	Hunterston B (EDF Energy Nuclear Generation Ltd)	No change
	Low Level Waste Repository (LLWR)	No change
	Metals Recycling Facility, Lillyhall (Cyclife UK Ltd)	No change
	National Nuclear Laboratory (Sellafield Central Labs)	No change

Regulatory attention	Licensed site/premises/new build	Change in attention over 2020/21
Routine (continued)	National Nuclear Laboratory (Preston)	No change
	National Nuclear Laboratory (Windscale)	No change
	Oldbury (Magnox Ltd)	No change
	Pacific Nuclear Transport Ltd (PNTL)	No change
	Sizewell A (Magnox Ltd)	No change
	Springfields (Springfields Fuel Ltd)	No change
	Sizewell B (EDF Energy Nuclear Generation Ltd)	No change
	Synergy Health (Harwell)	No change
	TN International Orano	No change
	Torness (EDF Energy Nuclear Generation Ltd)	No change
	Tradebe Inutec (Inutec Ltd)	No change
	Trawsfynydd (Magnox Ltd)	No change
	Winfrith (Magnox Ltd)	No change
	Wylfa (Magnox Ltd)	No change

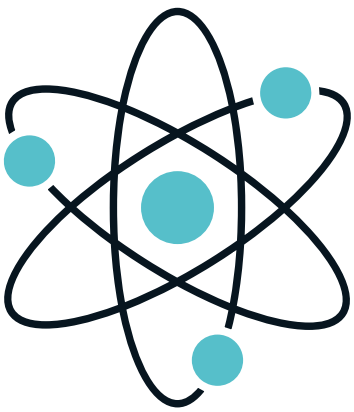


Table 3: Regulatory attention levels for civil nuclear security performance of approved carriers from 31 March 2020

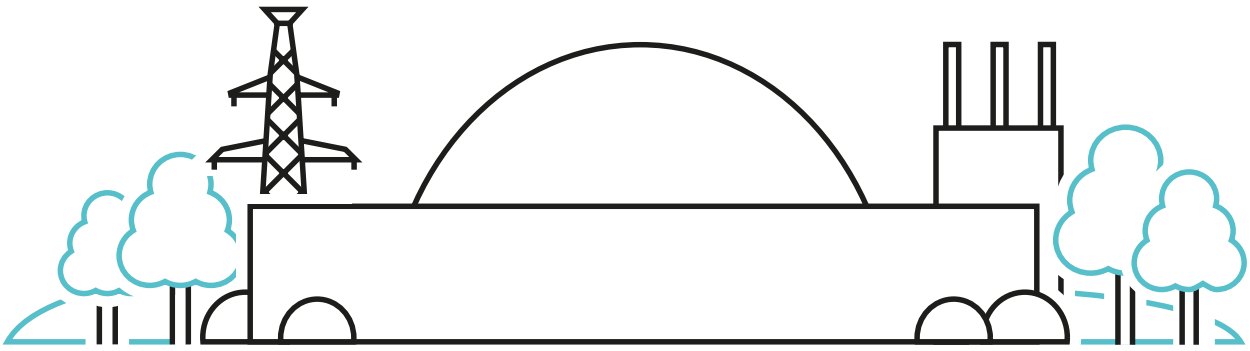
Regulatory attention	Approved carrier	Change in attention over 2020/21
Routine	CTS Logistics (GB)	No change
	Daher NT GmbH (Germany)	No change
	David Watts Transport Ltd	No change
	Direct Rail Services (DRS)	No change
	Dounreay Site Restoration Limited (DRSL)	No change
	EDF Energy Nuclear Generation Ltd	No change
	Express Transport S A (Spain)	No change
	International Nuclear Services (INS)	No change
	Pacific Nuclear Transport Ltd (PNTL)	No change
	Sellafield Ltd	No change
	Société De Transports Spéciaux Industriels (STSI) (Belgium)	No change
	Springfields Fuels Ltd	No change
	TN International (France)	No change
	Transrad (Belgium)	No change
	WH Bowker Ltd	No change

2.3 In the later sections of the report, we have included 'radar diagrams' for sites that receive enhanced levels of regulatory attention to illustrate the factors that influenced the regulatory attention level, and to indicate the licensee/dutyholder's progress in delivering improvements since last year's assessment. It should be noted that in this report the attention level scale on the radar diagrams has been inverted compared to those in previous reports. This has been implemented to improve data visualisation.

2.4 **Level 3:** Routine attention applies to those sites, facilities, or organisations that we consider require no additional regulatory focus or effort over and above that which we would normally apply.

2.5 **Level 2:** Enhanced attention describes sites that, either by virtue of their safety and security performance or due to specific technical safety and security challenges, will be subject to a greater level of regulatory attention than would, otherwise, be the case.

2.6 **Level 1:** Significantly enhanced attention recognises additional factors such as emergent or long-standing safety or security issues and/or the magnitude and nature of the risk associated with specific facilities. It may also reflect instances where we have substantially refocused our regulatory strategy to secure a specific outcome, such as accelerated hazard and risk reduction at Sellafield. We might in other circumstances assign such an attention level where the dutyholder has fundamental shortcomings in its safety or security performance or has failed to address long-standing and significant regulatory issues.



Nuclear industry inspection performance

2.7 For all inspections that we undertake across our purposes, our inspectors allocate an overall rating of the observed performance of licensees and other dutyholders against expected standards.

2.8 We use red-amber-green (RAG) inspection ratings to track performance; the rating system being assigned against the action that we propose to take in response to inspection findings, namely:

- Green – No formal action
- Amber – Seek improvement
- Red – Require improvement

Compliance and system-based inspections

2.9 Over the last year, we have rated the majority of compliance inspections as green. For the inspections that were rated as amber or red, our inspectors have raised the need for improvements with the licensee and obtained their commitment to making such improvements. In some instances, we have decided to take formal enforcement action in line with our enforcement policy statement[1] (EPS).

2.10 System-based inspections (SBIs) have continued to be an important feature of our inspections on licensed nuclear sites. SBIs seek to establish that systems important to safety are maintained so that they perform as expected, fulfilling their safety functional requirements as required by the facility's safety case.

2.11 During the reporting period, 40 SBIs were planned. However, to protect our staff, our licensees and the public considering the COVID-19 pandemic, many SBIs were deferred or cancelled. Of the SBIs that were carried out, we judged in 16 out of 17 undertaken that the safety systems we had examined met the requirements of the safety case. For the system that did not meet the safety case requirements, satisfactory plans have been established to remediate shortfalls. Future intervention plans have been adjusted to account for deferred or cancelled SBIs.

2.12 The issues arising from our inspection activities are recorded through our well-established regulatory issues management process. These issues are shared with the relevant dutyholder, and ONR inspectors ensure that any corrective measures are monitored to a satisfactory conclusion so that appropriate improvements to safety and security are delivered.

1 https://www.onr.org.uk/enforcement.htm

Enforcement

2.13 On the occasions where we have identified shortfalls in licensees' arrangements, proportionate enforcement action has been taken in accordance with our enforcement management policy. Over the last year, we have employed a range of enforcements[2] to hold dutyholders to account and to secure sustained compliance with the law. During this period, we:

- Issued 2 security related directions under the Nuclear Industries Security Regulations 2003 (NISR);
- Issued 2 security related enforcement letters;
- Served six safety-related improvement notices, one of which has now been satisfactorily complied with. At the time of writing, we anticipate the requirements of the remaining five will be met by dutyholders in accordance with the required schedules;
- Issued 40 safety-related enforcement letters; and
- Issued one direction under Licence Condition (LC) 15(4) – periodic review of pressure systems safety.

2.14 Where we considered there to be shortfalls, we were satisfied that the required improvements are now being implemented, and that, overall, adequate levels of nuclear safety and security have been maintained despite some shortfalls.

2.15 We have also undertaken two prosecutions against licensees, both resulting in guilty pleas (See Table 4).

2 https://www.onr.org.uk/enforcement.htm

Table 4: Summary of concluded prosecutions during 2020/21

Licensee/ dutyholder	Details of incident and charges	Outcome
Atomic Weapons Establishment, Aldermaston	The prosecution arose from an investigation into an incident that occurred at the Aldermaston site on 20 June 2019. On that day a contractor narrowly avoided injury when a flash over of electricity occurred when he attempted to remove a flash guard in a fuse box, believing that the electricity had been isolated and disconnected, when in fact a live circuit was present. The incident was a conventional health and safety matter and took place in a 'non-nuclear' building. As such, there was no radiological risk to workers or the public.	On 7 December 2020, AWE Plc was fined £660,000 after pleading guilty to an offence under Section 3 of the Health and Safety at Work, etc. Act (1974). AWE was also ordered to pay costs of £9,945.71 during a virtual hearing at High Wycombe Magistrates Court.
Sellafield Ltd	An incident occurred on 24 April 2020 at the Sellafield site which resulted in a worker sustaining 15-20% burns whilst undertaking electrical work on high voltage equipment. The incident took place at an electrical substation on the site and there was no nuclear material present or any radiological risk to workers or the public.	On 18 December 2020, Sellafield Ltd was fined £320,000 after pleading guilty to an offence under Section 2 (1) of the Health and Safety at Work etc. Act (1974). The company was also ordered to pay costs of £12,079.07 at the hearing at Carlisle Magistrates Court

3 Civil nuclear security and safeguards

Summary of performance across Civil Nuclear Security and Safeguards Division

The civil nuclear industry has continued to meet its security and safeguards obligations during 2020/21 despite the challenges of working in a pandemic.

Our principal security activity during the period continued to be the assessment and approval of security plans aligned to our SyAPs. While most dutyholders were able to submit assessable plans in accordance with agreed timelines, there is still some work to do in this area and we are supporting those few remaining dutyholders to develop appropriate plans in accordance with our enabling approach.

We are pleased to note that due to improvements they have put in place, all approved nuclear carriers are now at a routine regulatory attention level, indicating the success of the regulatory action plans we implemented throughout 2020/21.

We have worked closely with the international safeguards inspectorates and other stakeholders to ensure that the UK continues to fulfil its international safeguards obligations.

From January 2021, we assumed responsibility as the state regulatory authority for safeguards. This means running the SSAC as well as regulating UK operators against the UK's domestic safeguards regulations.

Paul Fyfe
Security and Safeguards Director
Deputy Chief Nuclear Inspector

Protective security

Implementation of SyAPs-aligned security plans

3.1 The challenges of introducing outcome-focused regulation were underestimated by the industry and ourselves, leading to challenges associated with aspects of implementation.

3.2 Certain areas of the industry have continued to struggle to deliver 'right first time' security plans, and consequently we have conducted a significant amount of enabling activity to ensure dutyholders' submissions are adequate.

The lack of personnel that were suitably qualified and experienced (SQEP) in nuclear security within some dutyholders' security functions, and their limited understanding of outcome-focused security regimes, were key factors in the continued challenge to deliver adequate submissions.

3.3 Notwithstanding the challenges of COVID-19, we successfully approved a total of 11 out of 20 SyAPs-aligned security plans over the period and anticipate issuing a further approval in the coming months. Those sites that did not have their security plans approved continued to operate under security plans approved by the predecessor to SyAPs (National Objectives Requirements and Model Standard), and we are satisfied that there are no gaps in security standards on those sites. Additionally, subsequent revisions of security plans for two Category 1 nuclear material sites have also been assessed and approved. Consequently, we have witnessed improvements in dutyholder ownership of nuclear security together with updated security arrangements demonstrating greater efficacy.

Professionalisation of security

3.4 Prior to the introduction of SyAPs, our Civil Nuclear Security and Safeguards Division (CNSS) underwent a significant programme of qualifications and upskilling of security inspectors to facilitate successful implementation of outcome-focused security regulation. The industry was strongly encouraged to do the same, as writing security plans requires individuals who are SQEP in more advanced risk management.

3.5 Our previous (2019/20) report identified areas of concern over dutyholders having sufficiently SQEP personnel during early engagement on draft SyAPs-aligned security plans and ongoing routine regulatory activities. We have observed improvements in capability, although evidence gathered over this period continues to indicate that this is an area of ongoing development for the industry.

3.6 In conjunction with our Human and Organisational Capability (HOC) specialists, CNSS inspectors have worked to take a more integrated approach to regulating industry arrangements associated with human performance, setting clearer expectations of industry on this aspect of security leadership and management and we will be continuing this work in the coming year.

Cyber security

3.7 We continue to place significant regulatory focus on assessing the ongoing adequacy of cyber security arrangements across the Sector. As the current Department for Business, Energy and Industrial Strategy (BEIS) Civil Nuclear Cyber Security Strategy (CNCSS) draws to an end, it is evident that the transition to outcome-focused security regulation has driven demonstrable improvements to the cyber security position of many dutyholders.

3.8 With responsibility for ownership and control of cyber security risk resting firmly with dutyholders, we have seen greater focus around understanding and mitigating cyber security vulnerabilities.

3.9 Throughout the year, several significant cyber vulnerabilities have been identified globally, affecting systems across numerous industries. In assessing the impact to the sector, we have gained valuable intelligence about its ability to detect, respond to and recover from such incidents. We continue to work with government and the industry to improve the awareness and response to these incidents.

3.10 Our regulatory intelligence has identified that many of the more tactical issues identified among dutyholders can often be traced back to wider strategic principles of security such as organisational strategies, organisational culture, and cyber security competence. These have been identified as areas requiring further regulatory attention and consideration in future sector-wide regulatory strategies.

3.11 We continue to support the sector through several ONR-sponsored industry forums. We also work closely with trade associations to engage effectively across the supply chain. However, capability development in respect to cyber security across the dutyholder community remains an area reflecting the dynamic nature of the cyber threat.

Regulation of the supply chain

3.12 Working with contracted partners, we have delivered 30 interventions across supply chain dutyholder facilities to assess the adequacy of arrangements for handling Sensitive Nuclear Information (SNI).

3.13 These 30 interventions of supply chain (List N[3]) dutyholders provided assurance regarding a general trend of compliance with the requirements for the protection of SNI, with all dutyholders being assessed as green and broadly meeting regulatory expectations. Several regulatory issues were raised to address minor non compliances, many of which related to the administration of List N and maintenance of areas such as List N approvals, security aspect letters, risk assessments and asset registers. Whilst some work was required in these areas, no issues were identified that posed a significant risk to the protection of SNI.

Safeguards

3.14 During 2020, we continued to enhance our safeguards capacity and capability through the SSAC project, in preparation for the UK exit from Euratom. We fully integrated the SSAC project into the CNSS division in December 2020, ready to deliver our new safeguards purpose from the end of the transition period.

3.15 As of 1 January 2021, new international safeguards agreements and domestic legislation came into force and we took on responsibility for delivering the new domestic safeguards regime, part of the UK SSAC. Our regulatory oversight during this period ensured that operators successfully submitted their initial qualifying nuclear material inventory and basic technical characteristics (BTC) documents in line with new regulatory requirements.

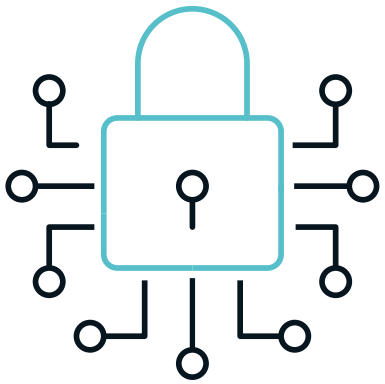
3.16 We commenced routine operations, reporting monthly nuclear material accounting reports from UK operators to the IAEA as required under our new international safeguards agreements. Our Safeguards Information Management and Reporting System (SIMRS) is functioning effectively, and this enables us to receive declarations from operators, process them and submit the required reports to the IAEA, as well as meeting the reporting requirements of our bilateral international nuclear cooperation agreements (NCAs).

3 List N refers to the clearance that companies are required to hold before handling information classified at OFFICIAL-SENSITIVE: SNI or above.

3.17 We have successfully facilitated IAEA inspections and IAEA equipment installation at the UK sites designated for IAEA safeguards, with no significant issues. We worked with UK operators on the preparation and submission of accountancy and control plans (ACPs) to our safeguards team, as required under the new regulations. We continue to engage with operators regularly to ensure regulatory expectations under the new regime are clear. We have also commenced the assessment of applications from qualifying nuclear facilities with limited operation for the derogated reporting regime provided for under the Nuclear Safeguards (EU Exit) Regulations 2019.

3.18 We continue to develop and implement our first full year of safeguards activities, working collaboratively with our other purposes, operators and other domestic and international safeguards stakeholders. The UK continues to meet its international safeguards obligations in accordance with our bilateral agreements with the IAEA and nuclear cooperation agreements in place with partner states.

3.19 In the coming year, we will undertake targeted inspection and assessment activities to gain regulatory confidence that nuclear material accounting reports, ACPs and BTCs meet legal requirements and our regulatory expectations. We will continue to assess applications for derogated reporting and anticipate these applications increasing over the coming months. We have built regular assurance activities into our first year of operations and will continue to engage closely with operators throughout to facilitate ongoing improvement and learning from experience.



4 Nuclear new build

Summary of performance across New Reactors Division

The enabling approach we are taking in our New Reactors Division continues to support new nuclear projects and facilitate high levels of safety and security.

We have continued to focus on the UK's first nuclear new build project in a generation at Hinkley Point C (HPC), where construction has continued to progress well despite the additional challenges faced over the last year. Specifically, we have continued to seek evidence that the licensee, NNB GenCo (HPC), has achieved the high levels of assurance and quality control necessary to build a nuclear reactor, and has the appropriate arrangements in place to ensure that equivalent standards are achieved through its supply chain. Whilst there are challenges, the overall assessment of the project is that it will continue to be subject to routine intervention.

We have also worked closely with NNB GenCo (SZC) regarding plans for the development of Sizewell C (SZC). The licensee submitted its nuclear site licence application early in the year and we are currently assessing it. We note that NNB's objective for SZC is to replicate, as far as is possible, the design of Hinkley Point C, and we are developing our regulatory approach to this. Design replication is an important aspect of reducing project risk, providing increasing certainty over schedule and cost, whilst also providing a level of assurance in standards of safety and security.

We have continued our detailed technical work on Step 4 of the UK HPR1000 GDA. Our focus is on ensuring that the Requesting Party, China General Nuclear Power Group (CGN)/Generation Nuclear International (GNI)/EDF Energy is demonstrating to our satisfaction that the reactor design meets the required safety and security standards and that risks are as low as reasonably practicable (ALARP).

We also continue to provide support to the UK Government through our work with advanced nuclear technologies (ANTs). This has enabled us to build capability in this area, developing understanding of the technologies involved and how we will approach the regulation of ANTs in the future.

Jane Bowie
New Reactors Director
Deputy Chief Nuclear Inspector

Hinkley Point C

4.1 There were no significant permissioning decisions during the 2020/21 reporting year. Our regulatory activity has focused on oversight of construction activities across the Hinkley Point C site in preparation for the November 2021 permissioning date for Mechanical Electrical and Heating, Ventilation and Air Conditioning (HVAC) (MEH) installation.

Impact of COVID-19

4.2 NNB GenCo (HPC) has responded effectively to the COVID-19 pandemic. It has implemented arrangements aligned with government guidance, which has allowed work to progress throughout the various national lockdowns. We have observed adherence to pandemic control measures on the site and are content with NNB GenCo (HPC)'s response and its protection of its workforce. Like other licensed sites, our regulatory presence was reduced over the lockdown periods, although we did continue to undertake inspections, including remotely where appropriate. We have increased our site attendance substantially since national restrictions have relaxed and have now re-established most routine inspection work on the site.

Development of the design and safety case

4.3 NNB GenCo (HPC) has made good progress with the development of the safety documentation for Hinkley Point C. It is on target to close all assessment findings associated with the upcoming MEH milestone and is developing the safety case for Unit 1 active commissioning. Three interim 'summary safety case documents' (SSCDs) are scheduled, and the first of these (SSCD1 - submitted to us early in 2020/21), was found to be largely acceptable and a good indicator of the quality of the ongoing development of the wider safety case.

Supply chain

4.4 This has been an area of significant regulatory focus for us as NNB GenCo (HPC)'s supply chain activities continue to increase. NNB GenCo (HPC) has been developing and implementing significant improvement plans, based on operational experience, to enhance its arrangements for supply chain manufacturing surveillance and lifetime quality records across the Hinkley Point C project.

4.5 Our regulatory approach has focused on seeking assurance that NNB GenCo (HPC)'s oversight arrangements are effective in securing sustainable improvements in producing components to the required quality standards, supported by robust quality assurance and record management arrangements.

Construction

4.6 During 2020/21, the construction focus has continued to be on the reinforced concrete foundation 'nuclear islands' for reactor Units 1 and 2, the conventional island for Unit 1 and tunnelling for the cooling water intakes and outfall. NNB GenCo (HPC) has identified several challenges related to the quality of off-site manufactured components delivered to the site, its proposals to address this continues to be a focus for us.

4.7 There continues to be effective learning from Unit 1 construction applied to Unit 2, which should also support the replication strategy for Sizewell C.

4.8 Overall, we consider that NNB GenCo (HPC) is constructing the nuclear power plant to the required safety and security standards.

Conventional health and safety

4.9 We have sought to ensure that conventional health and safety is regulated in a manner commensurate with the site's risk profile. Reports made under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2015 (RIDDOR) have been reviewed, found to be appropriate, and in line with our expectations.

4.10 A collapse of a ground granulated blast furnace slag silo occurred at the concrete batching plant of the Hinkley Point C site during the reporting period. The collapse did not result in any injuries to the workforce, or damage to any nuclear safety-related structures. We are maintaining close oversight of NNB GenCo (HPC)'s arrangements following their report to us on the incident, to ensure that appropriate learning is undertaken and actioned.

Forward look

4.11 We will maintain focus on NNB GenCo (HPC)'s development of its capability to manage the next significant regulatory permission – bulk installation of MEH systems in the site's nuclear island, and the subsequent delivery of these systems, as well as other critical safety components such as the nuclear steam supply system (NSSS).

Security at Hinkley Point C

4.12 NNB GenCo (HPC) continues to demonstrate effective delivery of security at Hinkley Point C and to meet regulatory expectations. Although this is a complex project, the strong relationship between Hinkley Point C and its primary security contractor has enabled any security challenges to be addressed proactively. The dutyholder has delivered consistent compliance with its project security plan (PSP). Based on this performance, we intend to maintain a routine level of regulatory attention at this stage of the project.

Sizewell C

4.13 NNB GenCo (SZC) submitted the Sizewell C nuclear site licence (NSL) application at the end of June 2020. We are currently progressing a proportionate programme of regulatory activity and assessment to inform our nuclear site licence decision that is currently targeted for June 2022.

4.14 Except for a small number of site-specific features, Sizewell C will be a replication of Hinkley Point C, adopting the same design reference configuration. We consider that replication is beneficial to nuclear safety and security; Sizewell C can and will benefit from the learning from experience generated from construction and commissioning of Hinkley Point C, and from the supply chain insight and experience generated by that project.

Generic Design Assessment (GDA)

4.15 In January 2017, the UK Government formally asked ONR and the Environment Agency to begin the GDA of the UK HPR1000.

4.16 The UK HPR1000 is a reactor design proposed for deployment at Bradwell-on-Sea, Essex. General Nuclear System LTD (GNSL) is a UK-registered company that was established to deliver the GDA of the UK HPR1000 reactor on behalf of three joint requesting parties, China General Nuclear Power Corporation (CGN), EDF, and General Nuclear International (GNI), the latter being a UK subsidiary of CGN.

Progress through GDA step 4

4.17 Step 4 of GDA commenced in February 2020 and is scheduled to last for 23 months. The UK HPR1000 GDA requesting party (RP) published updated versions of the UK HPR1000 pre-construction safety report (PCSR) and Generic Security Report (GSR) on its GDA website.[4]

4 http://www.ukhpr1000.co.uk/documents-library/step-4

We are now conducting a rigorous and in-depth assessment of these documents and the underpinning safety and security submissions containing the detailed evidence presented by the requesting party that forms the basis of the safety and security cases.

4.18 To date over 1,660 regulatory queries (RQs) and 60 regulatory observations (ROs) have been raised. RQs are requests by the regulators for clarification and additional information and are not necessarily indicative of any perceived shortfall. ROs are raised when we or the Environment Agency identify potential regulatory shortfalls which require action and new work by the requesting party for them to be resolved. We publish the ROs together with the requesting party's resolution plans in our joint regulators' GDA website.[5]

4.19 In parallel to our Step 4 assessment, the Environment Agency is conducting a public consultation on the outcomes of its GDA assessment to date. We have supported all the events organised as part of this consultation.

4.20 At the end of Step 4 we will judge whether a design acceptance confirmation (DAC) can be issued for the UK HPR1000 design. In accordance with our commitment to continued openness and transparency, we will also publish our Step 4 technical assessment reports and a summary assessment report underpinning our decision on our GDA website.

Collaboration with overseas regulators

4.21 We believe that international co-operation is important to the successful regulation of new reactors. Thus, in our GDA projects, we seek and welcome opportunities for collaboration with overseas regulators who are dealing with the same or similar reactor designs. The outputs from our international work are used, as relevant, to inform our step 4 assessment.

5 http://www.onr.org.uk/new-reactors/uk-hpr1000/ro-res-plan.htm

Bradwell B nuclear power plant project: pre-licence application engagement

4.22 Bradwell Power Generation Company Ltd (BRB GenCo) is a joint venture between General Nuclear International (GNI) and EDF, created to deliver the Bradwell B Nuclear Power Plant project, intended to be based on deployment of the UK HPR1000 reactor technology.[6] Our UK HPR1000 regulatory team has engaged with BRB GenCo to ensure that it understands our expectations as regards consideration of site suitability and the establishment of sufficient organisational capability commensurate with the issuing of a nuclear site licence and responsibly discharging the legal duties that this bestows.

Advanced nuclear technologies (ANTs)

4.23 Through the second phase of the advanced modular reactor (AMR) programme, the UK Government has continued to provide funding to allow ONR to develop the regulatory capability, guidance and processes to regulate any future ANTs, including Small modular reactors (SMRs) and AMRs.

4.24 Over the last year, we have progressed the implementation of our ANT training strategy and plans. We have built on the operational experience for ANTs gathered during the first phase of the government's ANTs programme and undertaken a series of further engagements with international regulators and technical support organisations.

4.25 We have worked closely with the government to establish the framework for ANTs to be able to enter GDA. We contributed to establishing criteria and processes for entry to a modernised GDA process and will assist in assessing the readiness of potential entrants over the coming period.

4.26 We have participated in a series of pre-GDA engagements with the UK SMR consortium, providing early clarity on regulatory expectations and our experience from previous GDAs.

4.27 We have also contributed to the ongoing discussion on the options for the future regulatory regime for nuclear fusion, engaging with both BEIS and the Regulatory Horizons Council.

6 https://bradwellb.co.uk/

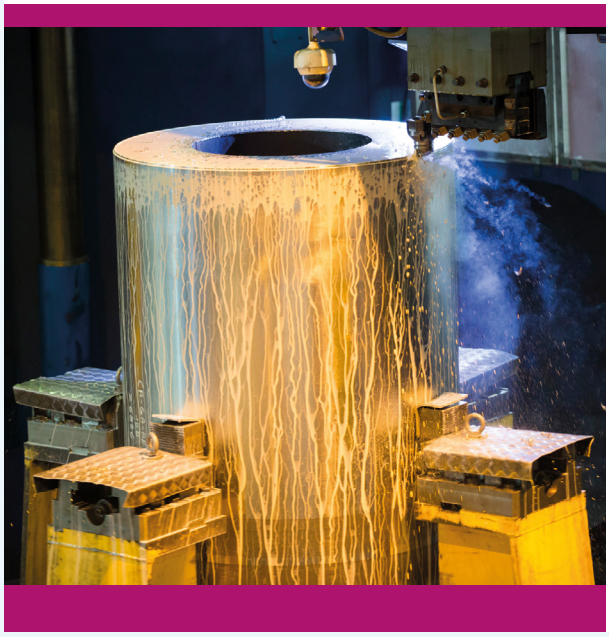
Technical case study

Securing equipment and records to the right quality

Record and quality management at Hinkley Point C

NNB GenCo (HPC) is constructing two EPR™ reactors at Hinkley Point C in Somerset. This mega project involves a significant investment in the supply chain of over £12 billion for the manufacture and supply of high specification equipment from over 400 factories around the world. To underpin the manufacture, installation, commissioning, and early operations, it is also essential NNB GenCo (HPC) produces a comprehensive set of lifetime quality records.

NNB GenCo (HPC) commenced construction of the nuclear island raft (which supports the reactor, safeguard, and fuel buildings) in December 2018, and by the end of 2022 the project's suppliers will have delivered 90% of the equipment for the first reactor unit and 75% of the equipment for the second reactor unit to the site.



NNB GenCo (HPC) must ensure, as an intelligent customer, that all the equipment for the power station is of the right quality to reliably meet the design and safety intent, supported by comprehensive records on how the equipment was manufactured, installed, and commissioned.

Previous inspections have indicated areas of potential weakness in manufacturing oversight, which could potentially increase the likelihood that sub-standard manufactured products could be installed. Nevertheless, to date, due to multiple lines of defence, NNB GenCo (HPC)'s systems have prevented sub-standard products being installed.

We utilised our enabling regulation approach to ensure the findings from our various inspections were addressed appropriately. The first step was to discuss the themes with NNB GenCo (HPC) and scrutinise their response and self-identified plans for improvement in a workshop environment. Our inspectors evaluated their replies and the evidence to systematically determine our regulatory approach.

Our inspectors have worked with NNB GenCo (HPC) to identify priority areas from the emerging themes, enabling the licensee to focus its attention on the areas that would result in more effective systems for sustainable manufacturing oversight.

- NNB GenCo developed a comprehensive manufacturing surveillance improvement plan (MSIP). This encompasses a portfolio of improvements to the manufacturing oversight arrangements. These include improvements: to the procedures used by NNB GenCo (HPC)'s surveillance contractor; in communications and co-ordination with suppliers; and to intelligent customer activities. We have worked with NNB GenCo (HPC)'s internal regulator to ensure these were implemented.
- NNB GenCo (HPC) reviewed manufacturing activities already underway in early 2020 to provide itself, and us, with confidence that it could continue to manufacture whilst improvements to its oversight systems were being developed and implemented.
- We required NNB GenCo (HPC) to conduct a review of its manufacturing oversight arrangements. NNB GenCo (HPC) did this by bringing together a panel of experts, internal and external, and chaired by its internal regulator. The recommendations arising from this are being taken forward by the licensee.

Over 2020/21, significant progress has been made by NNB GenCo (HPC) in implementing improvements to manufacturing oversight.

In parallel, our inspectors, in conjunction with the internal regulator, also identified several shortfalls in the provision of lifetime quality records across the project. Our inspectors actively engaged with the licensee to understand the root causes of these shortfalls and instigated a regime of increased oversight to ensure timely action was being taken. NNB GenCo (HPC) prepared a comprehensive improvement plan and established a dedicated project team, with executive oversight, to drive forward the required improvements. This improvement plan involved enhancing management arrangements, recruiting specialist resources and educating key staff and suppliers on the importance of high-quality records.

NNB GenCo (HPC) has recently delivered the scope of the improvement plan and is now embedding the improved working practices across the project.

Recognising the importance of adequate manufacturing oversight and lifetime quality records, we will conduct a major cross-cutting inspection which will assess the effectiveness of the improvements, from product specification, through manufacturing control and installation on-site. This intervention will provide NNB GenCo the opportunity to further demonstrate the effectiveness and sustainability of the improvements, which should ensure components are manufactured, installed, and commissioned to the right quality, and with the right quality records.

“

NNB GenCo (HPC) must ensure, as an intelligent customer, that all the equipment for the power station is of the right quality to reliably meet the design and safety intent.”

5 Operating facilities

Summary of performance across Operating Facilities Division

In our Operating Facilities Division, we continue to concentrate our attention across the defence sector and the operating fleet of reactors to ensure the protection of society. In particular, our focus has been on four of the sites we regulate that are subject to enhanced regulatory attention, namely the two Atomic Weapons Establishment sites, Aldermaston and Burghfield, Devonport Royal Dockyard and Dungeness B power station.

Across these four sites, we are maintaining our enabling approach to ensure that the sustainable improvements necessary are delivered in a timely fashion that will enable these sites to be considered for a return to routine regulatory attention. However, we will continue to hold these sites, as well as the wider defence and reactor sites, to account should they fall short of the expected standards.

For the operating fleet of reactors, safety justifications associated with the graphite cores continue to occupy a significant amount of our assessment time. It is through the increased understanding and confidence in the graphite safety case for the end of generation that we have been able to reduce the attention level of Hunterston B from enhanced to routine attention.

For the defence sector, common areas of focus for many of the sites we regulate are around asset management of ageing facilities and infrastructure, along with the capacity to deliver adequate quality safety cases on time and the implementation of associated facility upgrades.

Michael Finnerty
Operating Facilities Director
Deputy Chief Nuclear Inspector

Overview of performance across the reactor fleet

Dungeness B

Figure 1. Dungeness B performance radar diagram

Showing performance comparison between the end of the 2019/20 period and end of the 2020/21 period

Dungeness B 2019/20
Dungeness B 2020/21

1. Significantly enhanced attention
2. Enhanced attention
3. Routine attention

5.1 Dungeness B entered enhanced regulatory attention in late 2018, with both reactors having remained in a shutdown condition since October 2018. This was due to several age-related engineering issues, including corrosion of concealed systems which also led to the serving of a formal direction in September 2018. Since then, the station has been engaged in an extensive corrosion management programme.

5.2 During the station's extensive remediation work, other concerns were identified by the licensee, EDF Energy Nuclear Generation Ltd (EDF-NGL), which prevented the return to service of the reactors and took significant EDF-NGL resources to address.

5.3 We, and EDF-NGL management, were also concerned about underlying shortfalls in relation to the high standards of safety management and culture that we expect at an operating nuclear power station. EDF-NGL established an extensive and wide-ranging 'performance improvement programme' (PIP), which is led by a senior manager on site, sponsored by the station director and subject to an oversight board that includes senior managers from the wider EDF and other experts independent of the station. We have witnessed the improvements made by this programme and we wish to see these improvements sustained before any decision will be taken on returning the site to a routine level of attention.[7]

Sizewell B

5.4 Sizewell B has an adequate compliance record as regards health and safety legislation and the requirements of the nuclear site licence conditions, confirmed through compliance and system-based inspections. The site has continued to demonstrate a good record of safety and security performance in the reporting period.

Heysham 1 and Hartlepool

5.5 We consider Heysham 1 and Hartlepool to have a safety performance that meets, overall, the standards of safety and security management that we would expect. However, they are amongst the most challenging AGRs to operate reliably because of the design of the reactors. Regulatory attention levels have remained at routine throughout the reporting period.[8]

7 On 7 June 2021, EDF made the decision that Dungeness B would not return to service and would move immediately into the defuelling phase. We are now in the process of revising our strategy to oversee the safe transition of the station into defuelling and beyond. We have agreed initial objectives with EDF which include the requirement for them to demonstrate safe continued shutdown of the reactors whilst defuelling safety cases are produced.

8 Subsequent to the reporting period an issue was identified relating to thermal sleeve wear at Sizewell B. The potential for this issue had been anticipated and we have had extensive technical discussions with EDF as they develop plans to address the issue and return to service.

5.6 We took enforcement action at Heysham 1 on two occasions due to shortfalls in compliance with the Pressure Systems Safety Regulations 2000 (PSSR):

- On 11 May 2020, an improvement notice was issued requiring EDF-NGL to complete a small number of reactor pressure vessel penetration examinations; and
- On 14 December 2020 a direction was issued under licence condition 15(4) requiring EDF-NGL to carry out a thorough review of Heysham 1's arrangements to secure compliance against the PSSR.

5.7 A similar action was placed on EDF-NGL to review the entire reactor fleet position against compliance with PSSR. The activities required by this direction were completed to the required timescale and the direction has been closed.

5.8 We provided agreement to two requests from EDF-NGL for extensions to the commencement of Heysham 1 Reactor 1's statutory outage due to essential maintenance activities required prior to the outage and the disruption caused by the pandemic.

5.9 We issued one enforcement letter to Hartlepool due to a failure by the site to conduct the necessary PSSR inspections on critical plant items within the intervals specified in the relevant written schemes of examination.

Hunterston B

5.10 Hunterston B has a long-standing good safety record and continued to demonstrate a strong nuclear safety performance during the year. The enhanced attention levels for 'nuclear safety case adequacy and currency' and 'significance and timeliness of issue resolution' relate to known graphite ageing effects described within the safety case, rather than concerns about the safety or security performance of the site itself.

5.11 We did, however, issue two enforcement letters during the reporting period, seeking improvements to the implementation of operating rules under LC 23. The station has responded well to these enforcement letters and is taking positive steps to reinforce adherence to the expected standards.

5.12 We agreed to the restart of Reactor 3 and Reactor 4 in August and September 2020 respectively after a prolonged shut down (necessary to allow EDF-NGL to develop adequate safety cases to justify the return to service). This safety case was subject to rigorous assessment by our specialist inspectors. Both reactors have operated safely and in compliance with their safety case for the first agreed six-month period of power generation. In April 2021 we approved a final six-month period of power generation for Reactor 3 and 4 before shutdown and defuelling operations begin.

5.13 EDF-NGL has confirmed that power generation at Hunterston B will cease by 7 January 2022. With the increased understanding and confidence in the graphite safety case to the end of generation, we have now reduced the attention level of Hunterston B from enhanced to routine attention.

Hinkley Point B

5.14 Hinkley Point B has a good safety record but, like Hunterston B, both reactors spent much of the reporting period shut down whilst an adequate safety case was developed to demonstrate that the safety functions of the graphite core can be maintained in all reasonably foreseeable circumstances. This safety case was subject to rigorous assessment by our specialist inspectors before we agreed to the restart of the reactors in March 2021.

5.15 EDF-NGL has now confirmed an end of generation date of July 2022. A significant proportion of our effort is now being directed towards the preparations to move the site from operation to defuelling.

5.16 We are also starting to engage on the decommissioning strategy for the site. The focus on decommissioning will continue to increase over the next few years as the site moves towards the end of defuelling.

Heysham 2 and Torness

5.17 Heysham 2 and Torness have faced challenges over the reporting year due to several events, safety case challenges and operational difficulties. The response of both stations to these challenges has been good, and we consider the stations to have an appropriate and mature safety culture, supported by an experienced leadership team.

5.18 In October 2020, the fuelling machine interspace for Heysham 2 lost pressure whilst preparing for operation. We have maintained oversight of the technical investigations into this event and the implications for the fuelling machine safety cases at Heysham 2 and at Torness, which has the same design of fuelling machine. Consequently, pressurised refuelling activities have been suspended at both sites until safety case amendments have been made.

5.19 In April 2020, we served an improvement notice on EDF-NGL for shortfalls in safety procedures the station's return to service, during which the reactor was taken critical whilst several power indicators were configured incorrectly. EDF-NGL complied with this improvement notice in July 2021.

5.20 In June 2020, a dropped load incident occurred in the new fuel cell at Torness. We conducted follow up interventions to gather more information on the incident, which identified several compliance gaps and resulted in an enforcement letter being issued to Torness. The site has since made several improvements, and we will review the adequacy of their implementation by the end of 2021.

5.21 I am satisfied that the reactor fleet continued to operate safely and securely in accordance with EDF-NGL's operation programme during the pandemic.

'End of generation' preparations

5.22 As end of generation approaches for several AGR stations, we have placed increased focus on the defuelling preparations at those stations closest to end of generation, and on corporate changes within EDF-NGL. The initial focus is on Hunterston B and Hinkley Point B, and increased focus will also be applied at Heysham 1 and Hartlepool as they move closer to their end of generation.[9]

5.23 Significant organisational change will occur at the sites during defuelling, and we recognise the challenges faced by EDF-NGL to ensure that the safety of the reactors continues to be maintained. This will require updated safety cases, which ONR will assess prior to the defuelling operations.

5.24 EDF-NGL has also embarked on an organisational transformation of its corporate centre. As stations reach the end of generation, EDF-NGL's support functions at Barnwood and East Kilbride will transform to keep pace with the AGR station closures and to meet the changing work demands. We will work with EDF-NGL in an enabling way to gain assurance that robust management of change arrangements are implemented, which will ensure continued safety and security on the sites.

Security Performance

5.25 The main focus during the reporting period was the assessment of EDF-NGLs site security plans (SSP) under SyAPs, which marks the move away from a prescriptive regime to outcome-focussed regulation. All security plans were approved, and arrangements have been implemented.

9 Dungeness B will now be added to these discussions.

5.26 With the onset of COVID-19, EDF-NGL implemented its pandemic contingency plan and proactively submitted temporary security arrangements (TSAs) for our approval. We regularly reviewed these temporary arrangements and supported EDF-NGL's prevailing pandemic contingency arrangements.

5.27 EDF-NGL has directed significant effort into the implementation of cyber and information security improvements. This is part of a three-year programme designed to update security measures and procedures across corporate and operating fleet systems. There has also been a corresponding increase in EDF-NGL staff to drive these improvements.

5.28 Our Safety-Informed Nuclear Security (SINS) inspectors have started assessment of related work for defuelling against the EDF-NGL programme to support regulatory oversight and security inspection activity.

Defence sites

5.29 There are three types of nuclear sites used for defence purposes:

- Nuclear licensed sites, which we regulate in accordance with the standard nuclear site licence. In the sole instance of AWE Plc, ONR's licence conditions do not apply to the extent that they may impact on the design of weapons;
- Authorised sites, which do not require a nuclear site licence because of exemptions relating to specific activities or a general disapplication to activities that are under the control of the Crown (the Ministry of Defence (MOD)). In these situations, the sites are authorised and regulated by the MOD. However, we are appointed as the enforcing authority for the Health and Safety at Work etc. Act 1974 (HSWA) and its relevant statutory provisions; and
- Nuclear warship sites, for which the Health and Safety Executive (HSE) is appointed as the enforcing authority for HSWA. We are the enforcing authority for the enforcement of Radiation (Emergency Preparedness and Public Information) Regulations 2019 (REPPIR19) and the Ionising Radiations Regulations 2017 (IRR17).

5.30 The Defence Nuclear Safety Regulator (DNSR), part of the MOD's Defence Safety Authority, provides assurance to MOD on nuclear safety where these legal exemptions apply, and on the transport of defence-related radioactive materials. Security is regulated by the Defence Nuclear Security Regulator (DNSyR). We have continued to work closely with both these bodies to ensure proportionate and effective regulation.

Atomic Weapons Establishment sites' safety performance

5.31 AWE Plc operates the AWE nuclear licensed sites at Aldermaston and Burghfield. These sites deliver the design, manufacture, maintenance, and support of the UK nuclear deterrent. Both sites have received enhanced regulatory attention for approximately eight years due to several safety performance factors.

5.32 In November 2020 the UK Government announced the termination of the contract with the commercial consortium that managed and operated AWE Plc (AWE Management Ltd) and the transition of AWE Plc into a wholly owned arm's-length body of the Ministry of Defence. This was effective July 2021. Post transition, AWE Plc remains the nuclear licensee responsible for compliance with its two nuclear site licences at the Aldermaston and Burghfield sites.

5.33 Relationships with ONR and some aspects of safety performance have benefitted from organisational changes during the reporting period. AWE continues to maintain focus on delivering safety improvements through a challenging holistic approach, which is led by the AWE Chief Executive Officer.

5.34 Improved safety performance outcomes are being realised at Burghfield earlier than Aldermaston. This is in line with regulatory expectations, and this variation is due to several factors, including the nature of operations, age of facilities and comparative size and complexity of the sites.

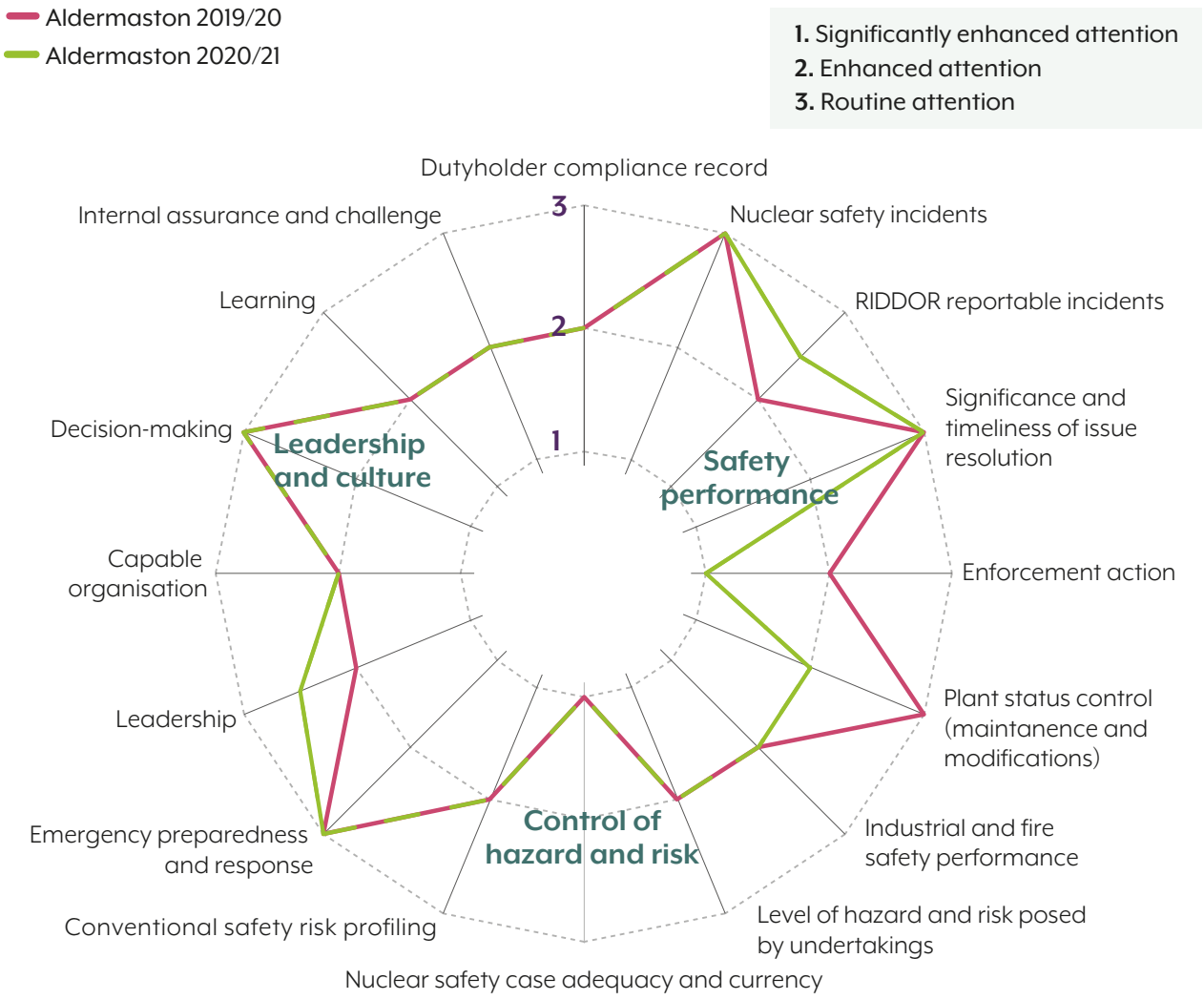
5.35 Our strategy for the regulation of the two AWE sites focuses on how the AWE executive team can both sustain Burghfield's performance and deliver timely safety performance improvements at Aldermaston.

5.36 As the AWE sites are both in enhanced attention, the regulatory attention levels are formally reviewed by us on a 6-monthly basis. The radar diagrams below show a 12-month view during which two reviews have been completed. They show that improvements in safety performance have been made at both sites over this period.

Aldermaston

Figure 2. AWE Plc, Aldermaston performance radar diagram

Showing performance comparison between the end of the 2019/20 period and end of the 2020/21 period



5.37 There are still areas of significant challenge at the Aldermaston site. Key areas include asset management of ageing facilities and infrastructure, along with the capacity to deliver adequate quality safety cases on time and the implementation of associated facility upgrades. We have again enforced against periodic safety reviews during the period and will continue to maintain an oversight of AWE's delivery against its associated improvement plans.

5.38 In December 2020 AWE was fined £660,000 after pleading guilty to an offence under Section 3 of the Health and Safety at Work etc. Act (1974). It followed an electrical flashover incident in June 2019 at the Aldermaston site, which resulted in a contractor narrowly avoiding serious injury. Progress has been made regarding the control of work since this incident, however further work is required to ensure repeat similar events are avoided.

5.39 During the year we were notified of one incident rated INES[10] Level 1, relating to the reporting of an AWE safety assessment that predicted a likelihood of collapse due to wind loading on a flue stack at a disused facility. Consequently, it was necessary for us to work in an enabling way to allow the licensee to accelerate the safe deconstruction and removal of the stack.

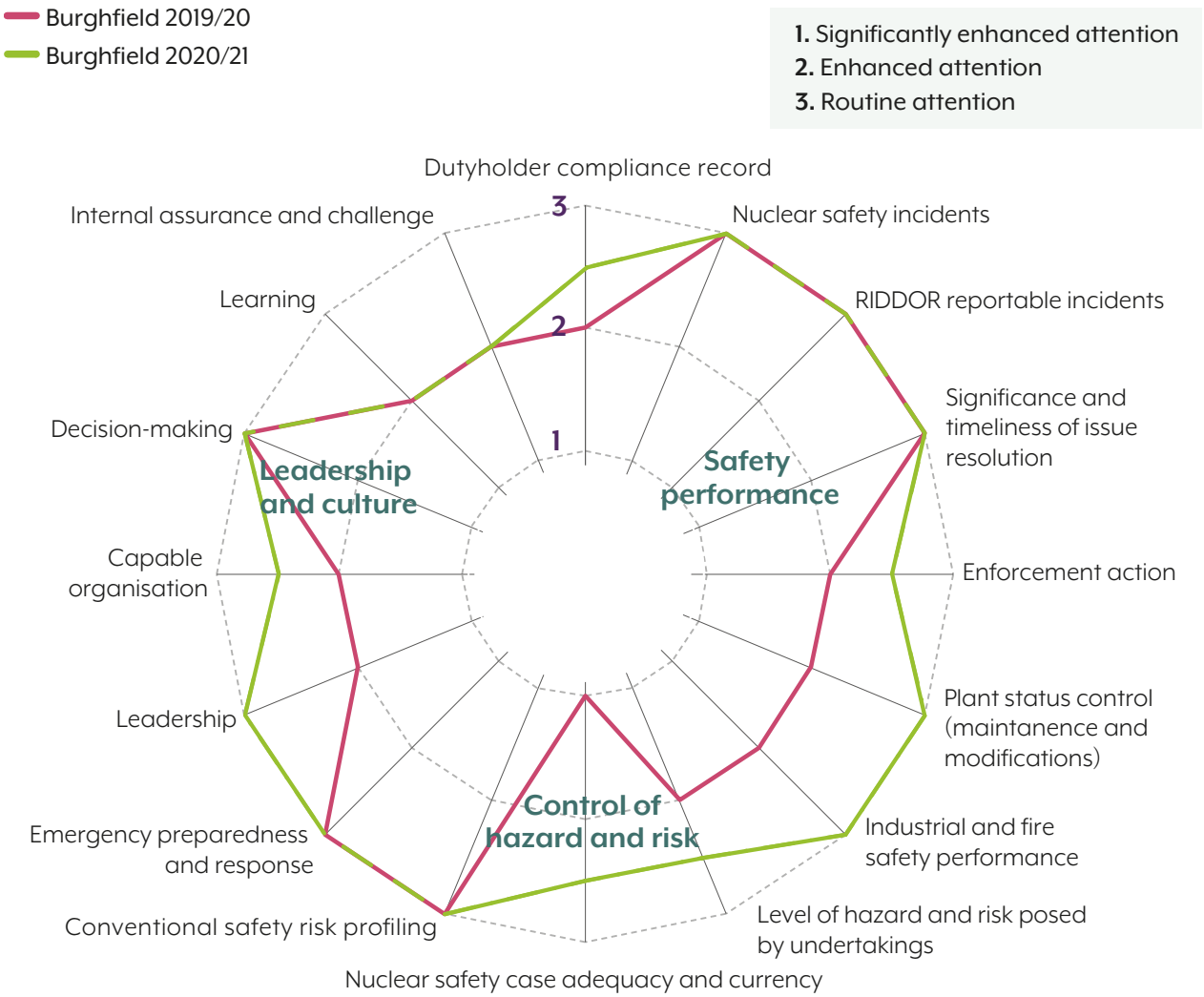
5.40 Overall, Aldermaston has made some progress, but significant improvement will need to be delivered in key areas, with consideration for a move to routine attention not thought likely before the end of 2022 at the earliest.

10 https://www.iaea.org/resources/databases/international-nuclear-and-radiological-event-scale

Burghfield

Figure 3. AWE Plc. Burghfield performance radar diagram

Showing performance comparison between the end of the 2019/20 period and end of the 2020/21 period



5.41 Following implementation of AWE's second periodic review of safety (PRS2) upgrades and its subsequent close-out of the PRS2, the Assembly Technology Centre (ATC) has demonstrated a period of sustained and safe operations.

5.42 Construction of the modern standards ATC replacement facility, Mensa, continues with the ongoing installation of the process plant and equipment. Within this period, we have granted permission for the commencement of the inactive commissioning of Mensa. The Mensa leadership team has demonstrated a proactive approach to safety management and culture.

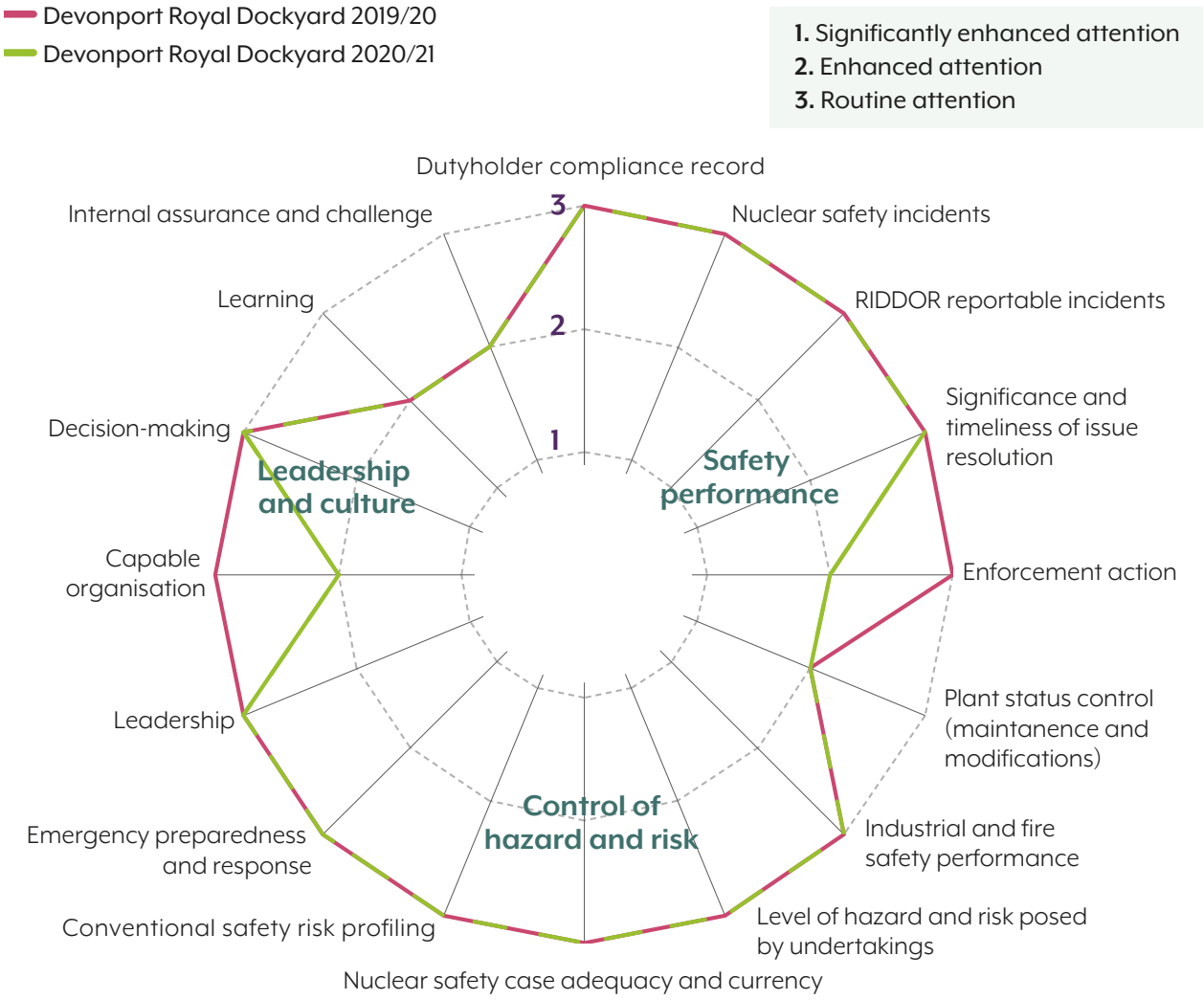
5.43 In summary, AWE has demonstrated evidence of significant improvement at Burghfield. Throughout 2021 we will be assessing the sustainability of safety improvements and the underpinning licensee autonomy. At the end of 2021 we will review whether it would be appropriate for this licensed site to move to routine regulatory attention.

Propulsion sites' performance

Devonport Royal Dockyard Limited

Figure 4. Devonport Royal Dockyard Limited performance radar diagram

Showing performance comparison between the end of the 2019/20 period and end of the 2020/21 period



5.44 Devonport Royal Dockyard is the UK's principal site for the maintenance of submarines. It contains a nuclear licensed site and an authorised site, operated by Devonport Royal Dockyard Limited (DRDL). There is also an authorised site operated by HM Naval Base (HMNB) Devonport that provides support to the UK's fleet of operational submarines. HMNB Devonport also stores 13 of the MOD's 20 redundant submarines on its authorised site.

5.45 There is significant infrastructure upgrade work required across the site in preparation for an increase in activity over the coming years in relation to submarine defuel and dismantling, commission extension and basic and deep maintenance periods for current and future classes of submarine.

5.46 DRDL has been subject to enhanced regulatory attention for six years based upon several safety performance factors. Our regulatory strategy is a balance between compliance inspection, and an enabling approach based on expert advice and guidance in key root-cause areas. The strategy also clearly defines criteria for the site exiting enhanced attention, based on root cause analysis.

5.47 Our January 2020 delivery confidence review reported that the nuclear safety improvement plan (NSIP) was on track and delivering.

5.48 From March 2020, DRDL developed and implemented amended arrangements to manage the risk presented by COVID-19. This led DRDL to prioritise key projects and programmes and also the cessation of non-essential activities in consultation with the MOD. COVID-19 restrictions also had a significant impact on the planned improvement programme as features such as multi-participant workshops could not be delivered as originally intended. The increase in homeworking and reduced leadership presence in the field also impacted the improvement programmes.

5.49 As part of our drive for effective and efficient regulation that adopts innovative approaches, we have convened a multi stakeholder forum with the MOD, DRDL and regulators. This 'in-service senior user group' aims to address barriers to safe, strategic programme delivery, using the collective experience and decision-making authority of the group to promote fit for purpose, innovative solutions.

Rolls-Royce Submarines Limited (RRSL)

5.50 The RRSL site at Derby is the principal location for the manufacture and basic testing of nuclear fuel cores to support the UK submarine programme. It contains two separate nuclear licensed sites: the Neptune Reactor site, which includes a 'zero energy' test reactor, and the Nuclear Fuel Production Plant (NFPP).

5.51 On balance, we are satisfied with the general levels of safety on the two sites and both remain in routine regulatory attention. However, following a series of events relating to criticality control certificates we issued an improvement notice requiring shortfalls to be addressed. RRSL has progressed the work well and has a broad programme of work that we are confident will deliver the improvements required.

5.52 In addition, we have been providing expert advice to RRSL on organisational and safety culture, which is an area they are focusing on.

5.53 The Neptune Reactor refurbishment project is of national strategic importance in supporting the Dreadnought programme. There have been technical issues over the reporting period resulting in delays to safety submissions and permissions. We have worked with RRSL to support their continued progress and this will remain an area of focus in the coming period.

BAE Systems, Barrow

5.54 Nuclear submarines are constructed at BAE Systems in Barrow. The site contains a nuclear licensed site (Devonshire Dock Complex), operated by BAE Systems Marine Ltd, and an authorised site. Currently, Astute and Dreadnought class submarines are under construction.

5.55 Major site development work is underway to provide the infrastructure to complete the build and commissioning of the Dreadnought class submarines. Our regulatory work is focused on the continued safety of the site, enabling these programmes and on supporting the remaining Astute programme.

5.56 We are satisfied with compliance and nuclear safety performance across the site.

Rosyth Dockyard

5.57 Rosyth Dockyard contains a nuclear licensed site, operated by Rosyth Royal Dockyard Limited (RRDL). The nuclear licensed site contains a dry dock used to dismantle the seven decommissioned submarines on the site, and a waste storage facility. The first phase of submarine dismantling (low-level waste removal) is currently underway at Rosyth. RRDL is undertaking work to expand its capability to undertake the next stages of submarine dismantling. This will support operations to remove intermediate level waste from the boats, requiring a significant uplift in organisational capability and the development of site facilities.

5.58 RRDL and the MOD has determined the solution for the second phase of submarine dismantling (intermediate level waste removal) and we will be assessing the preliminary safety submission associated with this in the coming period.

Policy – regulatory vires for defence nuclear sites

5.59 Following review of our statutory responsibilities in respect of sites used for defence purposes, we have formed a joint working group (JWG) with the MOD. The purpose of the JWG is to look at key elements of the way in which defence nuclear sites are regulated and consider any potential improvements.

5.60 The work of the JWG is ongoing. Next steps will require engagement with stakeholders on the principal outcomes of the JWG..

Non-licensed propulsion sites

5.61 HMNB Clyde, located at Faslane in Scotland, is the operational base for most of the MOD's submarines and is an authorised site. Our regulatory responsibility is therefore limited to the enforcement of HSWA and its relevant statutory provisions. There have been no safety issues of note in the period.

5.62 The Vulcan Naval Reactor Test Establishment near to Dounreay is an authorised site. It was a test facility for naval pressurised water reactors. The Vulcan test reactor was shut down for the final time in July 2015 and the facility is now considered to be in a long-term quiescent state. There have been no safety issues of note in the period.

5.63 We maintain close working relationships with both the defence nuclear safety and security regulators, to continue our awareness and understanding of operational activities undertaken on the authorised sites, and to gain the necessary assurances on these where required.

Technical case study

Basis for enhanced attention at Dungeness B

Background

In 2018, in light of concerns about the progress of corrosion management at Dungeness B, we issued a 'direction' under LC 15 (4) for the station to assess the extent of corrosion of concealed pipework. During the outages that followed, the station identified several significant ageing-related problems that challenged the station's safety case.

We, and EDF-NGL management, were concerned that the extremely high standards of safety management and culture that we expect for a nuclear power station were not being met. The wide range of issues associated with the station prompted our decision to place the station under enhanced attention.

Though the station will not restart operations (as of 7 June 2021), the improvements required at Dungeness B will still be crucial to supporting the safe defuelling and decommissioning of the reactor site.

Our approach

With advice from EDF-NGL and global contacts, Dungeness B developed an extensive performance improvement plan (PIP) overseen by senior EDF-NGL managers and other experts independent of the station. We believe this is based on an accurate and honest characterisation of problems. Experience shows us that EDF-NGL is a mature licensee capable of delivering the plan effectively, and the current approach to regulation of the station reflects that.

Our approach to Dungeness B has two main areas of focus. For the shorter term, we are in extensive dialogue with the station concerning improvements to the plant and the safety case. This will now include the stations' defuelling preparedness, so that we are confident that they are in a safe condition before fuel is removed from the reactor.

For the slightly longer term, ONR has assigned an extra project inspector to Dungeness B to engage with the broader performance improvement plan and provide advice and feedback on progress.

We identified those areas of performance we most needed to see improve:

- Leadership and culture necessary for sustained safe and reliable operation;
- Plant in suitable condition to reliably meet its safety functional requirements and the assumptions of the safety case; and
- An adequate safety case that clearly informs decisions and practice at the station.

Evidence of progress is being gathered from our normal interactions such as our inspections and permissioning activities, and from close engagement with the PIP. We will continue to engage with the station on these areas for improvement as they form the basis for confidence for the station as it begins to defuel and decommission the reactor.

“

The improvements required at Dungeness B will still be crucial to supporting the safe defueling and decommissioning of the reactor site.”

Examples of corrosion management as a part of the performance improvement plan

Progress to date

EDF has made considerable investments over more than two years to upgrade the plant. For example, the corrosion programme alone has spent more than £50 million, and 8,000m of pipework has been replaced weighing 2,500 tonnes. Inspectors visiting the station have witnessed considerable change in the condition of the site.

EDF also stabilised the management team at the station and brought in outside experience. The progress of the longer-term PIP programme was delayed at the outset with the onset of the pandemic but built momentum through 2020. Early progress has included work to ensure more efficient use of maintenance resources so extra attention can be applied to plant improvements. Most visible to ONR inspectors has been extensive work to coach managers and teams to improve safety leadership and safety culture. Inspectors observe real effort in the daily work of the station to secure high professional standards, and to learn from experience.

The station and ONR have also worked together to improve the effectiveness with which Dungeness B interfaces with and responds to the regulator. This included workshops and guidance for staff, and new arrangements for management of issues. The number of outstanding regulatory issues has almost halved in the past 12 months.

In summary, Dungeness B has made significant efforts to improve plant and site performance in the period since enhanced attention was introduced. The evidence of our inspections and other interactions is that most aspects of safety are improving strongly, and that the station responds much more constructively. Of our key areas of interest, it is likely that leadership, culture, and condition of the plant will be close to coming out of enhanced attention by 2022. We are now in the process of engaging with the station and revising our strategy to oversee the safe transition of the station into defuelling and beyond now that the reactor will not return to service.

6 Sellafield and decommissioning, fuel and waste sites

Summary of performance across Sellafield, Decommissioning, Fuel and Waste (SDFW) Division

Safe and secure progress continues to be made at Sellafield with ongoing remediation of the highest hazard facilities on site. However, there have been some delays to hazard and risk reduction projects during the year. These resulted from technical difficulties and the issues associated with making complex safety cases, including making provisions for the safe retrieval and storage of radioactive waste from the Magnox Swarf Storage Silo (MSSS) which was further compounded by working restrictions brought about by the pandemic. At our request, Sellafield Ltd has reviewed its retrievals and decommissioning programmes to determine and justify the extent of any deferrals. We are content with the outcome of this review and that Sellafield Ltd continues to demonstrate satisfactory progress with reducing hazards and risk on the site.

Other noteworthy progress that has been achieved over the year includes:

- The first MSSS Silo Emptying Plant (SEP) has completed inactive commissioning, and the installation of the second machine has commenced;
- Completion of the safety case, and our agreement to implement changes to the operating regime at the Pile Fuel Cladding Silo (PFCS) in preparation for early waste removal; and
- Continued safe progress with construction of the Sellafield Retreatment Plant (SRP), essential for long-term management of special nuclear material (SNM). In addition, progress towards completing improvements to ventilation and electrical systems at existing SNM storage facilities.

The Sellafield site remains our top regulatory priority and the most hazardous areas will continue to receive significantly enhanced attention for many years to come.

We are satisfied that during the year steady progress was made with decommissioning and safe management of radioactive waste on most of the other decommissioning, fuel and waste sites under our regulation, however almost all sites were to some extent affected by COVID-19 restrictions, with work being paused for several months.

Paul Dicks
Sellafield, Decommissioning, Fuel and Waste Director
Deputy Chief Nuclear Inspector

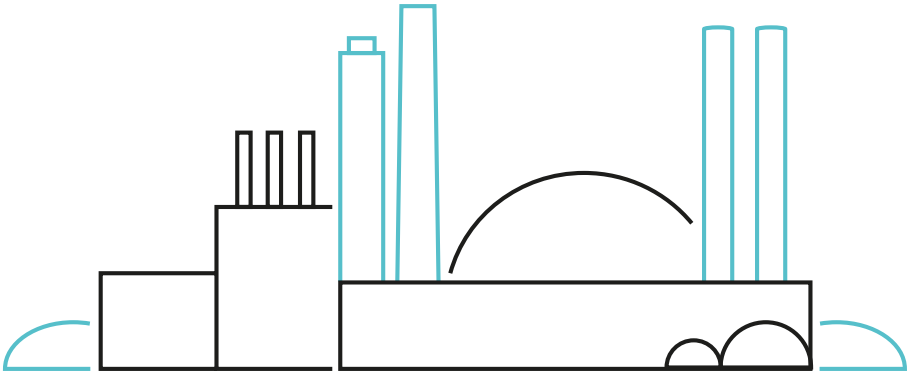
Sellafield

Overview of the site

6.1 Sellafield is one of the most hazardous nuclear facilities in Europe. Reducing the hazard and risk on the site in a safe and timely manner is a national priority and this is reflected within our strategy for regulation of the site. One of the most significant challenges facing Sellafield Ltd relates to retrieval of large quantities of higher activity waste and spent fuel from, and associated decommissioning of, several of its legacy facilities. Some of these are many decades old. The nature of some of these high hazard facilities means that retrieval of the waste requires complex engineering. As the retrieval work progresses, we and other stakeholders recognise that there will inevitably be a short-term increase in risk in some areas to secure long-term safe clean-up of the site.

Safety performance

6.2 Throughout the COVID-19 pandemic ONR inspectors have continued to undertake inspections through remote interventions and on-site visits. The inspections targeted operational facilities for safe and compliant operations, adequate maintenance, oversight, and contingency planning. In addition, we inspected several buildings to confirm that there were suitable arrangements in place to manage the risks from COVID-19.



Legacy ponds and silos

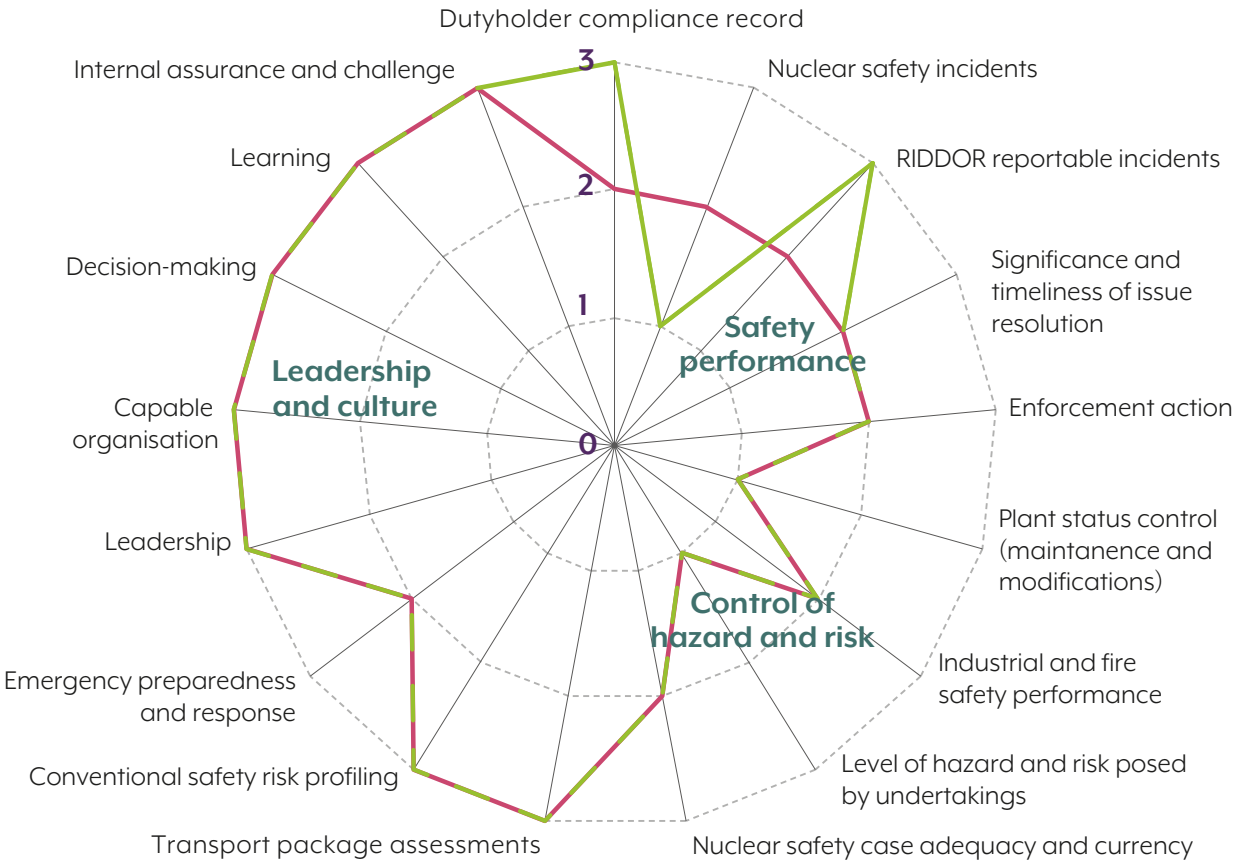
Figure 5. Sellafield legacy ponds and silos performance radar diagram

Showing performance comparison between the end of the 2019/20 period and end of the 2020/21 period

First Generation Magnox Storage Pond, Magnox Swarf Storage Silo and Pile Fuel Cladding Silo

FGMSP, MSSS and PFCS 2019/20
FGMSP, MSSS and PFCS 2020/21

1. Significantly enhanced attention
2. Enhanced attention
3. Routine attention



6.3 Sellafield Ltd has continued to make progress with waste and spent fuel retrievals from the legacy ponds, and in its preparations for waste retrieval from the legacy silos. In late March 2020, in response to the pandemic, retrieval activities were put on hold and facilities were placed into a quiescent state under close monitoring and surveillance. Subsequently, hazard and risk-reduction programmes safely recommenced whilst adhering to COVID-19 risk management measures.

6.4 Removal of radioactive waste sludge from the Pile Fuel Storage Pond (PFSP) and First-Generation Magnox Storage Pond (FGMSP) has continued along with preparations for further retrievals of the more challenging waste and fuel-based inventories in the ponds. Overall, progress within legacy ponds remains broadly on programme. However, supply chain delivery and quality issues have arisen that may adversely impact Sellafield Ltd's programme in some areas. We are therefore maintaining regulatory scrutiny of the licensees work in this area to ensure it resolves these issues and secures a reliable supply chain.

6.5 Remediating the MSSS is a complex undertaking, requiring several projects to be coordinated, while developing complex safety cases. The programme for remediation of MSSS has extended because of several engineering and safety case challenges during the year and operational constraints brought about by COVID-19. We are, however, content that adequate progress has been maintained.

6.6 Last year we reported on leakage of contaminated water ('liquor') from MSSS and, whilst we remain satisfied that this poses a very low risk to workers and the public, we have required Sellafield Ltd to ensure effective management and mitigation of the leak and to enhance its safety case in this area. We have assessed Sellafield Ltd's groundwater modelling and underpinning research and we are currently content with its conclusions, namely that any migration of radionuclides resulting in contamination through the ground would take decades. This exceeds the time it will take to remove and remediate the MSSS facility.

6.7 Sellafield Ltd continues to monitor the leak to provide reassurance that its approach and the wider programme of retrievals remains adequate. We will continue to work closely with other regulatory bodies, such as Environment Agency, to monitor this matter. This forms the basis of the attention associated with the nuclear safety incidents from enhanced to significantly enhanced.

6.8 We assessed and agreed to Sellafield Ltd implementing changes to the Pile Fuel Cladding Silo (PFCS) operating limits and conditions to enable the next stage of retrievals. The licensee is also taking steps to de-risk waste retrievals from PFCS by opening-up an alternative interim waste storage route to accelerate waste retrievals. We have encouraged the site in taking this approach, given the learning this will provide for future bulk retrievals from the silo, ultimately enabling faster progress with remediation.

6.9 Sellafield Ltd continues to make progress in preparing for operation of a new facility (known as BEPPS/DIF) for long-term storage of waste from MSSS and PFCS. Although challenges in constructing this storage facility have delayed its commissioning and operation, we are satisfied that Sellafield Ltd has adequately resolved these matters. As a result, we have granted permission to commence inactive commissioning of the store.

6.10 Sellafield Ltd safely completed the work to stop leakage of radioactive liquid to the ground (reported last year) from a redundant storage tank (RST) in the legacy pond area.

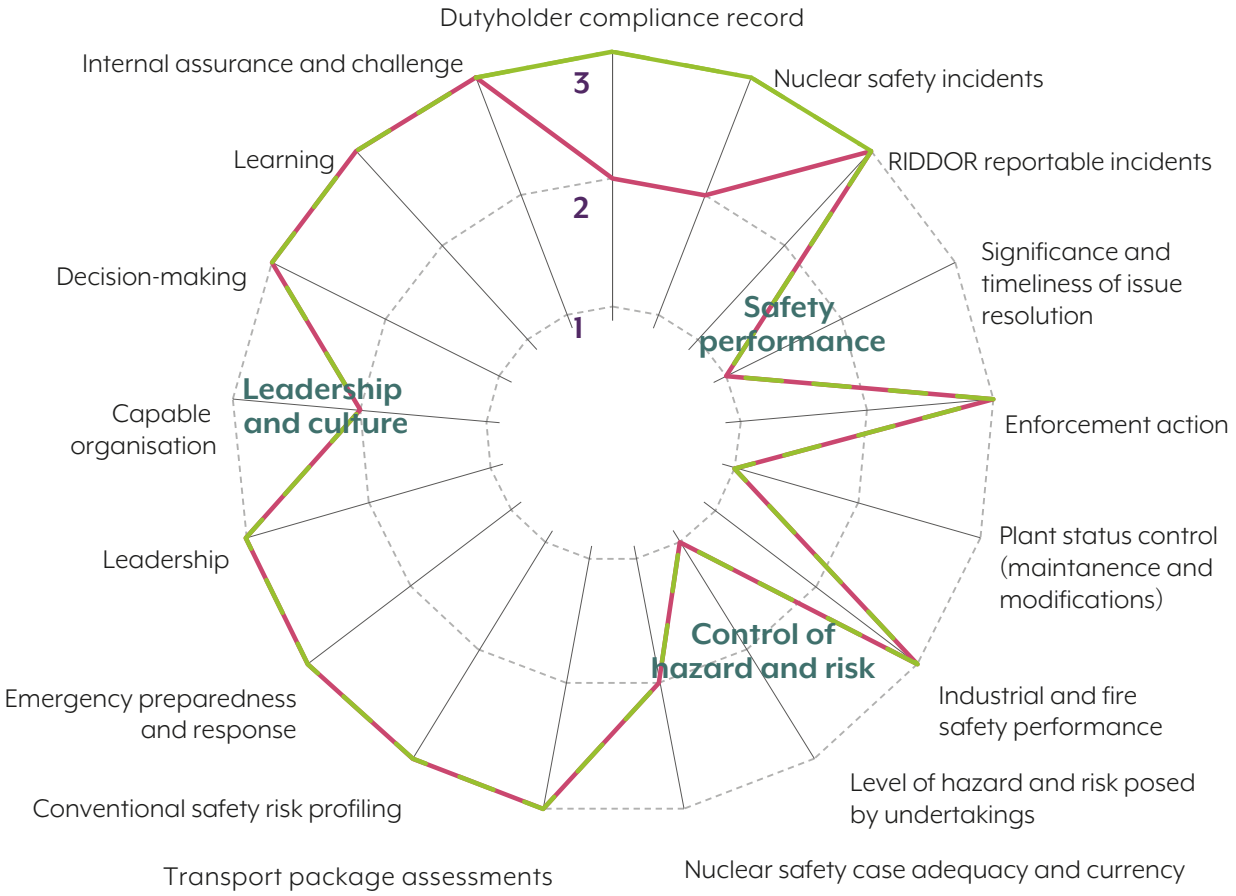
Special nuclear material (SNM) facilities

Figure 6. Sellafield special nuclear materials facilities performance radar diagram

Showing performance comparison between the end of the 2019/20 period and end of the 2020/21 period

Special Nuclear Materials Facilities 2019/20
Special Nuclear Materials Facilities 2020/21

1. Significantly enhanced attention
2. Enhanced attention
3. Routine attention



6.11 Sellafield Ltd has continued to make good progress with improvements to, and remediation of, some of its ageing SNM facilities. There is a continuing need to develop facilities to treat degrading SNM containers, both in view of their age, and to accommodate those packages transported to Sellafield from Dounreay. The provision of new facilities is key to the ongoing safe and secure management of the plutonium inventory stored at Sellafield, and we will maintain focus in this area to secure the timely availability of these capabilities.

6.12 Despite the progress this year, there have been delays to some of the improvement projects including completion of the Finishing Line Number 3 containment wall. Given this situation, we have increased our focus in this area to ensure Sellafield Ltd prioritises this work and accelerates delivery.

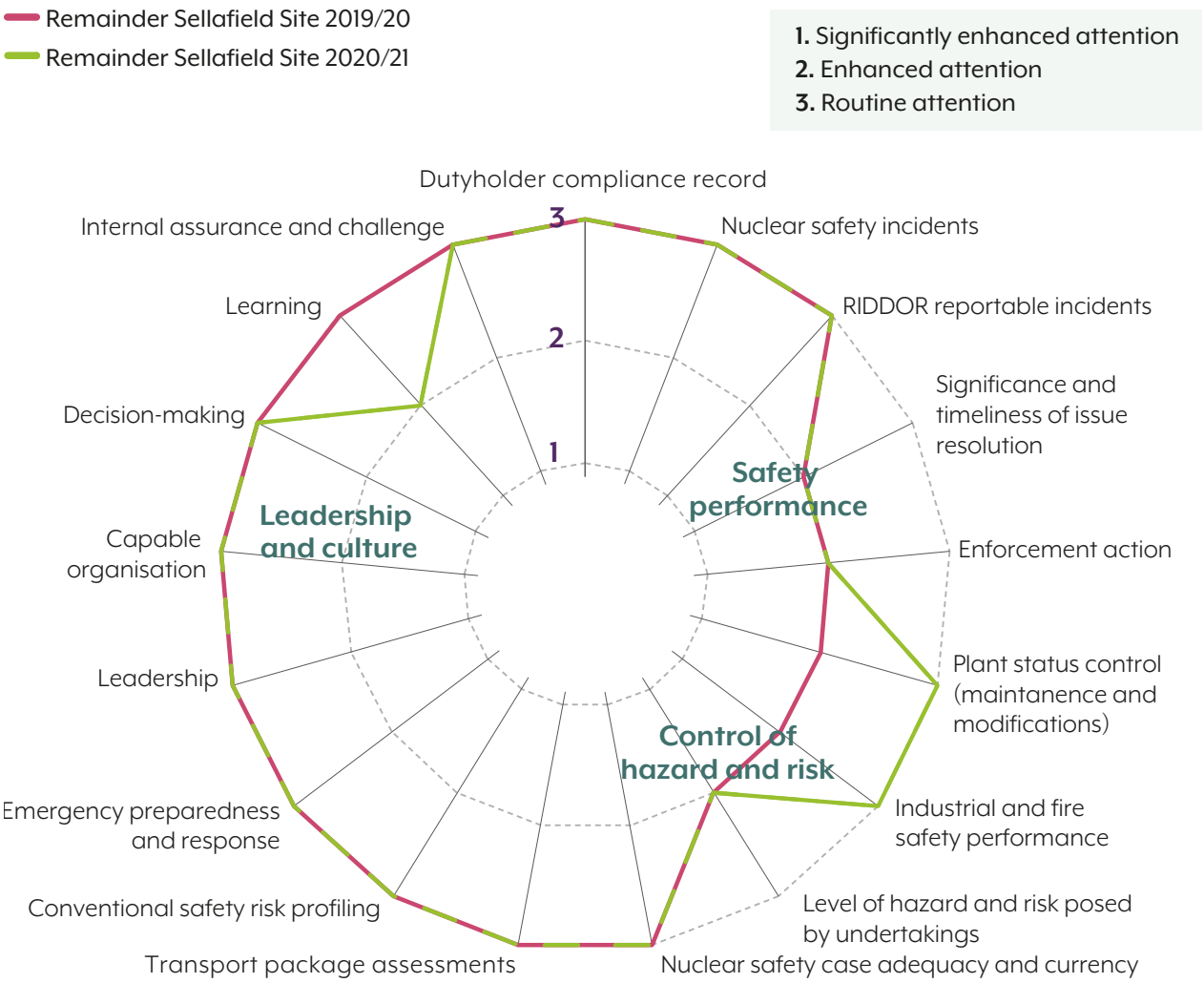
6.13 In addition, the site has made progress to fabricate work equipment to facilitate safe retrieval of SNM inventory from one of its legacy stores. We have received the safety case, seeking our permission for commencing retrieval activities, which is scheduled for later this year.

6.14 Risk-reduction work in the SNM complex remains challenging and involves invasive, manual operations. The addition of Dounreay 'exotics' material to Sellafield's existing inventory has increased the totality of the remediation work. We will therefore continue to attach a significantly enhanced level of regulatory attention to this area.

Remainder Sellafield site

Figure 7. remainder Sellafield site performance radar diagram

Showing performance comparison between the end of the 2019/20 period and end of the 2020/21 period



6.15 **Reprocessing:** the Magnox Reprocessing Facility continues to operate safely, aiming to complete its mission of reprocessing the spent fuel from the shutdown Magnox reactors as soon as is reasonably practicable.

6.16 **High level waste plants:** the Waste Vitrification Plant continues to safely reduce the site's highly active liquor (HAL) stocks. HAL stocks at Sellafield are now at their lowest level and lowest heat loading since 1983, representing a significantly reduced hazard and demonstrating the effectiveness of our strategic approach to hazard and risk reduction over many years. We will continue to maintain regulatory focus in this area to ensure sustained progress.

6.17 **Learning from incidents:** in response to our concerns in relation to work delivery, Sellafield Ltd has proactively considered its arrangements and implementation across site to deliver improvements in operations and control and supervision. Given the significance of this work, we will be undertaking a targeted intervention during the 2021/22 reporting period. Sellafield Ltd's response to learning from incidents is a key driver for the enhanced attention level noted in the above radar diagram.

6.18 Sellafield Ltd is making progress towards returning to routine attention in this area. A positive example of this was Sellafield Ltd's decision to produce an electrical improvement plan following the number of site-wide electrical events in advance of us issuing an improvement notice in this area.

6.19 **Emergency preparedness and response:** the site's annual demonstration emergency exercise has been deferred until October 2021 because of the pandemic. The forthcoming exercise will be a combined safety and security demonstration of Sellafield Ltd's emergency preparedness. We have gained assurance of the ongoing adequacy of the site's emergency arrangements through a series of alternative interventions.

6.20 **Conventional health and safety:** Sellafield Ltd continues to improve its conventional health and safety arrangements. Moving to an upper tier site under the Control of Major Accident Hazards (COMAH) Regulations 2015 resulted in the production and submission of a safety report in accordance with the regulations. We have assessed Sellafield Ltd's safety report and did not identify any deficiencies to warrant a specific regulatory intervention. Good progress has been made with the site-wide chemical management improvement programme.

6.21 A multi-disciplinary intervention initiated in the previous reporting period examined the site's lifting operations for nuclear and conventional lifts and some non-compliance issues were identified that resulted in an enforcement letter being issued requiring the necessary improvements to be made.

6.22 **Incidents on the site:** one incident has been rated at INES Level 1 (anomaly), which involved a leak of uranyl nitrate from a pipe on an overhead pipe-bridge within the Magnox Reprocessing Facility. The leak was effectively dealt with by the licensee.

6.23 Sellafield Ltd continues to responsibly report nuclear and radiological safety incidents and events. Notwithstanding legal obligations, we have observed an open and positive reporting culture, which we strongly encourage.

6.24 **Investigations and enforcement:** Two investigations into incidents that occurred in the previous reporting period were completed, relating to the leakage of radioactive liquor from MSSS and an RST. The investigations resulted in enforcement letters issued to Sellafield Ltd.

6.25 A further investigation was undertaken following an electrical incident in April 2020. This resulted in the prosecution in December 2020 for offences under Section 2 (1) of the HSWA, where Sellafield Ltd pleaded guilty and was fined £320,000.

6.26 Two improvement notices (IN) were issued during the year. The first, in December 2020, was a result of several incidents related to electrical safety. The second was issued in January 2021 to a sub-contractor, Morgan Sindall Construction, and Infrastructure Ltd. In both cases the dutyholders have responded positively, providing us with effective action plans to comply with the notices.

6.27 **Dutyholder compliance:** we have seen improvements in performance during site and remote based inspections such that dutyholder compliance is within routine attention. The basis of our judgement is associated with Sellafield Ltd's planning and preparation; we have observed increased self-reflection and awareness in the identification of shortfalls with associated actions being addressed proactively without the need for our intervention.

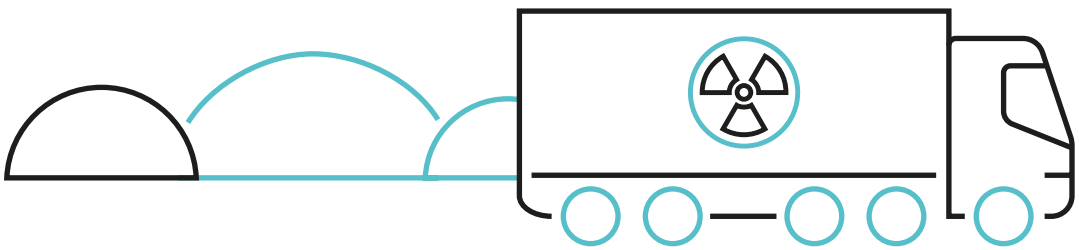
6.28 We have undertaken planned compliance inspections against Licence Conditions, Ionising Radiations Regulations, and other relevant legislation. The inspections were rated in-line with our inspection rating guide. Most inspections (over 90%) were rated Green – no formal action required. Two inspections were rated Amber, for which we sought improvement. No inspections were rated Red.

6.29 When appropriate during inspections, we have sought assurance of compliance with Sellafield Ltd's COVID-19 control measures. No matters were identified that required formal action.

Security performance

6.30 We have worked closely with colleagues across our purposes to deliver coordinated regulation of Sellafield Ltd. The aim of this is to proactively ensure our activity supports high hazard risk reduction. We have approved a range of contingency security measures that gave Sellafield Ltd the time-limited flexibility to alter security arrangements in the case that staff numbers were affected by COVID-19. We did so safe in the knowledge that all approved security arrangements ensured the site was always able to meet all required security outcomes.

6.31 Sellafield Ltd continues to be subject to significantly enhanced regulatory attention; this is likely to endure given the unique hazards on the site. During the year we have continued to hold Sellafield Ltd to account and accordingly issued targeted formal enforcement where appropriate and proportionate. We have worked very closely with nuclear safety colleagues from various specialisms to deliver joint interventions on topics such as leadership and management for safety and security of plant systems, competency management and emergency preparedness and response.



Technical case study

Magnox Swarf Storage Silo remediation and our regulatory approach

Background

The MSSS on the Sellafield Site stores legacy intermediate level radioactive waste (ILW) arising from the past reprocessing of irradiated fuel elements from Magnox nuclear power stations. The facility presents one of the highest nuclear safety risks and hazards in the UK and is under significantly enhanced regulatory attention to ensure its remediation is progressed as a matter of priority. Sellafield Ltd has instigated an extensive programme of work to address the nuclear safety risk posed by MSSS by retrieving the bulk waste and storing it safely and securely in new purpose-built facilities.

The MSSS was constructed in four phases between the early 1960s and early 1980s. The original building, built in the 1960's, stores waste cladding material that was removed from used Magnox nuclear fuel rods. The MSSS facility was extended three times during the 1970s and 1980s. Today, approximately 10,000[3] ILW, consisting mostly of magnesium alloy fuel cladding (swarf), is held in 22 vertical reinforced concrete silos; the silos are partially below ground. The waste is stored under water to shield, cool, and prevent the risk of igniting the magnesium metal. The last bulk addition of waste occurred in 1991; magnox swarf has since been treated and stored elsewhere on site in modern facilities.

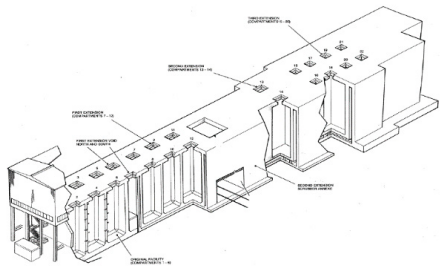


Figure 8: Layout of the 22 MSSS compartments

MSSS remediation and our regulatory approach

Our engineering assessment of MSSS identified that the original building and the first extension, which were constructed to the prevailing standards of the time, have less structural withstand to external hazards than modern-standard facilities (mainly seismic withstand). Consequently, safe, and timely removal of the waste from MSSS is one of our regulatory priorities. Sellafield Ltd will use three unique machines known as Silo Emptying Plants (SEP) (see figures 9 and 10) to retrieve waste from the silos.

We have applied 'hold-points' to specific activities in the MSSS waste retrievals programme where Sellafield Ltd requires our permission to proceed. We have given permission to several activities following our assessment of safety and engineering arguments presented in safety cases. Sellafield Ltd will require our further agreement to proceed with future key activities, including commencement of bulk retrieval of magnox swarf.

Figure 9: SEP 2 machine

Figure 10: Installation of SEP 1 transfer tunnel

“

Safe, and timely removal of the waste from MSSS is one of our regulatory priorities.”

Preparing for first retrievals

The SEP machines will provide the principal means by which the silos will be safely emptied. These machines are highly engineered and are the product of years of careful planning, design, and manufacturing to enable their safe installation. Many technical issues associated with some of the components incorporated in the SEP machines have been overcome. The building and its associated infrastructure have also required extensive modifications to accommodate the SEP machines and to support retrieval operations. This included installation of a replacement new high-integrity building crane, installation of seismically-qualified SEP rail systems, and installation of a new high-integrity retrievals ventilation and a gas-inerting system.

Sellafield Ltd has completed inactive commissioning of the first SEP machine and has commenced installation of the second. Following our assessment of Sellafield Ltd's safety case, we issued permission to commence movement of the SEP machine into its final position ready for commissioning and first waste retrievals. Overall, approximately a year's delay has been experienced in the MSSS remediation programme as a result of COVID-19. It is anticipated that first waste retrievals will now take place in 2022/23.

Technical case study

First Generation Finishing Line remediation and regulatory approach

First Generation Finishing Line background

The Sellafield First Generation Finishing Line (FGFL) is the site's first plutonium finishing line built in the 1940s/50s. The FGFL was operational from 1962-85, and processed plutonium in a suite of gloveboxes. Due to its age, the facility does not meet modern standards and parts are in a degraded condition. The main risks arise from the redundant plant and residual material contained within the gloveboxes and furnaces.

Although the bulk inventory of material was removed from this area in 2014, sufficient loose contamination remained to represent a significant risk of radiological release in the unlikely event of an incident which led to a loss of containment at the facility.

Our regulatory strategy

As part of our strategy for prioritised hazard and risk reduction on the Sellafield site, we raised a key regulatory issue associated with the risk of loss of containment from the FGFL. In response, Sellafield Ltd designated removal of the Finishing Line contaminated gloveboxes and furnaces as a key decommissioning milestone (KDM).

The delivery of this KDM has been extremely challenging, as working in the area required the decommissioning teams to wear specialist personal protective equipment (PPE) involving the continuous use of air-fed suits. There are numerous health and safety constraints when wearing such PPE, requiring both rigorous discipline while conducting the work and reliable support infrastructure.

We applied an enabling regulatory approach by engaging early with Sellafield Ltd to understand its proposals and the challenges associated with using some innovative techniques assessing, and regulating, the safe deployment of these tools.

Figure 11: Remote pipe-cutting equipment

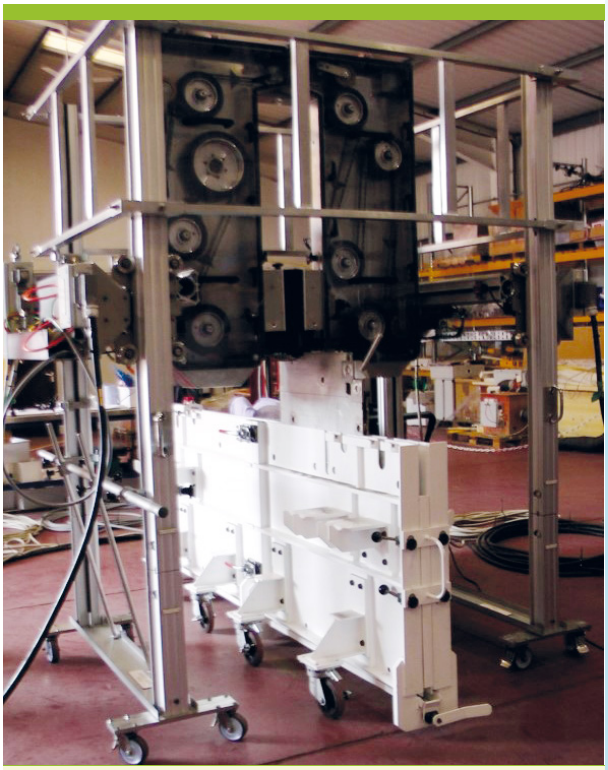


Figure 12: Diamond wire cutting machine

Novel and innovative solutions

Sellafield Ltd's proposal involved a combination of novel semi-remote cutting and size reduction techniques, which would package cut items into crates without the need for manual intervention. This technique resulted in a significant reduction in risk to the operators. This contrasted with the licensee's previous method of manually cutting items into small pieces to fit into drums.

The project was quick to harness the innovative application of industrial lifting and cutting techniques and tailoring them for use within a radiologically-challenging environment.

Decommissioning success

This project resulted in the removal of approximately 35kg of bulk residues and 9 tonnes of contaminated material from cut gloveboxes. All of these were consigned to an established waste route and modern storage facility on the site. The safety benefits to workers from using these techniques included a significant reduction in the amount of manual cutting necessary and distancing them from the hazard.

Examples of innovative solutions deployed were the size reduction and removal of some fume-hoods using a bespoke diamond wire cutting machine and residue removal via a criticality-safe vacuum cleaner. Using these presented its own unique set of challenges which manifested as 'lead and learn' opportunities for future decommissioning projects.

To enable this project, we co-ordinated our efforts across our safety, security, and safeguards purposes. We regard the successful delivery of this project as a visible demonstration of Sellafield Ltd's commitment to risk reduction on the site which paves the way for the continued clean-up of this area. We supported the use of innovative techniques combined with appropriate control measures, which provided an excellent opportunity for learning, that can be used to support accelerated hazard and risk reduction both within the facility and more widely across the site.

“We regard the successful delivery of this project as a visible demonstration of Sellafield Ltd’s commitment to risk reduction on the site.”

Decommissioning, fuel and waste sites

6.32 Decommissioning continued safely and securely on most of the 20 licensed decommissioning, fuel and waste sites, which have accumulated significant quantities of ILW from years of operation as well as from decommissioning activities. Where shortfalls in safety or security were identified we worked with the respective licensee to remediate the shortfalls in a timely manner. The ILW is being progressively made passively safe for long-term storage and ultimately for disposal. The nuclear fuel manufacturing sites continued to operate safely throughout the year.

Dutyholder performance

Dounreay

6.33 DSRL has continued to make reasonable progress in safety implementation across its decommissioning programmes. In April 2021, the licensee became a wholly owned subsidiary of the NDA. We assessed this significant change from the previous organisational model and considered it to be well managed. We did not observe any drop in safety performance prior to its implementation and will continue to monitor for any adverse impact on safety.

6.34 Safe progress continues to be made in removal and shipment of breeder fuel from the Dounreay Fast Reactor to Sellafield. The site also successfully removed the residual metal coolant from the base of the Prototype Fast Reactor pressure vessel and is progressing preparations to remove residual coolant. The demolition of the Dounreay Materials Test Reactor continues to make steady progress.

6.35 Decommissioning the facilities within the fuel cycle area (FCA), where the fuel reprocessing plants and higher activity waste management facilities operated, presents DSRL with a significant workload. The site continues to make safe and steady progress in several FCA facilities. Additionally, DSRL continue to make progress with efforts to remediate legacy material disposed of in the shaft and silo.

6.36 DSRL safety performance meets the required legal standards; this is supported by evidence gathered through planned inspections and assessments by our inspectors.

Security at Dounreay

6.37 DSRL completed an action plan set by ONR to enable it to return to routine regulatory attention and we accordingly closed a corresponding level 2 regulatory issue. We approved version 2 of DSRL's SyAPs-aligned security plan, which enabled the Civil Nuclear Constabulary to adopt a response-based model and reduce the number of officers on site.

6.38 We have noted further continuous improvements to cyber security arrangements – in particular plant systems cyber risk assessment. We also welcome a strengthening in DSRL's independent assurance arrangements in relation to security.

Magnox Limited sites

6.39 Magnox Ltd manages 12 licensed sites as one of the NDA's site licence companies. Although now wholly owned by the NDA, Magnox Ltd has its own board for governance purposes. In July 2020, Magnox Ltd and the NDA announced they would no longer place all reactors into extended periods of care and maintenance, as seen at the Bradwell site. This revised approach will mean a rolling decommissioning programme based on site-specific strategies. The sites reported on below are those where matters of note have been identified.

6.40 **Berkeley:** safe progress continues with the removal of the accumulated ILW in the large underground concrete vaults. The project to empty the vaults has not been without some difficult technical issues, which we are maintaining oversight of.

6.41 **Hinkley Point A:** this is currently one of the busiest Magnox sites, situated between an operating power station and one under construction. The licensee is constructing and installing new facilities to enable the safe and secure retrieval, packaging, and storage of its legacy waste. Priorities continue to be commissioning of the ILW store, the encapsulation facilities, and the associated waste conditioning facilities.

6.42 **Hunterston A:** the licensee has almost concluded the work in its Solid Active Waste Bunker Retrieval facility, as the contents of ILW from the fifth and final concrete bunker continue to be safely removed, packaged and put into interim storage in the site's dedicated ILW store. When complete, this will be a notable decommissioning milestone for the site.

6.43 **Winfrith:** at the Steam Generating Heavy Water Reactor (SGHWR) Magnox Ltd and its sub-contractors are preparing to segment and remove the reactor core. We continue to assess aspects of the associated safety case and we have placed regulatory hold-points prior to the commencement of active commissioning for core segmentation.

Security performance

6.44 Over the reporting period, security outcomes across the Magnox Ltd civil nuclear estate have remained broadly compliant. However, some Magnox Ltd dutyholders have been challenged by the nature of the SyAPs process and this delayed the submission schedule for new security plans.

6.45 The Magnox Ltd corporate centre has delivered some improvements through the development of clear and comprehensive security strategies, but challenges remain. When relevant security plans have been submitted and approved, dutyholders currently subject to an enhanced level of regulatory attention for security should be able to revert to routine attention status.

Fuel manufacturing

6.46 **Capenhurst Works:** in September 2020, Urenco UK Ltd (UUK) complied with an enforcement notice that we issued in December 2019. This related to the maintenance of fire detection and alarm systems in one of its facilities. UUK undertook a thorough and wide-ranging investigation into the prevailing circumstances, which identified further areas for improvement beyond that required by the notice. The licensee satisfactorily completed the work required and we continue to monitor the wider improvement actions being taken.

6.47 In November 2020, we issued our agreement to the site to commence active commissioning of the new Tails Management Facility (TMF) which will progressively de-convert Urenco's accumulated backlog of depleted uranium hexafluoride ('Hex Tails') to a more stable form. The TMF operators continue with safe active commissioning prior to moving into routine operations.

Low Level Waste Repository

6.48 **Low Level Waste Repository (LLWR):** the site has drawn up a management of change proposal to assess the safety implications of it becoming a wholly owned subsidiary of the NDA in the summer of 2021. We have reviewed the proposal and identified no potential adverse effects on safety.

6.49 The transfer of drummed contaminated waste plutonium back to the Sellafield site has been paused and is now planned to resume in the summer of 2021. The pause will allow the licensee to further assess the drums using new, more sensitive equipment. It is anticipated that this will result in the re-categorisation of many of the drums to LLWR, thereby reducing Sellafield's liability.

Sites in final stages of decommissioning and delicensing

6.50 The main reactor building at Imperial College Research Reactor in Ascot has now been demolished, the building slab removed, and local area cleaned up. The licensee is compiling its delicensing safety case with a view to demonstrating that its nuclear site licence can be revoked, which we are expecting to receive in 2021. It is anticipated that licence revocation will take place in 2022.

Geological Disposal Facility (GDF)

6.51 The consent-based process to identify a suitable location for a GDF in England or Wales for the disposal of the most hazardous radioactive waste is underway. Radioactive Waste Management (RWM), the developer of the GDF, is engaging with several parties that have asked RWM to consider whether a GDF could be located in their areas. Two working groups (the first formal step in the process) have been formed in West Cumbria – in Copeland and Allerdale. Although not directly involved in identifying a site, we continue to advise interested parties on the role we will play as the licensing authority for any future GDF.

6.52 In preparing for future licensing, we ran a public consultation exercise, ending in January 2021, on proposals to revise the interpretation of what constitutes 'bulk quantities' of radioactive material as cited in the Nuclear Installations Act 1965. Our revised interpretation of bulk quantities is intended to extend beyond storage to underground disposal of radioactive material and waste. We intend to publish our response to the consultation and our updated interpretation later in 2021.

7 Regulation across our integrated functions

Summary of performance across our integrated functions

This section of the report examines the performance of our dutyholders in terms of radioactive materials transport, emergency preparedness and response and conventional health and safety. It also provides a summary of the results of the inspections we have performed on our licensees' vendors.

The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Amendment Regulations came fully into effect on 21 April 2020. Over the past year we have helped operators develop their understanding of these regulations through advice, communications, inspections and where necessary, enforcement.

We have supported local authority implementation of the Radiation (Emergency Preparedness and Public Information) Regulations 2019 (REPPIR19), working in an enabling manner so that all dutyholders achieved full compliance by November's legislative deadline. Having achieved this milestone, our focus will now move to inspecting the adequacy of these plans, while continuing to support all REPPIR19 dutyholders as they adapt to their new duties.

We have also continued to regulate the industry's conventional health and safety performance. Under RIDDOR regulations, COVID-19 has been a part of the reports from dutyholders, adding to the amount of reporting this year.

Our vendor inspection programme has continued over the last year to influence improvements in both licensee and supplier management system arrangements.

Steve Vinton
Technical Director
Deputy Chief Nuclear Inspector

Radioactive materials transport performance

7.1 We are the Great Britain Competent Authority for the transport of class 7 dangerous goods – radioactive material – and carry out a range of regulatory activities. We assess transport package designs and grant the necessary approvals to ensure they meet international safety standards. We also regulate through a programme of risk-informed inspections and enforcement in line with our enforcement policy statement.

7.2 Our inspection strategy has been adapted to accommodate the impact of COVID-19. We have successfully delivered a programme of remote inspections of consignors and carriers of radioactive material, including hospitals. Our analysis of inspection findings has given us the necessary confidence that the transport of radioactive materials sector is achieving good standards of compliance with the required safety, security and safeguards standards, despite the limitations of virtual working.

Influencing improvements

7.3 Transport packages where quantities of radioactive material (such as radiopharmaceuticals) are below set regulatory limits do not need to be approved by us prior to their use. Nonetheless, we undertook an intervention this year to review some of these package designs in order to confirm their compliance with regulations. Though in most cases the packages were compliant, shortfalls were identified in some designs. These were subsequently addressed by the package designers.

7.4 The results of our review were presented to the IAEA Transport Safety Standards Committee and received a positive response, with several other countries noting they had seen similar issues. We are continuing to work with our international counterparts to further improve safety standards worldwide.

Significant incidents

7.5 There have been no significant incidents during the period. However, we have followed up on several mis-consignments of radioactive light sources, leading to enforcement letters being issued to the parties involved. We are content that this will resolve the issues in these cases.

Transport package approvals in the nuclear and non-nuclear sector

7.6 We issued 18 transport approvals to support a broad range of activities. These approvals have supported the safe transport of:

- Radioactive waste, such as high-level vitrified waste, supporting the safe repatriation of nuclear material overseas and the consolidation of special nuclear materials within the UK;
- Nuclear fuel, such as enriched uranium oxide nuclear fuel and uranium hexafluoride, and the return of irradiated fuel from nuclear power plants in the UK to Sellafield; and
- Radioactive material used in cancer treatment and industrial radiography.

Stakeholder engagement

7.7 We have continued to be proactive in engaging other organisations with a shared interest in improving wider aspects of radioactive materials transport. This year, we have established closer working relationships with several other transport regulatory bodies, including taking part in several joint inspections. This led to increased cooperation and understanding across regulators, and more efficient regulation of matters related to radioactive materials transport.

Emergency preparedness and response performance

Implementation of REPPIR19

7.8 REPPIR19 became law in May 2019 and was followed by a 12-month transition period to allow operators and local authorities to demonstrate full compliance with the revised regulations. During this period, we focused on ensuring that existing nuclear emergency arrangements were maintained and that all dutyholders were fully aware of and maintained suitable temporary arrangements to address any gaps that had arisen during the transitional period.

7.9 COVID-19 affected the final months of the transition period, as local authority emergency response teams were deployed to support the pandemic response. This necessitated slower than anticipated implementation of REPPIR19.

7.10 By November 2020 (the extended legislative deadline included in the regulations to cater for unforeseen delays), REPPIR19 had been implemented by all dutyholders.

Off-site nuclear emergency exercises

7.11 During the year, the testing of several off-site nuclear emergency plans was postponed owing to pandemic lockdown measures. We are now reviewing both on-site and off-site plans and preparing a regulatory strategy for the inspection and testing of these arrangements, which will re-commence as soon as practicable. This will provide us with the assurance that our licensees have in place suitable arrangements in the event of an emergency.

7.12 In relation to the testing of local authority REPPIR19 off-site emergency plans, we will continue to liaise closely with all key stakeholders. Our regulatory strategy for inspection and testing will take account of factors such as the extent to which elements of the nuclear emergency arrangements were utilised for real as part of local authority responses to COVID-19.

Transfer of responsibility for detailed emergency planning zones (DEPZ) determination

7.13 REPPIR19 transferred the legal requirement for the determination of DEPZ from ONR to the local authority responsible for the off-site nuclear emergency arrangements for each nuclear licensed site. As such, we no longer make determinations but remain responsible for their regulation.

7.14 We have undertaken a sampling review of REPPIR19 DEPZs. Our sampling, which covered two operating reactor sites, Sellafield, two defence sites and a decommissioning site, was intended to gauge how well the requirements of REPPIR19 had been interpreted and implemented across a broad range of nuclear sites. Our review concluded that this aspect of REPPIR19 had been well-implemented.

Judicial review of West Berkshire Council determination

7.15 A judicial review of West Berkshire Council's determination of the DEPZ for AWE's Burghfield site was brought by a group of property developers who challenged the methodology that had led to a significant increase in the size of this DEPZ. In addition, the developers also asserted that there had been insufficient regulatory oversight by ONR, and we were thus identified as an interested party to the judicial review. We appointed legal counsel, and the High Court hearing was held in December 2020. The ruling in the case was published in February 2021 and rejected all aspects of the claimants' case. In particular, the judge dismissed the claimants' assertion that there had been insufficient regulatory oversight, describing our regulation of the Burghfield determination as 'multi-layered'.

Regulation of conventional health and safety

7.16 We regulate CH&S under the Health and Safety at Work etc. Act 1974 and associated secondary legislation. In regulating under this purpose, we also utilise data from several information sources in additional to the trended data that we collect. These include reports received from licensees and other dutyholders under RIDDOR 15, as well as statutory examination defect reports provided under specific legislation, including that relating to pressure systems and lifting equipment.

Dutyholder conventional health and safety performance

7.17 COVID-19 has had a major impact on industry working patterns and practices, with lower RIDDOR reporting rates likely to be correlated with lower levels of on-site activity. We have also seen several RIDDOR reports associated with cases of COVID-19 where it has been deemed that the infection was contracted due to occupational exposure.

7.18 Information on CH&S incidents is detailed in Annex 1. The impact of the pandemic on licensees' workplace activity patterns precludes a meaningful direct comparison with last year's incident numbers. The benchmarking project below was developed to enable comparisons of the performance of the nuclear industry with other high hazard sectors. This is intended to address restrictions caused by the relatively small data sets involved and the different methods of data collection and processing techniques used by other regulatory bodies and industries.

7.19 We continue to develop new ways of integrating CH&S data to ensure that trending and comparisons can be improved. This includes engaging with a major HSE-led research project, 'discovering safety', to apply modern data analytics to provide comparative insights on health and safety performance in mature sectors. This has allowed us to apply similar techniques to evaluate CH&S performance across the nuclear sector. Steps are being taken to identify alternative datasets and indicators currently used by licensees to assist us in identifying further trends and indicators of performance. We are taking forward that work this year.

7.20 We have continued to ensure that all dutyholders have implemented proportionate health protection measures in line with the government's 'COVID-19 Secure' guidelines, and to this end we have promulgated internal guidance to inspectors to ensure necessary controls are in place. As scientific/government advice has developed during the pandemic, we have reviewed and updated the guidance accordingly.

7.21 It remains a priority that we ensure that industry initiatives continue to drive further improvements in managing CH&S risks. We continue to see evidence of the industry making improvements to its management systems to appropriately recognise and integrate CH&S. However, this requires continuing focus to ensure these improvements are embedded.

7.22 We have identified adverse trends in specific areas that the industry will need to address in the coming year. Firstly, there has been a rise in the number of electrical incidents and near misses reported across the industry. We have engaged with industry which, as a result, has agreed to share leading safety performance indicators relevant to electrical safety to facilitate a learn, review, and improve process. We are considering specific regulatory initiatives in this area, spanning our core purposes.

7.23 Secondly, following several interventions to assess lifting operations across the industry, we are aware of varied levels of performance in relation to compliance with relevant licence conditions and statutory provisions. We will therefore continue to focus on this topic to ensure compliance and consistency across the regulatory framework.

7.24 We continue to take steps to assist the continuous improvement of CH&S standards across the industry, focussing on those sites with hazards representing the greatest CH&S risks or where there are compliance gaps. Our inspectors have continued to work closely across our core purposes to ensure efficient and effective regulation of areas of common interest across the licence conditions and relevant statutory provisions.

7.25 We will continue to apply regulatory focus to construction activities for the foreseeable future given the relatively high hazards these activities present. Ongoing construction activities are associated with new and proposed nuclear reactors, and the post operational clean out, decommissioning and demolition of existing facilities.

7.26 We have continued to work with licensees and requesting parties to ensure they fulfil their duties under the Construction (Design and Management) Regulations 2015 (CDMR). This is to ensure that future projects are effectively planned, and designs are produced that enable safe construction and operation while considering future decommissioning during the design phase.

7.27 We have also this year turned more regulatory attention onto the control of contractors. This work is wide-ranging and aims to ensure licensee management systems achieve a joined-up approach that reflects the overall risk profile across all areas of safety.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Technical case study

Conventional health and safety benchmarking project by HSE Science Division

Project overview

Purpose: a research project to evaluate the CH&S performance of the nuclear sector in Britain compared to other high-hazard industry sectors. The HSE Science Division (HSESD) was contracted to carry out the first phase of this research, evaluating four nuclear licensees, selected to represent the breadth of activities conducted within the nuclear industry. The licensees selected were Sellafield Ltd, EDF-NGL, NNB GenCo (HPC) Ltd and AWE Plc.

Results: HSESD first generated a set of sector-wide injury frequency rates using relevant HSE datasets.[11] Table 5 shows the rates generated. The most relevant to each licensee's work activities was then selected as the reference benchmark.

HSESD then generated a statistically robust set of injury frequency rate ranges for the licensees selected. These injury rates are subject to statistically random year-to-year variation. As such, owing to the low counts, HSESD used statistical confidence limits around the injury frequency rates. Figure 13 shows each licensee's injury frequency rate range compared to their selected sector injury frequency rate benchmark.

11 HSE datasets used: Reporting of Injuries, Diseases and Dangerous Occurrences (RIDDOR) reports and an extract from the Office for National Statistics' Labour Force Survey (LFS) and Annual Survey of Hours and Earnings (ASHE).

Table 5. HSE RIDDOR injury frequency rates per million hours worked (FR), sector benchmarks (for financial year 2019/20)

SIC industry sector		RIDDOR injury FR
20	Manufacture of chemicals and chemical products	0.91
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.54
25	Manufacture of fabricated metal products, except machinery and equipment	2.23
26	Manufacture of computer, electronic and optical products	0.24
27	Manufacture of electrical equipment	0.70
35	Production of electricity	0.36
42	Civil engineering	0.90

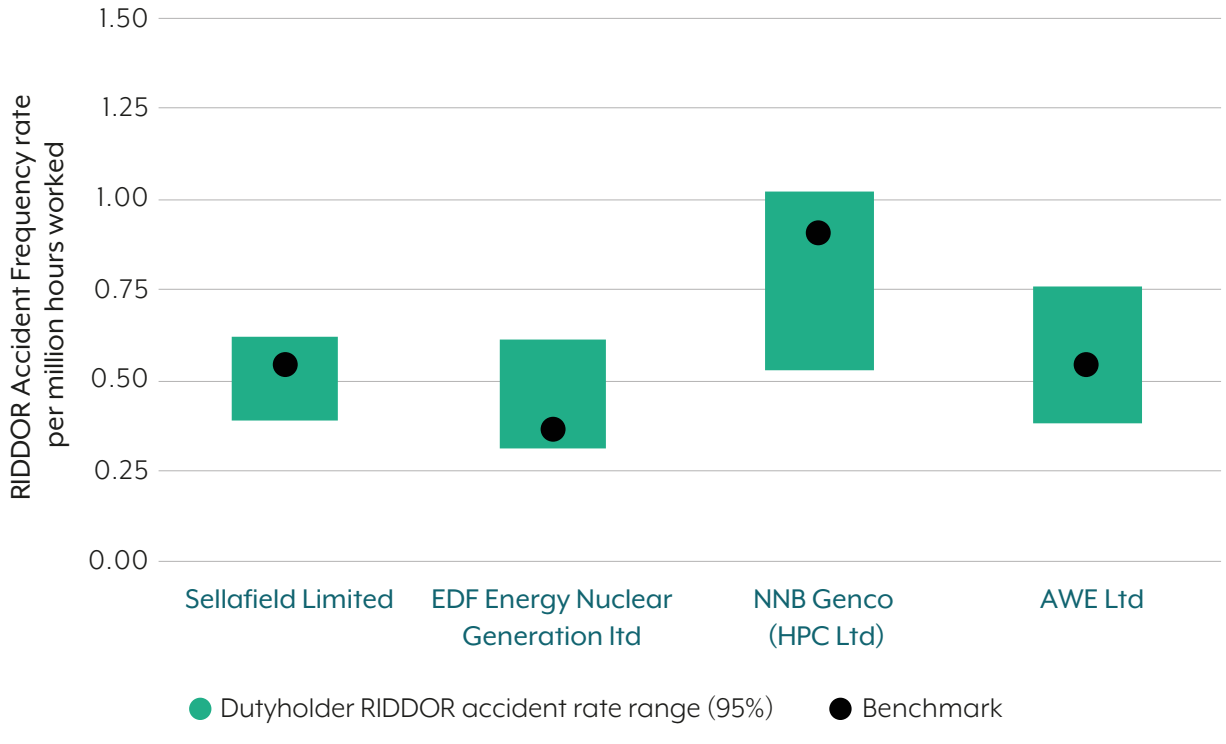

Figure 13: Accident frequency rate range against selected industry sector benchmark

Summary

To date, the analysis indicates that the nuclear site licensees' general CH&S performance is within the parameters of other comparable UK high-hazard sectors.

While reassuring in terms of general sector performance, this does not negate the need for continued focus in delivering CH&S improvements in specific areas across the nuclear industry. We have gathered assurance from regulatory intelligence, licensee reporting and enforcement action that, on balance, risks around CH&S are being sub-optimally managed acrossthe industry, and that the frequency of near misses is high.

The project has demonstrated it is feasible to bring together data from several licensees to enable injury frequency rates to be calculated in a consistent and statistically robust manner. Using HSE datasets, it has also been possible to generate a set of reference industry sector rates to provide a benchmark for ongoing comparison.

The resultant rates do not provide a definitive position on the CH&S performance of the UK nuclear sector, as injury frequency rates are lagging indicators, reliant on data from past events. However, if they are used in conjunction with leading indicators, which use proactive data to seek to prevent events happening, then they can enable safety performance to be assessed objectively, leading to improvements in targeted areas, in safety culture, and in wider CH&S performance. We are encouraging industry to use a suite of lagging and leading indicators to give themselves the most accurate picture of their performance – thus enabling them to target resources effectively.

We will now consider what work might be undertaken to refine the data. This might include work to consider; the feasibility of assessing injury frequency rates for other licensees, and to calculate a statistically robust injury frequency rate for the UK nuclear sector as a whole, and identification and use of existing leading indicators.

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The project has demonstrated it is feasible to bring together data from several licensees to enable injury frequency rates to be calculated.”

Fire safety

7.28 Our programme of fire safety inspections on licensed sites during the reporting year aimed to ensure that the industry's existing fire safety arrangements and management procedures are both effective and resilient. The industry took a proactive approach in maintaining the effectiveness of fire safety of its buildings whilst introducing measures to control COVID-19 virus transmission.

7.29 We continue to monitor the progress of the public inquiry into the Grenfell Tower fire, although there appear to be no fire safety implications directly applicable to the nuclear industry.

7.30 We also continue to monitor the government's responses to recommendations to the Hackitt Report including the Fire Safety Bill and Building Safety Bill.

Control of Major Accident Hazards (COMAH)

7.31 This year, we have maintained focus on industry performance around compliance with COMAH Regulations. In general, industry compliance with COMAH is good and improving, though we are continuing to target resources at those sites where shortfalls in performance have been identified.

7.32 We continue to build relationships and integrate operations, particularly with site inspectors and emergency planning colleagues. Consequently, licensed COMAH sites benefit from a unified approach to emergency planning and combined site interventions to minimise duplication and maximise synergies.

7.33 Similarly, interactions with local authority resilience teams are being co-ordinated in cases where REPPIR and COMAH off-site emergency planning and modular emergency exercise development overlap.

7.34 Where applicable, we are seeking to ensure inclusion of CH&S and COMAH aspects within development of licensees' corporate decommissioning strategies and subsequent plans.

Vendor (supplier) inspections

7.35 We are the enforcing authority for Section 6 (General Duties of Manufacturers) of the Health and Safety at Work etc. Act 1974, under certain circumstances, for products and services supplied to nuclear facilities. The purpose of our vendor inspections is to consider the adequacy of licensees' supply chain management arrangements for the provision of nuclear safety-related products and services.

7.36 We undertook 13 vendor inspections during 2020/21, targeting suppliers whose products or services carry the highest nuclear safety consequences and those who supply multiple licensees. Our inspection scope was achieved by conducting some inspections remotely, utilising teleconferences or through a combination of dutyholder visits supplemented by remote engagement. We observed evidence of licensees responding effectively to the challenges presented by COVID-19 and adapting their supply chain management approaches where appropriate.

7.37 Though we saw several enhancements in licensee and vendor arrangements, we noted three areas requiring further improvement. These areas will be subject to our continued focus in future licensee engagements and vendor inspections:

- **Counterfeit, fraudulent, and suspect item (CFSI):** while we saw enhancements in some dutyholder CFSI arrangements, shortfalls were identified across several our inspections relating to the development and implementation of adequate CFSI awareness and mitigation arrangements;
- **Management of deviations and non-conforming items:** we found shortfalls in some dutyholders' arrangements for the management of deviations and non-conforming items, including in the identification, reporting and resolution of deviations; and
- **Records management:** shortfalls were identified in the generation, timely completion, handover, and retention of records associated with the supply of products or services.

7.38 Where shortfalls were identified, we took proportionate action to ensure appropriate improvements were put in place. In addition, we have provided feedback to licensees as a group via the Safety Directors' Forum's Supply Chain Quality Group, to ensure cross-sector learning.

8 Research statement

8.1 The Energy Act 2013 enables us to carry out or commission research in connection with our purposes and requires us to publish the results if we consider it appropriate to do so.

8.2 Research plays an important role in our understanding of a wide range of complex, and sometimes unique challenges. Our research is aimed at supporting our independent regulatory decision-making as well as helping us base our decisions on an objective, scientific and well-founded technical understanding of the safety, security and safeguards risks posed by nuclear operations.

Strategic research objectives

8.3 The main objective of our research is to ensure that our inspectors can form their regulatory judgements confidently and effectively using sound, up-to-date scientific and technical information in support of balanced decisions that avoid over-conservatism or over-optimism.

8.4 We have identified three main drivers for commissioning research, where:

- We require independent advice to assist with our decision-making, particularly when the decisions we might make could be considered contentious;
- We have identified a knowledge gap that requires research and have invited the relevant dutyholders to complete the work and share their results, but they have declined to do so, or declined to do so within acceptable timescales; and
- Our specialists require greater understanding of developing innovations or emerging subjects to enable our regulatory decisions to be based on the most up-to-date information.

Research identification and funding

8.5 Our research activities are coordinated by our Regulatory Research Delivery function, which manages our research budget and provides advice and support to our regulatory specialisms and project officers, who are accountable for the delivery of the research projects in their individual technical areas.

8.6 We follow a rigorous process to identify research needs and opportunities, determine associated costs and ensure good value for money, and monitor the progress of delivery.

8.7 It should be noted that we do not commission research to support the commercial development of nuclear technologies, or in areas which other public bodies have regulatory responsibilities or are responsible for providing authoritative advice.

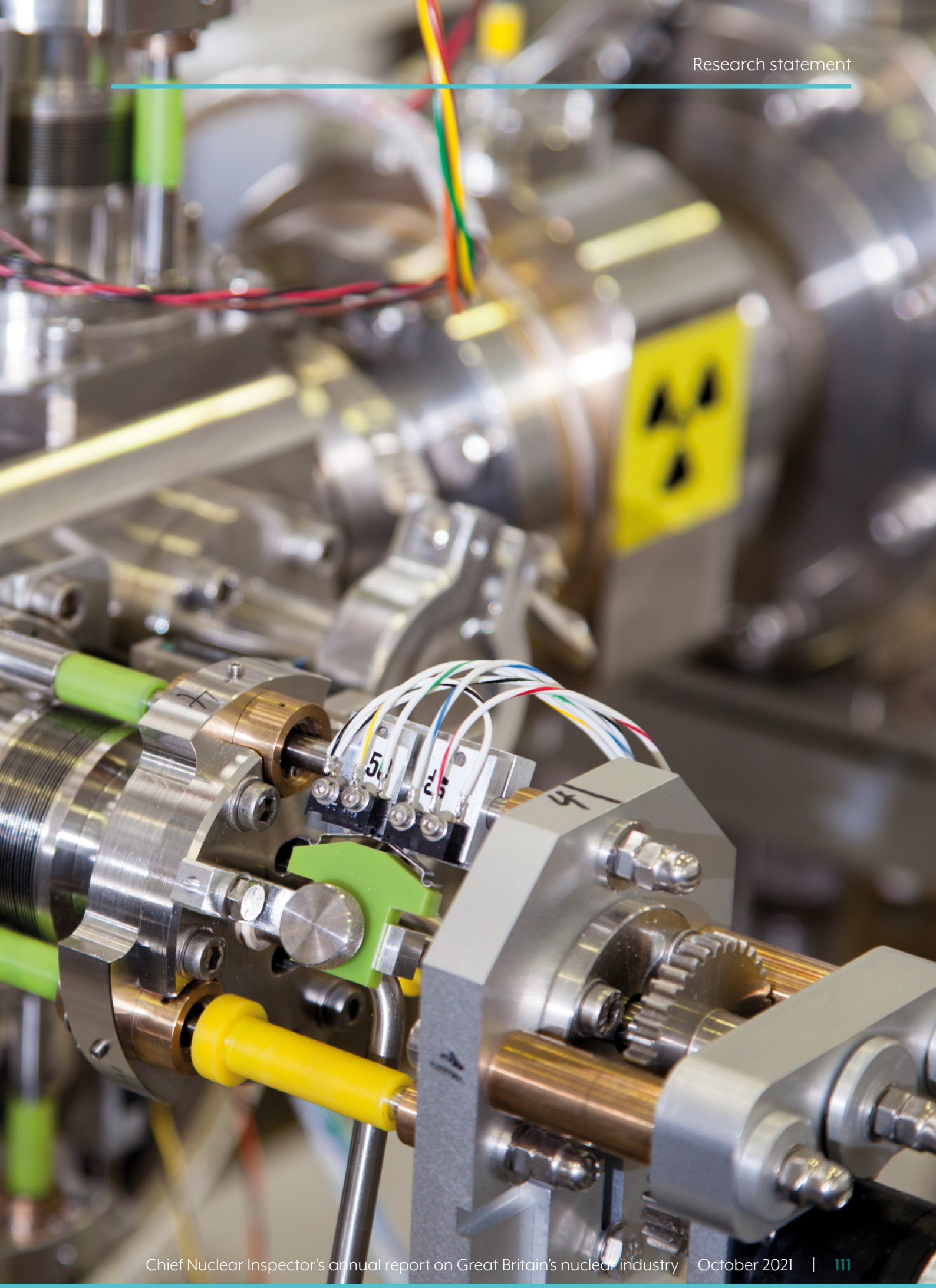
Costs

8.8 We seek to gain maximum value from our research activities by partnering, where possible, with other key national and international research institutions and projects. This approach enables us to gain UK or ONR access to the results of multi-million pound, cutting-edge research that helps to support our assessment activities, often for relatively modest annual contributions.

8.9 Our research portfolio includes approximately 50 projects. Of these, about half are developed into work specifications and delivered by technical support organisations funded directly by us, with a typical annual budget of £2.5 million. The remaining projects are funded and delivered directly by the nuclear industry while we monitor progress and provide oversight.

8.10 Value for money is a fundamental consideration in the management of our research portfolio, especially since we recover the costs of research from dutyholders through our regulatory charging regime.

8.11 Avoiding the duplication of research projects is also an important factor in helping us to achieve value for money. This is another reason why we continue to engage proactively with industry, and at a wider national and international level.



Technical case study

Graphite friction

Challenge

- The UK's fleet of AGRs uses a large assembly of graphite components known as the graphite core to support the nuclear chain reaction. To ensure safe operation and shutdown of reactors, it is important that the graphite core assembly maintains its position and alignment during all foreseeable events.
- Ageing of the graphite core leads to cracking of the graphite fuel-bricks, which has challenged safety justifications for safe shutdown during a 1 in 10,000-year seismic event. EDF-NGL proposes to address that challenge by including friction within its simulations of the graphite core response, that is, by removing a modelling conservatism whereby frictionless interactions are assumed.
- However, the complexity of both the graphite core's assembly and the behaviour of graphite friction in AGR conditions introduces significant uncertainties on the actual benefit of this modelling change.
- It is therefore necessary for us to better understand the accuracy and the level of uncertainty underpinning the dutyholder's proposal to model graphite friction. However, there is very little available expertise in the friction properties of irradiated and oxidised AGR graphite that is fully independent of the licensee's own efforts.
- To ensure a robust regulatory position on a timely basis, we engaged independent graphite advisors at an early stage, whilst ensuring open and transparent communications between all parties. This ensured our specialist inspectors had access to clear, targeted, and independent expert advice which in turn allowed us to make well-informed and robust regulatory decisions.

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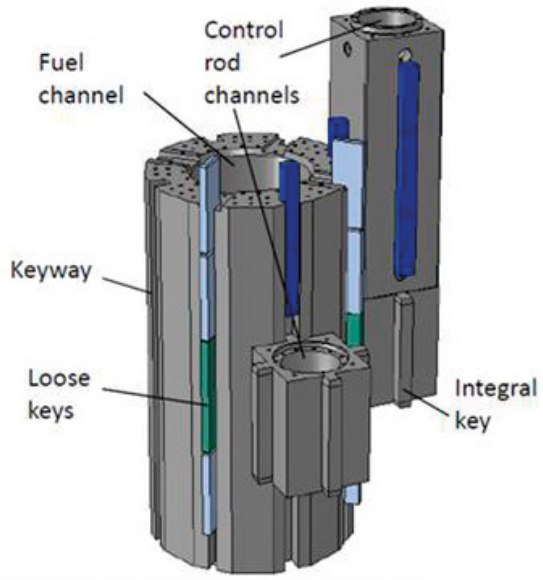
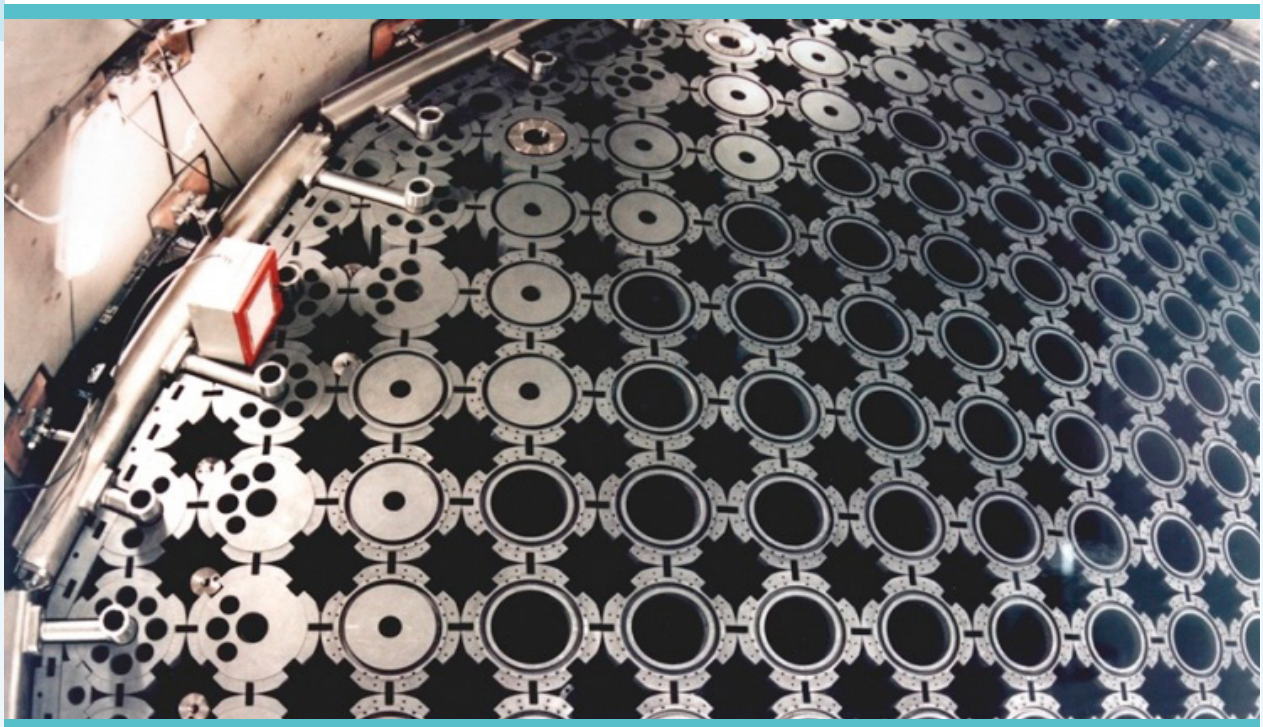


Figure 14: Graphite fuel and control rod channels

Research activity

- Our Graphite Technical Advisory Committee (GTAC) has provided independent expert advice to us on subjects including material behaviour, graphite weight loss, testing programmes, analysis techniques and inspection activities since 2003.
- We commissioned GTAC to engage at an early stage with the licensee regarding the inclusion of friction into the graphite core modelling simulations and to provide us with GTAC's independent view of the licensee's approach.
- That early engagement led to improvements in the clarity of the licensee's safety justifications and enabled our specialist inspectors to provide robust regulatory challenge where required. Whilst our independent experts corroborated the acceptability of including friction into simulation calculations, their independent advice enabled us to provide robust challenge in favour of a more conservative regulatory position which better reflected the prevailing uncertainties.
- The licensee has since commissioned a new graphite testing programme to underpin its understanding of the contribution of friction to safety justifications in support of its AGR operations. We have likewise engaged GTAC to follow the testing programme and advise us on the effectiveness of that programme.



Safety intelligence gained

- A detailed understanding of the level of modelling confidence that can reasonably be inferred from experimental graphite friction data.
- Independent advice on the key areas of uncertainty related to the inclusion of friction into the dutyholder's seismic safety cases.
- The extent to which friction modelling can reliably be used as part of safety arguments supporting continued AGR operations.

Technical case study

Cyber security assessment

Challenge

The assessment of cyber security has traditionally been based on information technology (IT) security approaches, which brings with it several implied assumptions based on mass-market commodity devices. This is particularly evident when vendors adopt a single approach to demonstrating assurance and the functional qualities of a product to many customers.

The area of cyber security is evolving at a significant pace, particularly in an operational technology (OT) environment, where equipment and systems are often not mass-market commodity items. The understanding and awareness of how these systems and components contribute to effective cyber security has significantly improved in recent years, particularly given the increasing trend in cyber-attacks that target OT in critical national infrastructure. To keep pace with these changes we are seeking to develop and improve our regulatory knowledge and expectations for the assessment of cyber security and the standards we expect to be achieved.

In line with our 2025 Strategy, since cyber security threats pose significant risks to the safety, security and safeguarding of nuclear facilities, we have adopted a collaborative approach across our regulatory purposes.

Research activity

We utilised the National Cyber Security Centre (NCSC) to gain insight and understanding of up-to-date knowledge and experience of multiple critical national infrastructure applications, as well as a better understanding of relevant good practice in terms of techniques and measures that have been demonstrated to add value in the identification of cyber security vulnerabilities in OT systems.

Our work with NCSC sought independent, authoritative advice on specific aspects of good practice and the issues to be considered in ensuring the cyber security of OT systems and components. This enabled us to gain valuable insights into how the assurance and functional qualities of systems and components should be assessed for cyber security purposes. We have used the learning gained to develop a strategy for the assessment of OT cyber security in a nuclear context. This strategy is now being implemented in both our nuclear security and nuclear safety regulation across a range of facility types.

Safety and security intelligence gained

This research quickly and efficiently identified approaches for assessing assurance and functional properties of OT systems and components to improve our regulation of cyber security risks within the nuclear context. The cyber security approach aligns regulatory expectations within the SyAPs and established practices for the justification of computer-based safety systems, in particular the demonstration of production excellence (PE) and independent confidence building measures, described within our SAPs, and associated Technical Assessment Guides (TAGs).

The adoption of similar approaches for the safety and security justification of OT provides an effective way for dutyholders to demonstrate that both safety and security requirements are being met. This provides a consistent approach for our nuclear safety and nuclear security inspectors to make regulatory decisions with regards to cyber security aspects and has established a basis for a more integrated and collaborative way of working that aligns two of our purposes in a proportionate and consistent manner.

The research also identified new principles for cyber security architecture being developed by NCSC that are being incorporated into our guidance to ensure it keeps pace with technology developments. It also established a working relationship with NCSC that will enable the continued sharing of expertise and learning between our two organisations.

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This research quickly and efficiently identified approaches for assessing assurance and functional properties of OT systems and components to improve our regulation of cyber security risks.”

Technical case study

Better understanding of combustible gas and fission product behaviours in accident conditions

Challenge

Despite the measures and defence-in-depth employed to prevent and mitigate them, there remains the remote possibility that an accident could occur at a nuclear facility. Understanding the consequences of these is an important part of ensuring licensees' accident management strategies will reduce the risks to as low as reasonably practicable (ALARP).

During postulated accident conditions, phenomena that are dependent on the behaviour of combustible gases or radioactive fission products are complex and can depend on several different, often interrelated, influences. However, these are key factors which can impact the nature, likelihood and size of the resultant hazards and their consequences on safety.

Improving our understanding and ability to predict these behaviours is important in developing better safety cases and designs for current and future water-cooled reactor designs, as well as other nuclear facilities more generally. The approach often taken by dutyholders involves making conservative assumptions about such behaviours and using computer modelling to underpin the safety case claims.

There is inherently a range of uncertainties associated with these behaviours however, and developments in both designs and accident management strategies employed at nuclear facilities means that an up-to-date understanding of behaviours, the adequacy of assumptions, and the limitations of any modelling tools employed can be an important aspect of regulatory decision-making.

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The insights gained from this work have already contributed towards our regulation of new reactor build.”

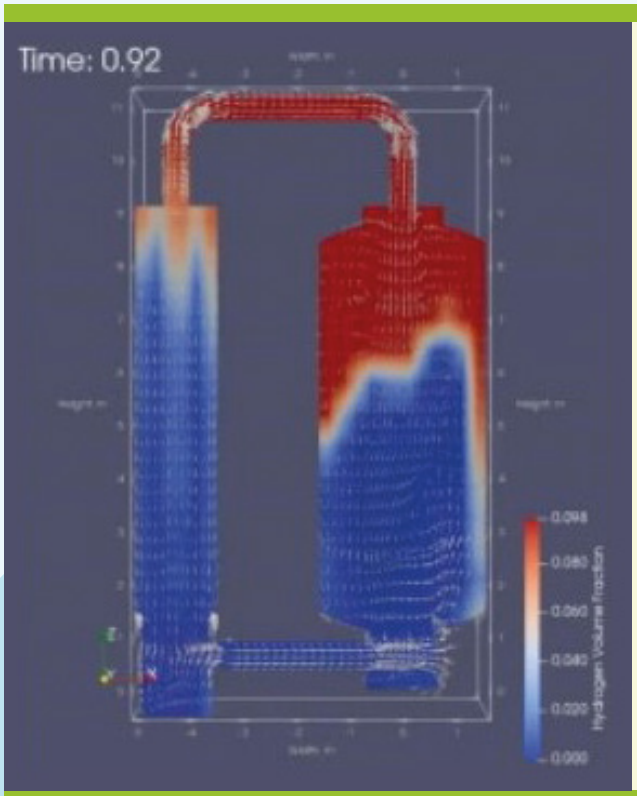


Figure 15: Graphic displaying a thermal hydraulic analysis

Research activity

We have participated in the OECD/NEA THAI-3 (Thermal Hydraulics, Aerosols, and Iodine) experimental programme.[12] This was a 3.5-year project, with a total budget of over €4.75 million with participation from 16 international partners.

THAI-3 is a continuation of previous experimental programmes examining hydrogen and fission product-related issues in water-cooled reactor containment under accident conditions. Previous programmes have focussed on improving the fundamental understanding of the behaviours of combustible gases and fission products, including, for example, gas distributions, hydrogen removal by Passive Autocatalytic Recombiners and iodine and aerosol interactions.

The scope of THAI-3 was focussed on the further topics identified as the most beneficial, based upon the opinion of 37 experts from 14 countries representing 27 organisations, including ourselves. The scope included multiple experimental tests associated with:

- PAR performance in the adverse conditions of counter-current flow;
- Hydrogen combustion and flame propagation in a two-compartment system, and looking at the impact of higher flow velocities of the unburned gas on flame acceleration;
- Fission product re-entrainment from water pools at elevated temperatures; and
- Resuspension of fission product deposits (aerosol and molecular iodine) due to a highly energetic event, such as hydrogen deflagration.

The THAI programme was unique in that it was conducted in a dedicated large-scale test facility. For THAI-3, the facility was further enhanced to a linked, two-vessel apparatus named THAI+ with a total enclosed volume of 80m^3. The THAI-3 programme conducted multiple large-scale experiments and provided detailed results and interpretation.

In addition to the experimental tests, another important part of the THAI-3 programme was the complementary modelling activities. Participants used their computer models to predict some of the experimental results, providing a valuable insight into the strengths and limitations of current modelling capabilities and tools.

12 https://www.oecd-nea.org/jcms/pl_25509/thermal-hydraulics-hydrogen-aerosols-and-iodine-thai-project#toc_1_3

Safety and security intelligence gained

Experimental and analytical results for the full scope of THAI-3 have been provided to us and are also available to the UK nuclear industry. At a high level, they provide cutting edge understanding and information on the behaviour of combustible gases and fission products, as well as relevant mitigation devices – ranging from a better theoretical understanding to data with direct practical applications. More detailed findings have resolved or clarified specific aspects of knowledge in this field, enhancing the overall understanding of combustible gas and fission product behaviour.

The information covers a broad range of topics and activities of relevance to us and the insights gained from this work have already contributed towards our regulation of new reactor build.

Other important aspects of the THAI-3 project were the complementary analytical activities which provide insights into the accuracy of computer models and highlight limitations and areas of uncertainty where additional verification and validation may be required. This has enhanced our understanding of such matters and has highlighted areas where regulatory scrutiny may potentially need to be focussed.

There are also additional benefits in participating in such large international programmes. Technical exchanges with international experts have provided us with further insights, for example in relation to discussions regarding various modelling codes and approaches, other related research projects, including sharing of results, and discussions with experts from other regulators or technical organisations. These exchanges have helped maintain and develop the technical expertise of our inspectors as well as allowing our expertise to be shared with international colleagues. Participation in THAI-3 provided us with a highly effective route to access significant safety research at a fraction of the actual costs involved.

The THAI-3 summary report will be published by OECD/NEA.

Technical case study

Internal hazards

Challenge

Preventing and protecting against fire at nuclear facilities is a key aspect of nuclear safety cases. It is important that our inspectors have confidence in the methods and evidence base used to underpin fire and explosion safety case considerations to inform our regulatory decision-making.

Research activity

We are participating in three national and international research projects to address uncertainties and reduce knowledge gaps for fire and explosion hazards:

PRISME 3, a joint research project run by the OECD-NEA, is designed to investigate fire behaviour in conditions representative of nuclear operational facilities. The project is generating data on large scale real-life scenarios that go beyond the coverage of previous datasets. The datasets are being used to test the performance of complex computational fluid dynamics tools.

MISTS 2 is a multi-sector project principally funded by HSE. The experimental programme is investigating fire and explosion hazards associated with mists of combustible fluids. It is providing new knowledge on how flammable clouds depend on pressure, leak rate, fluid type and fluid temperature.

The Fire Incidents Records Exchange (FIRE) project is run by the NEA. Its FIRE database currently holds data from nuclear-relevant fire events covering numerous operating reactors in 15 member countries, including the UK. Our participation allows the UK to contribute to and access useful international data to better understand events and their causes, and so improve fire prevention and protection measures.

Safety intelligence gained

By participating in PRISME 3, MISTS 2 and the OECD FIRE project, both ONR and the UK nuclear industry are gaining access to multi-million-pound experimental research and international operational experience for a relatively modest annual contribution.

The PRISME 3 programme has already identified several key observations, for example where current modelling methods cannot accurately predict some of the recorded phenomena. By performing the test and seeing these behaviours, measures can be put in place to mitigate any risks.

Both we and dutyholders are gaining a better understanding of the strengths and weaknesses of the fire modelling tools used to support nuclear safety cases for existing and new build facilities. This improved understanding is enabling us to ensure that adequate measures are taken to appropriately reduce or even eliminate these risks.

The knowledge gained from the MISTS 2 project is enabling licensees and us to recognise when high flashpoint fluids may pose an explosion risk. This in turn is helping us to target our regulatory interventions.

In addition to direct access to operational experience from around the world, membership of the OECD FIRE Project allows us and the UK nuclear sector to learn from international experience and so drive improvements.

The tangible benefits of each of these three research programmes not only relate to the collection of technical data but also to its application, shared learning across the international community and the incorporation of this into UK nuclear safety cases.

9 Annex 1 – Incidents reported to ONR

Dutyholder requirements

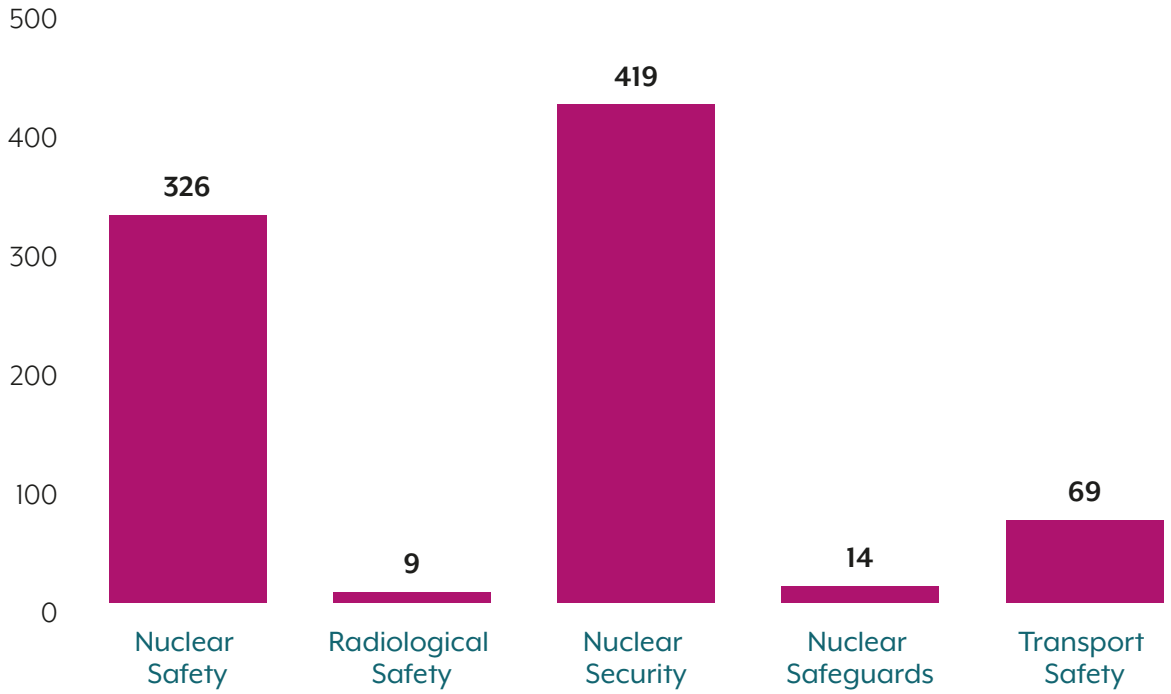
9.1 Dutyholders are required to report nuclear and radiological safety incidents to us in accordance with current legislation, namely conditions made under the Nuclear Installations Act 1965, the Nuclear Industries (Dangerous Occurrences) Regulations 1965, and the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (CDG). Dutyholders must also:

- Ensure we are notifed of civil nuclear security incidents in accordance with duties under the Nuclear Industry Security Regulations 2003;
- Report safeguards incidents to us in accordance with the Nuclear Safeguards (EU Exit) Regulations 2019 and the UK/IAEA Voluntary Offer Safeguards Agreement (INFCIRC/951); and
- Report conventional health and safety incidents under the Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations (RIDDOR) 2013.
- Notwithstanding those obligations, an open and positive reporting culture for all incidents is something we strongly encourage and observe across the industry.
- Our incident reporting system provides an established mechanism for the industry to report relevant incidents in the following topic areas:
- **Nuclear safety –** covering incidents involving plant and equipmen t issues, typically at nuclear sites, that have a potential impact on nuclear safety.
- **Radiological safety –** covering incidents where personnel have been exposed or could have been potentially exposed to radiation above or near statutory levels.
- **Transport safety –** covering incidents relating to the safe movement of radioactive material.
- **Security –** covering events or matters reported under NISR 2003 Regulations 10, 18 and 22, relating to the security of nuclear premises, transport of nuclear material and sensitive nuclear information respectively.
- **Nuclear safeguards –** covering incidents where there are issues relating to the accountancy and/or control of relevant radioactive material.

Incident reporting in 2020/21 across our purposes

Figure 1 presents an overview of the incidents reported to us against each of these five topic areas during the reporting period April 2020 to March 2021.

Figure 1: Incident reports during the financial year 2020/21



9.2 The level of reporting against each of our regulatory purposes remains consistent with previous years, with nuclear safety and security being the predominant subject areas. There has been a small increase in numbers of radiological and transport safety incidents that we have been notified of compared with the previous year. This will be discussed in the relevant sector analysis later in this annex.

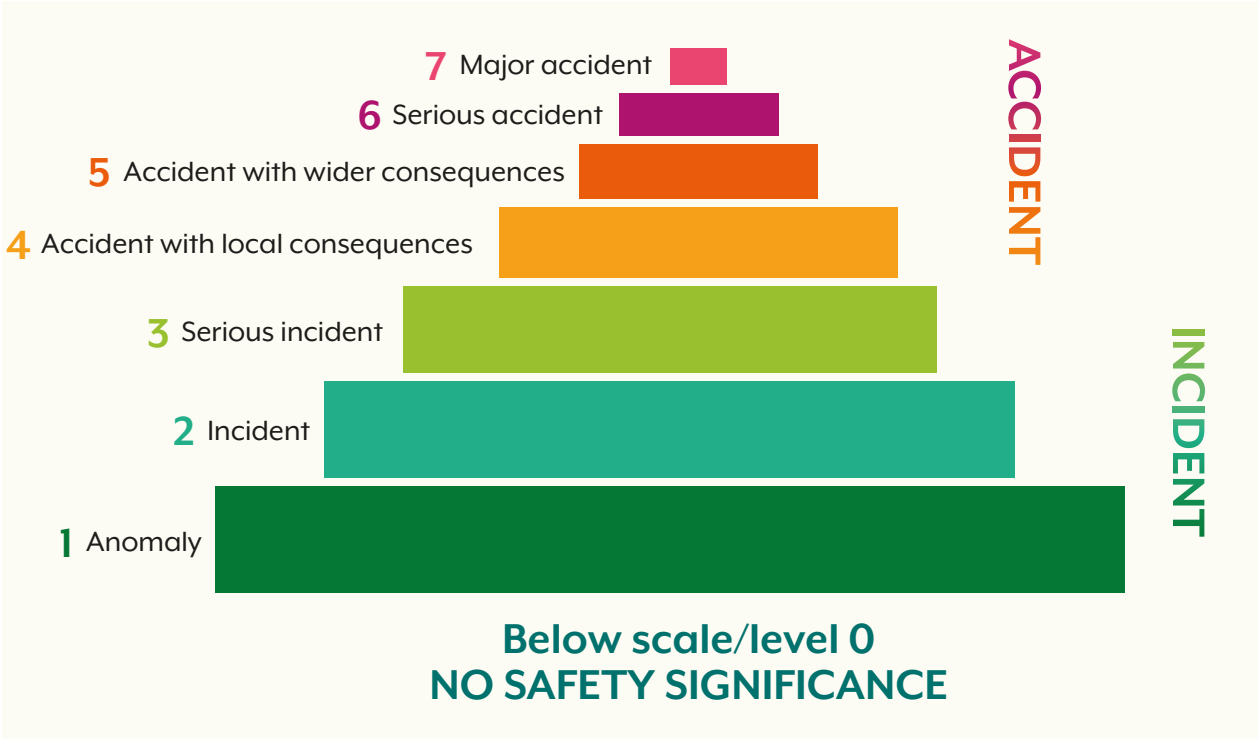
9.3 In the previous annual report, we committed to commencing a periodic review of our incident reporting guidance. This work has commenced as planned and initial discussions with relevant industry groups are ongoing to ensure that notifications continue to provide value to our regulation, insight into dutyholder safety and security performance, while ensuring that the reporting burden to dutyholders remains proportionate.

9.4 It should be noted that that the large number of security events reported are a consequence of the legal requirement to make such reports. We have adopted a policy of proactive reporting to encourage a positive security culture.

Significance of incidents

9.5 Nuclear, radiological and transport safety incidents are also categorised against the International Nuclear and Radiological Event Scale (INES). The INES is a communication aid to help general understanding of the significance of an incident and its impact in three specific regards: on people and the environment; on radiological controls and barriers at facilities; and on defence-in-depth.

Figure 2: The International Nuclear and Radiological Event Scale (INES) incidents reported to ONR



9.7 The INES ranges from 0 to 7, with 7 being the most significant. At the lowest level, incidents are categorised and reported at INES 0/below scale if they have no safety significance. However, these incidents may nonetheless be important in identifying potential weaknesses in defence in depth and radiological controls and barriers at facilities. By analysing these incidents, dutyholders can maintain and improve safety performance.

9.8 Defence in depth comprises a series of independent physical and/or non-physical barriers (inherent features, equipment, and procedures) aimed at preventing faults in the first instance and ensuring appropriate protection or mitigation of accidents if prevention fails. Defence in depth should prevent faults, or if prevention fails should ensure detection, limit the potential consequences, and stop escalation.

9.9 For the incidents categorised at INES 1 (an anomaly), this usually means that there have been minor problems with safety components but with significant defence in depth remaining.

9.10 There are a range of criteria defined for incidents categorised at INES 2 (an incident), including:

- exposure of a worker in excess of the statutory annual limits, which in the UK are set by the Ionising Radiations Regulations 2017 (IRR17);
- significant radioactive contamination within a facility in an area not expected by design; and
- significant failures in safety provisions but with no actual consequences.

Nuclear, radiological and transport safety significance

9.11 Most incidents (404) were categorised as having no safety significance (below scale/INES 0). Eight incidents were categorised as INES 1 (an anomaly), typically because of minor problems with safety components, but with significant defence in depth remaining. Three of these incidents were reported during the final quarter of 2020/21 and the categorisation remains provisional until completion of the respective dutyholder's investigations. No incidents were categorised above INES 1 during the period.

9.12 The tables below, provide details of incidents rated as INES 1. The period covered in this report is April 2020 to March 2021.

9.13 The combined number of INES-notifiable incidents is consistent with the average reported over the last five years. Numbers of incidents remain low, and none had any detrimental effect on public safety.

Security and safeguards significance

9.14 Security events or matters (as opposed to incidents) are categorised as major, moderate, minor or none. Major events/matters involve a total loss of defence in depth such that nuclear or other radioactive material, or sensitive nuclear information, becomes unacceptably vulnerable to theft or sabotage, or where malicious acts have been carried out against the site.

9.15 Moderate events/matters are those where there has been a departure from expected standards resulting in a reduction in defence in depth. Minor events/matters are where there has been a breach of standards or procedures that are of low risk to the overall security regime. Other events may be reported for information purposes that are not considered to have any effect on site security and these are categorised as None.

9.16 Just over 90% (378) of the security events/matters were categorised as minor or None. No major events/matters were reported. None of the security events reported were considered to have a safety significance (below scale / INES 0).

9.17 Thirteen of the safeguards incidents were categorised as having no safety significance (below scale/INES 0). One incident was categorised as INES 1 (an anomaly), because of minor problems with safety components, but with significant defence in depth remaining.

Regulatory response to incidents

9.18 Each incident reported to us is evaluated by an inspector who identifies a proportionate regulatory response taking account of its safety, security, or safeguards significance. Most incidents are of no or minimal significance; however, the reporting of such incidents provides opportunities to identify additional actions that dutyholders can take to improve their overall performance or help us target our regulatory interventions.

9.19 We conducted preliminary enquires in response to 31 incidents in this period, the purpose of which was to obtain sufficient information to support an informed decision on whether the matter met our investigation criteria. In addition, four incidents met our investigation criteria on immediate notification. Our preliminary enquiries and/or investigations led to us taking formal enforcement (the level being proportionate to the issues we identified) in response to nine of these incidents. Preliminary enquiries into three incidents are ongoing.

Incident analysis

9.20 Each of our divisions and technical specialisms has an appointed regulatory intelligence lead inspector, who screens incidents and then facilitates further discussion, analysis, and follow-up where appropriate to their regulatory area. Typically, the regulatory intelligence leads produce quarterly regulatory intelligence reviews, which outline the results from this work.

9.21 Our regulatory intelligence reviews use incident data to:

- Inform divisional intervention strategies
- Search for, and identify, common themes in industry performance
- Improve/better target our regulatory approaches

9.22 Common themes identified and then incorporated into either divisional strategies, or specialism plans to continuously improve our regulatory approach have included:

- Failures in configuration control or configuration management
- Ageing management
- Conventional safety topics relating to lifting operations, pressure systems safety and electrical safety

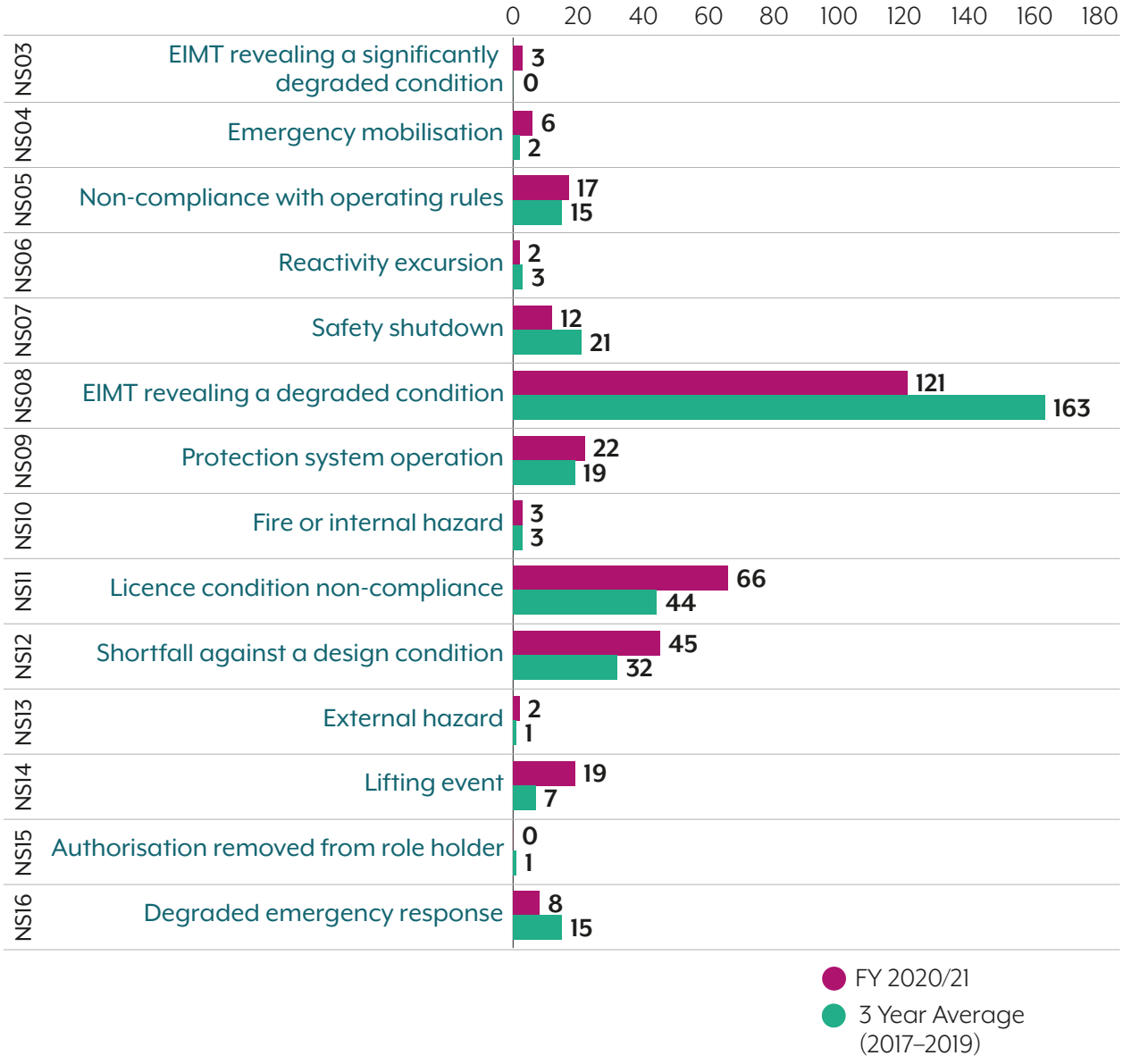
9.23 During the reporting period, several regulatory intelligence reviews resulted in advice notes to inspectors being produced and development of guidance for inspectors. Examples include:

- Diesel generator operational challenges – regulatory learning summarising a potential oversight in the maintenance and proof testing of diesel generators; and
- The maintenance and operation of saturated steam systems – highlighting some of the key findings and recommendations from our investigation into the failure of an 8-inch cast iron saturated steam system valve, which injured three employees at Heysham 1 power station in 2018 and resulted in ONR enforcement action.

Sector-level analysis – nuclear safety incidents

9.24 Dutyholders report incidents to us categorised according to specific criteria defined in the relevant ONR guide.[13] Focusing on nuclear safety related incidents, Figure 3 provides a breakdown of incidents reported against these criteria.

Figure 3: Breakdown of incidents related to nuclear safety for the financial year 2020-2021 in the categories reported to ONR



13 https://www.onr.org.uk/operational/inspection/onr-opex-gd-001.pdf

9.25 As in previous years, Figure 3 shows that the largest category used when reporting nuclear safety events to us remains NS08: 'Any examination, inspection, maintenance, test, surveillance, alarm, alert, indication or notice that a system, structure or component reveals any matter indicating that the safe condition, including degradation of design safety barriers providing defence in depth or safe operation of that plant may be affected'.

9.26 The number of NS08 incidents this year has reduced compared to the three-year average. This reduction is in part due to work undertaken by our inspectors to influence dutyholders to improve their categorisation of incidents. It is also due to operational changes implemented by the licensees in response to the COVID-19 pandemic, including suspension of non-essential operations and the deferral of non-essential maintenance activities. Throughout the pandemic, our inspectors have undertaken targeted interventions to evaluate licensees' arrangements for these deferrals, assuring that adequate maintenance was conducted in accordance with the facility safety case.

9.27 The next largest group of incidents are in categories:

- **NS11:** 'Significant inadequacy in or significant failure to comply with the arrangements made under a condition attached to the nuclear site licence or permission granted under a licence instrument'; and
- **NS12:** 'Any problem or defect in the design, fabrication, construction, commissioning or operation of the installation that results in, or could result in, a condition that had not previously been analysed or that could significantly challenge the design basis assumptions or the safety case for operation'.

9.28 Last year we committed to engage with dutyholders to discuss revising the NS08 category definition to provide improved granularity and so enable potentially improved analysis. A review of the NS08 incident data for 2020-21 has been undertaken, the outcomes of which will be discussed with dutyholders this year as part of our wider periodic review of our incident reporting guidance.

9.29 Similar reviews will be carried out for the other dominant incident notification categories to establish any apparent trends and to inform discussions on potential future revisions to our incident reporting guidance.

9.30 The data indicates a few categories that, whilst total numbers are relatively low, there was a notable increase compared to the three-year average:

- Two of the three incidents categorised as NS03 were incorrectly categorised and should have been reported under NS08;
- three of the six NS04 incidents related to abnormal circumstances: two were due to severe weather and one was COVID-19 related; and
- The majority of the NS14 incidents occurred at Sellafield. We have conducted an intervention as a consequence and have taken appropriate enforcement action. We will continue to monitor our dutyholders' performance in this area via our overarching conventional health and safety theme.

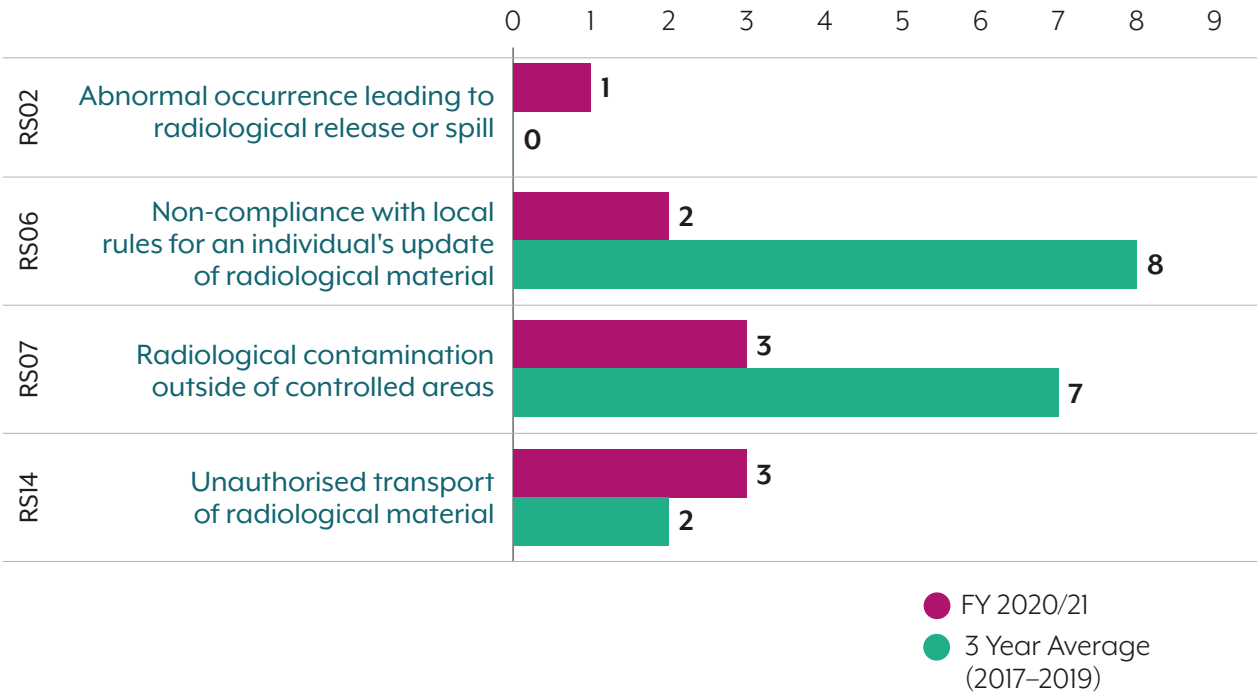
Sector level analysis – radiological safety incidents

9.31 Figure 4 provides a breakdown of radiological safety incidents by category reported to us during the financial year 2020/21. The number of events reported has reduced when compared with the preceding two years as a result of decisions taken by many of our dutyholders to reduce operations through 2020, in response to the pandemic.

9.32 There was a significant reduction in the number of RS06 criteria events reported, along with a modest reduction in RS07 criteria events. We anticipate that numbers of incidents categorised as RS06 and RS07 will return to pre-pandemic levels in 2021/22 as dutyholder operational activities return to normal. We will continue to monitor our dutyholder's radiological safety performance throughout this transitional period, using intelligence gained to inform our intervention plans. The definitions for the RS06 and RS07 criteria are as follows:

- **RS06 –** An incident or occurrence that leads to a person receiving an intake, or suspected intake of radioactive material, above that permitted by local arrangements; and
- **RS07 –** Discovery outside a controlled area boundary of radiation or contamination, including contamination on equipment, clothing or skin, significantly above that permitted by local arrangements.

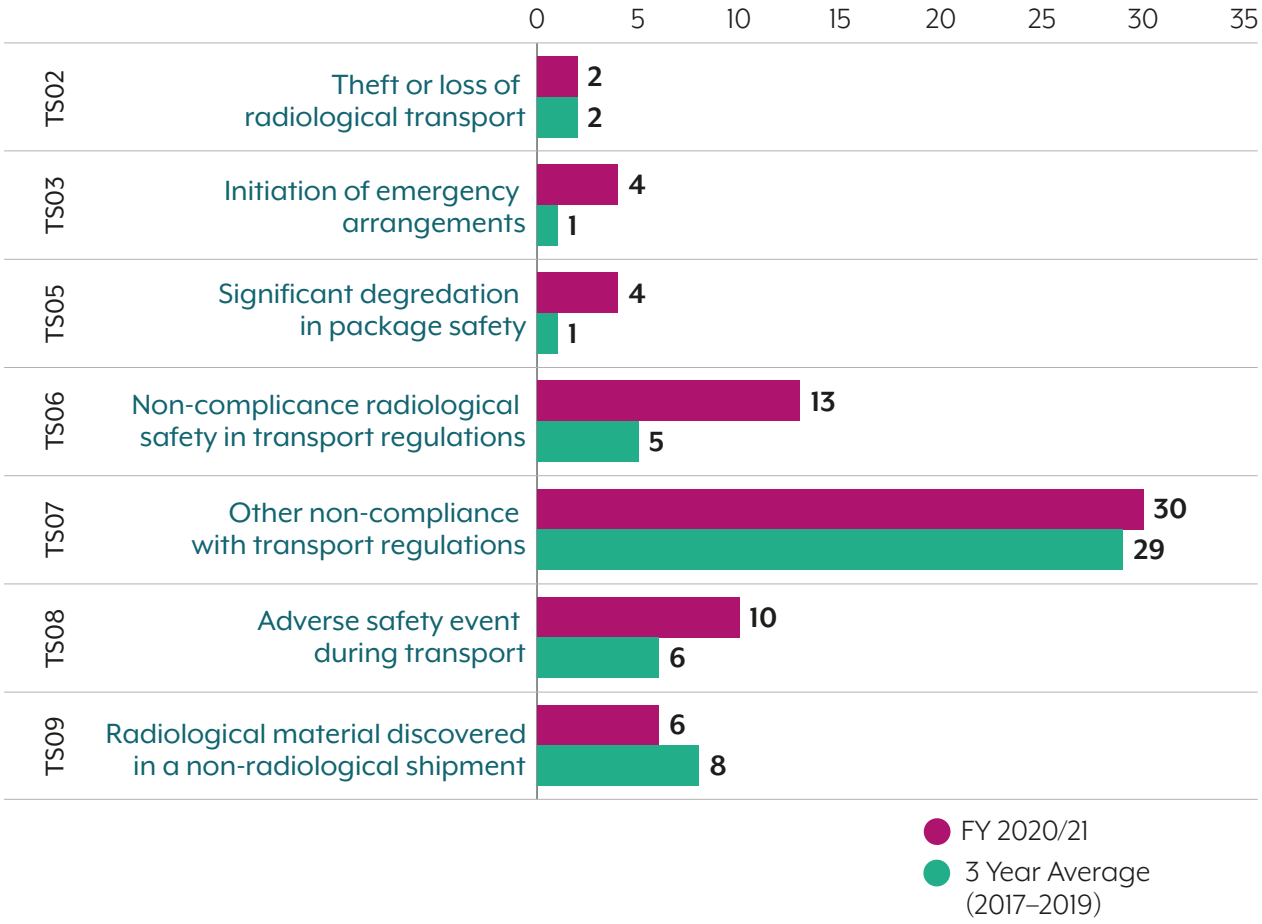
Figure 4: Breakdown of incidents related to radiological safety for the financial year 2020/21 in the categories reported to ONR



Sector level analysis – transport safety incidents

9.33 Figure 5 provides a breakdown of transport safety incidents by category as reported to us during the financial year 2020/21. Due to initial incorrect categorisation and duplicated reports (consignor and carrier reporting same incident) the actual numbers of transport incidents are less than those reported (69 reports, 60 actual events).

Figure 5: Breakdown of incidents related to transport safety for the financial year 2020/21 in the categories reported to ONR



9.34 Though the data is, statistically speaking, unchanged from past years, there are two trends to be highlighted in respect of categories TS06 and TS07. Firstly, we have seen an increase this year in the number of small, low-level radioactive items (miscellaneous items such a radium painted instrument dials) being sent from overseas by post which have been detected at the UK port of entry. Secondly, we have observed a small increase in incidents of medical radioisotope packages being mistakenly dispatched as empty.

9.35 Postal items being sent by foreign consignors is not an aspect that we can address directly, but we have nevertheless discussed these instances with the relevant national competent authorities and via our active interface with Border Force. Instances of transport of packages mistakenly dispatched as empty has been followed up in individual cases and discussed with organisations representing medical radioisotope users. These interventions have had a positive impact on the numbers of such incidents in the final quarter of the reporting year.

9.36 Of the four TS03 instances, three were minor road traffic accidents with no damage to the packages and minimal damage to the vehicles. We will conduct an inspection in respect to the fourth incident to confirm the dutyholder has appropriately implemented lessons learned.

9.37 One of the TS05 incidents was incorrectly reported and so downgraded after reporting to TS09. The three remaining incidents were all low-level involving damage to packaging during loading/unloading. There was no trend in the dutyholder or type of event.

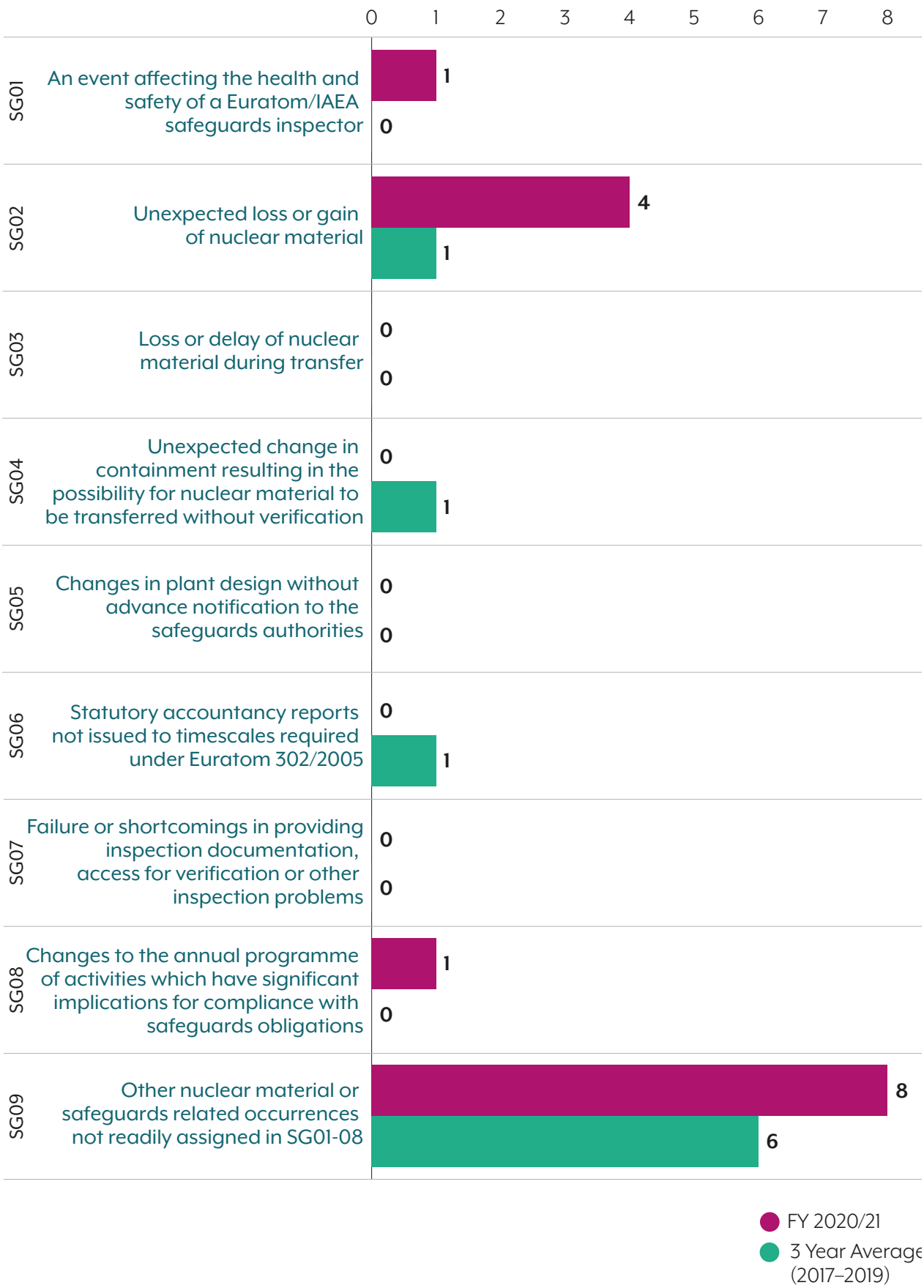
9.38 Although transport regulations require the reporting of TS01 to TS06 incidents, there are no legal requirements for non-nuclear dutyholders to report TS07 to TS09 incidents to us in view of their generally low safety significance. As a result, reporting against these criteria tends not to be particularly consistent. Nonetheless, the data still indicates that the number of incidents is very low considering the tens of thousands of transport movements carried out per year in the UK, with annual variations in reporting not indicative of any trends.

Sector level analysis – safeguards

9.39 The significance of safeguards incidents reported to us is assessed based on the implications for compliance with domestic UK safeguards regulation and the UK's international safeguards obligations. It should be noted that prior to 1 January 2021, Euratom were the UK safeguards regulator. When the new UK Safeguards (EU Exit) Regulations 2019 came into force on 1 January 2021, the incident reporting criteria were updated to align with new regulatory expectations. None of the safeguards incidents reported to us during the financial year 2020/21, impacted on the UK's compliance with our international safeguards obligations.

9.40 The numbers of safeguards events reported to us during the financial year 2020/21 has increased compared with the preceding two years. While numbers of reported incidents remain small compared to our other regulatory purposes, the increased level of reporting mirrors increased engagement between our inspectors and our dutyholders following the introduction of the Nuclear Safeguards (EU Exit) Regulations 2019 and the new UK/IAEA bilateral voluntary offer safeguards agreement.

Figure 6: Breakdown of incidents related to safeguards for the financial year 2019-2020 based on ONR's incident categories



9.41 The increased level of reporting in category SG02 is due to the successful recovery of legacy nuclear material as part of decommissioning and clean-up, in particular at Magnox reactor sites. This material was left within the facility following the cessation of routine operations. Its subsequent recovery during clean up and decommissioning was expected and allows nuclear material accountancy balances to be corrected for the facility in line with safeguards regulation. We are informed of these decommissioning 'finds' through our incident reporting process and they are later reported in the formal nuclear material accounting reports submitted for the facility. The number of these incidents is expected to increase in future years as more facilities enter active decommissioning and clean-up.

9.42 As in previous years, the largest category for safeguards reporting remains SG09, which is used for incidents that do not obviously meet other criteria. In addition, some operators use this category to notify us of an issue which does not reach the threshold/ significance required for formal notification. We use this information to inform intervention planning and follow-up activities evaluating the accuracy of information declared by dutyholders for safeguards regulatory purposes. The event recorded under SG01 involved an inspector sustaining a small cut to the finger while attaching a site visitor pass.

Sector level analysis – cyber security and information assurance

9.43 A total of 119 cyber security and information assurance events were reported to ONR in the reporting period, 90% of which were categorised as minor, with the remainder categorised as moderate. Around 20% of incidents and events occurred on nuclear premises and a single transport related event was reported, with the balance taking place in the supply chain. The distribution of events and incidents across the civil nuclear sector was broadly commensurate with the size of the organisations.

9.44 A little over 50% of the incidents involved the insecure transmission of sensitive nuclear information. These incidents saw information transmitted across the public internet with a lower level of encryption than is recommended by the National Cyber Security Centre. However, in each case, investigations found no evidence of unauthorised access to SNI. A spate of incidents clustered around the transition to home working at the beginning of the pandemic led to ONR's Civil Nuclear Security and Safeguards Director writing to dutyholders, urging greater vigilance during the transition.

9.45 Several peaks in reported events were seen throughout the year, which can be correlated with the transition to home working and major global cyber events, including the SolarWinds supply chain attack and exploitation of Microsoft Exchange vulnerabilities. However, it is noted that these events were reported to us in the context of the dutyholder using affected versions of the software, rather than having been compromised via them. Notwithstanding this, these events saw the BEIS-led Nuclear Cyber Co-ordination Group convene, comprising of representatives from BEIS, NCSC and ONR, to oversee the industry's response and to co-ordinate communications into central Government.

9.46 In February 2021, the sector came together to exercise its response to a simulated major multi-site cyber-attack. The exercise allowed industry participants to practice hands-on perishable cyber defence skills and allowed us to test our major cyber incident arrangements. Valuable lessons were learned, which led to us appointing a dedicated inspector responsible for co-ordinating our response to cyber security events. We also revised our guidance on Preparation for and Response to Cyber Events which sets out our expectations and draws on a range of relevant good practice – including alignment with relevant content from the NCSC's Cyber Assessment Framework.

Table 1 – Significant incidents by site

INES = 1 (Anomaly) | Site: Heysham 2

Date	16/04/2020
Event description	Reactor 8 at Heysham 2 was in the process of a return to service following a statutory outage. Just after the reactor had been taken critical and at very low power (30kW thermal), operators detected that three out of the four channels of the Log/Lin flux monitoring and control system were not responding to the reactor power increase as expected. During the event, the protection against any unplanned power increase continued to be provided by two other independent systems – the Low Power Pulse Protection and the Diverse Shut Down Amplifier Flux Protection – as well as by various control rod drive interlocks.
Dutyholder's response	Immediate inspection of the equipment in the protection suite found that three channels were still connected to their test leads, rather than being connected to the flux measuring devices. The operators brought the reactor to a sub-critical state three minutes after detecting the wrong connections and subsequently shut it down. The affected system was then restored to its appropriate configuration. Following an initial investigation and additional assurance work on a variety of reactor safety systems, the reactor was safely returned to service. EDF's event review identified that the event was due to inadequate plant design/labelling and inadequate maintenance procedure quality. This allowed multiple protection channels to be worked on simultaneously and lacked robust independent verification. Numerous contributing causes were also identified. Actions have been taken to address all these findings. The dutyholder has changed the equipment arrangement in a way that physically prevents plant being returned to service with test equipment still connected. In addition, there has been an extensive review and update to all documents, procedures and training associated work on the Heysham 2 reactors.

This incident was listed as INES 2 in Version 2. This was a typographical error, corrected in Version 3.

INES = 1 (Anomaly) | Site: Heysham 2

Date	16/04/2020
ONR's actions	We commenced a formal investigation and placed a regulatory hold on Reactor 8 start-up. This was lifted after additional safety assurance work was completed to a satisfactory level. We have obtained from the dutyholder a copy of the completed maintenance work pack from 9 April, when the Log/Lin flux detectors were last tested and formally interviewed a number of personnel on site including the maintenance technicians who performed the maintenance. Subsequently, we undertook a physical inspection of the flux detector test procedures (initially delayed due to COVID-19 restrictions). Following our formal investigation, we issued an improvement notice to EDF Energy Nuclear Generation Ltd against duties under Licence Condition 28(1).

Provisional INES = 1 (Anomaly) | Site: Heysham 2

Date	15/03/2021
Event description	Shortfalls have been found in the safety case substantiation of the reactor make-up shields' spherical pressure vessel split housing – which forms part of the fuelling machine used to refuel and defuel the reactors. Specifically, the original design for the reactor make-up shields' had not been assessed against a theoretical fault where a seal failure would lead to the void between the vessel and housing becoming pressurised. No event took place, this was the identification of a potential fault scenario that was not included in the safety case substantiation for this equipment.
Dutyholder's response	This shortfall was identified by the dutyholder's own assessment work on the fuelling machine safety cases at Heysham 2 and Torness. As a result, fuelling machine operations on pressurised reactors have been embargoed. Revised safety cases are being prepared by the dutyholder.

Provisional INES = 1 (Anomaly) | Site: Heysham 2

Date	15/03/2021
ONR's actions	We have found the dutyholder's actions to be appropriate in the short term. The embargoed operations are subject to regulatory hold points requiring our permission, which will be based on the assessment of the adequacy of the revised safety cases.

Provisional INES = 1 (Anomaly) | Site: Torness

Date	15/03/2021
Event description	Similar safety case shortfalls described above under Heysham 2 also applies to Torness.
Dutyholder's response	See above
ONR's actions	See above

INES = 1 (Anomaly) | Site: Sellafield

Date	10/09/2020
Event description	A leak of Uranyl Nitrate (UN) was discovered from a pipe between two buildings on the Sellafield site. The leak was approximately 3m away from the nearest walkway and no persons were affected. There were no nuclear, safety or environmental consequences as a result of this event.
Dutyholder's response	Sellafield Ltd completed a radiological survey of the leak area and found localised elevated contamination readings. Sellafield fire and rescue attended to cordon off the area and covered the leak area to reduce the impact to ground. Further surveys confirmed that no radioactive material had entered surface water drains within the site. The section of pipework where the leak site was located has been replaced, pressure-tested and the pipe bridge was put back into service. Sellafield Ltd identified the root cause of this incident to be an unexpected asset failure. The section of pipework was sent off for metallurgical analysis to gain an improved understanding of the corrosion mechanism and a management investigation was undertaken.

INES = 1 (Anomaly) | Site: Sellafield

Date	10/09/2020
ONR's actions	Our preliminary enquiries concluded that although our investigation criteria were met, a formal investigation would be disproportionate on the following grounds: • Although this is a potential breach of LC34(1) Sellafield Ltd appeared to have done everything reasonably practicable to prevent a leak; for example, the pipe was made of a suitable grade of stainless steel for containing the material and there was a suitable inspection regime in place; • The root cause of the incident was an unexpected asset failure; • No further actions were identified that Sellafield Ltd could reasonably take to prevent a reoccurrence or to secure compliance with the law; • There were no nuclear or environmental consequences resulting from the leak and no radiological exposures to workers or to the public; and • Our inspectors were satisfied with Sellafield's response to the incident, the repair of the pipe and the planned remediation of the ground. We did however challenge the initial INES 0 rating and, following a detailed review, Sellafield Ltd revised this to INES 1.

INES = 1 (Anomaly) | Site: Devonport Dockyard

Date	26/08/2020
Event description	Portal crane tripped (stopped) by zone protection system. The safety function of the 43-tonne portal crane zone protection system is to stop the crane from manoeuvring into a position where it could present a potential hazard. The zone protection system is a high-reliability system, independent of the control system. The zone protection system activated as the crane operator attempted to recover a load stranded following an earlier control system synchronisation error.

INES = 1 (Anomaly) | Site: Devonport Dockyard

Date	26/08/2020
Dutyholder's response	Devonport Royal Dockyard Ltd took the conservative decision to stop similar crane operations on the dock until the causes of the incident had been investigated. The investigation found that following the control system synchronisation error, the crane operator overrode part of the control system (using override keys) in accordance with written instructions. These overrides had no effect on the separate zone protection system, which operated as designed during the manoeuvre. The investigation found that the immediate causes of the incident were: • A failure to understand the function of override keys in relation to removal of the crane control system limit control; and • A failure to undertake appropriate supervision of crane operations. Crane operations were restarted on completion of appropriate follow-up actions.
ONR's actions	We followed up the incident with two inspections. These led to an agreed plan of actions for DRDL to complete to achieve compliance. A regulatory issue has been raised to monitor DRSL's implementation of the action plan within the framework of normal regulatory business.

INES = 1 (Anomaly) | Site: Springfields

Date	06/10/2020
Event description	During processing of low uranium content acidic effluent, material leaked down to the secondary containment ground floor and from there – through a pipe penetration – onto ground adjacent to the plant. The majority of the leaked material was contained within the plant area and in a bund on the ground floor.
Dutyholder's response	A plant operator detected the leak and shut down the process. Recovery actions for collection of the leaked material were successful.
ONR's actions	We are satisfied with the dutyholder's investigation which identified appropriate underlying root-causes such as the shortfalls in mechanical training. This was followed up by a plant inspection to ensure that initial short-term corrective actions had been implemented. For longer term corrective actions, a regulatory issue was used to track these to completion.

INES = 1 (Anomaly) | Site: Aldermaston

Date	23/10/2020
Event description	A stack on the AWE site is non-operational and is under decommissioning. It was taken out of use around 30 years ago and having been capped off was awaiting removal. The licensee's inspection strategy for the stack was found to be inappropriate, when assessed against modern standards. Remedying this led to an accelerated programme to decommission the stack.
Dutyholder's response	Local controls were immediately instigated. Formal monthly structural engineering inspections of the stack were introduced with the outcomes recorded on the site's asset management system. A review of the facility's emergency preparedness in the event of a premature failure was carried out to ensure that the FERP (facility emergency response plan) remained valid. Restrictions were imposed on operations adjacent to facility in wind speeds of 30mph or greater. The facility produced a safety case to allow the prompt removal of the stack and the removal work has since been completed.
ONR's actions	We challenged the initial INES 0 rating and following a detailed review AWE revised this to INES 1. We established routine early engagement meetings with AWE during the development of its stack demolition safety case to enable accelerated delivery of the project. Following our assessment of the safety case the stack demolition was permitted and subsequently executed. We are currently undertaking preliminary enquiries and will use these to establish any further regulatory response.

INES = 1 (Anomaly) | Site: Aldermaston

Date	08/02/2021
Event description	During routine maintenance on a furnace, a stirrer started moving unexpectedly. The maintainer activated the stop, but the stirrer continued to move. The maintainer then withdrew from gloves, stopped work, and successfully shut down the relevant systems. There was no injury to personnel and no release of material from the glovebox.
Dutyholder's response	The glovebox, and another similar glovebox were removed from service. AWE's investigation found that the direct cause for the incident was a fault in a process control panel which was beyond its expected service life.
ONR's actions	We judged that the initial dutyholder's response was appropriate and that the incident did not merit an investigation. However, the dutyholder has decided to revisit its internal investigation and root cause analysis to ensure that all appropriate learning is captured. We challenged the initial INES 0 rating and following a detailed review AWE revised this to INES 1.

Conventional health and safety incidents

9.47 Specified injuries to workers, diseases and dangerous occurrences on nuclear sites are reported to us under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 2013.

RIDDOR reportable injuries

9.48 Table 2 below provides information on the number of RIDDOR reportable injuries notified to us during the reporting period April 2020 to March 2021. The data presented includes all RIDDOR injuries reported for the sites, and thus includes those reported by contractors and tenants as well as by licensees. It is important to note that such a small dataset does not allow for clear comparisons in health and safety performance either between sites or year on year. Variables such as size of the undertaking; ranges and types of activities being performed; and reporting culture affect the number of incidents reported. As such, no trend analyses are reported here.

Table 2: RIDDOR reportable injuries April 2020–March 2021

Site	Total injuries reported	Site	Total injuries reported
Aldermaston	8	Dungeness B	2
Amersham (Grove Centre)	1	Heysham 1	1
Barrow	5	Heysham 2	1
Burghfield	3	Hinkley Point B	1
Capenhurst	1	Hinkley Point C	22
Derby	1	HMNB Clyde	3
Devonport Royal Dockyard	16	Hunterston A	1
Dounreay	1	Sellafield	13
		Total	**80**

Diseases

9.49 Notifications of reportable diseases have increased significantly from the four reported last year. This is fully attributable to the COVID-19 pandemic. Specifically, occurrences whereby a person at work (a worker), has been diagnosed as having COVID-19 and this is thought to be due to an occupational exposure to COVID-19, (that is, more likely than not that the person's work was the source of exposure to COVID-19) are reportable under RIDDOR. A total of 30 such cases were reported to us during the period:

- **Berkeley (Magnox Ltd) –** one RIDDOR report in relation to five cases;
- **Sellafield –** three RIDDOR reports in relation to 12 cases;
- **Trawsfynydd (Magnox Ltd) –** one RIDDOR report in relation to nine cases; and
- **Winfrith (Magnox Ltd) –** four RIDDOR reports in relation to four cases.

9.50 There was one RIDDOR reported incident in relation to carpel tunnel syndrome, by NNB GenCo HPC Ltd (Hinkley Point C).

Dangerous occurrences

9.51 Table 3 lists the RIDDOR dangerous occurrences notified to us during the reporting period April 2020 to March 2021, and which were significant enough to be selected for regulatory follow-up. The table provides a description of each dangerous occurrence and our response.

Table 3 – RIDDOR Dangerous Occurrences April 2020–March 2021

Dutyholder	NNB GenCo (HPC)
Date of incident	10/06/2020
Event description	A silo within the concrete batching plant sustained structural damage. This resulted in an unintentional release of approximately 4,000 tonnes of non-hazardous ground granulated blast furnace slag (a binder used as an addition to cement) within the concrete batching plant and onto an adjacent internal road. No injuries occurred.
Dutyholder's response	We conducted follow up inquiries. The incident did not however meet our investigation selection criteria. NNB GenCo (HPC) carried out a Priority 1 investigation, produced a report and shared its findings. The investigation concluded that failure of the structure occurred from the overloading of a bolted joint, made possible by the inadequate design of the silo.
ONR's actions	Our inquiries concluded that there were no nuclear or conventional health and safety impacts to the public or workers. We gained assurance that there were no similar structures on the site, so no potential ongoing risks. Our focus then moved to ensuring the safe removal of the silo and dissemination of learning for the wider construction industry. NNB GenCo (HPC) published a learning brief and has confirmed that wider learning will be shared via relevant industry bodies. We continue to engage with NNB GenCo (HPC) and its contractors to ensure all further relevant learning is taken forward appropriately.

Dutyholder	GE Healthcare Ltd
Date of incident	16/06/2020
Event description	A bespoke lifting frame, manufactured from proprietary (Unistrut) steel components, failed (buckled) when being used as per design to lift a boiler safety valve on a non-nuclear installation at the licensed site. No injuries were sustained. Work was stopped immediately.
Dutyholder's response	GE Healthcare Ltd carried out an internal investigation into the incident and established an improvement plan.
ONR's actions	Following review of the dutyholder's investigation report we met with GE Healthcare Ltd to obtain further information. This revealed shortfalls with its compliance with the Lifting Operations and Lifting Equipment Regulations 1998. An enforcement letter was issued seeking improvement and two regulatory issues were raised to monitor the dutyholder's progress. We closed these issues in December 2020 when satisfied that sufficient progress had been made with the implementation of the required improvements.

Dutyholder	AWE
Date of incident	26/08/2020
Event description	An event occurred on a steam valve in which its body failed, causing part of the valve and associated insulation to be ejected. As the valve was expediently isolated via double block and bleed valves, the steam system service was maintained without interruption. No one was injured during the incident and no damage was sustained to other services in the vicinity. Steam in the immediate area was isolated expediently and the valve was barriered off and made safe.
Dutyholder's response	AWE initiated an on-site emergency response and, after the area was made safe, initiated a level 3 investigation. Similar valves and plant configurations were subject to review and the failed valve underwent full metallurgical analysis. As a result of its investigation 'tool-box talks' were given to AWE staff and contractors about start-up procedures for related plant and the potential water hammer effects that can result.
ONR's actions	We undertook a reactive Licence Condition 26/28 inspection at site and issued a question set of around 25 detailed questions. These were to clarify AWE's arrangements and the potential for similar failures, as well as AWE's response to the event. AWE's response to the questions was thorough and the reactive inspection rated as 'green'. We therefore judged no further action was warranted.

Dutyholder	AWE
Date of incident	12/11/2020
Event description	During decanting of Methyl Ethyl Ketone solvent (MEK) in accordance with the relevant manufacturing process specification, an alarm in the control room indicated that the MEK delivery drum had <25% contents. Initial investigation found that ~170 litres of MEK had been released to the integral containment bund in the MEK enclosure. There was no loss of solvent to the ground, no injuries or ill effects to workers or responders.
Dutyholder's response	AWE staff responded appropriately to the event to ensure safe recovery of the solvent from the integral containment bund. A level 3 investigation was undertaken and as a result AWE has instigated a programme of work to address its findings.
ONR's actions	We were content with the immediate actions undertaken by AWE in response to this event. However, we have requested AWE to consider this event in aggregation with other events occurring recently in the same facility to identify wider learning. The facility site inspector has scheduled a Licence Condition 26 inspection to follow-up on some of the wider work control issues relevant to these events. We have enhanced our level of oversight within the facility in line with AWE's own regulatory governance arrangements. Our work here will be supported by staff from the HSE.

Annex 2 – Glossary

Terminology	Definition
Borated water	Borated water is used as a coolant during normal operation of pressurised water reactors (PWRs) as well as in their Emergency Core Cooling Systems.
Care and maintenance	A term used to describe decommissioned and defueled nuclear reactors placed in a safe and secure state for several decades in order to allow radiation levels to naturally decay over time.
Decay heat	Decay heat is the heat released as a result of radioactive decay. This heat is produced as an effect of radiation on materials: the energy of the alpha, beta or gamma radiation is converted into the thermal movement of atoms.
Generic Design Assessment (GDA)	Design assessment process used by ONR and the environment agencies to assess new nuclear reactor designs ahead of site-specific proposals.
Graphite core	The graphite core of AGR reactors acts as moderator slows down the speed of neutrons produced during nuclear fission and helps to sustain the chain reaction so that the heat can be used for electricity production. The core is constructed from thousands of interlocking graphite bricks, which also form a large number of important channels.
High Level Waste	Waste where the temperature may rise significantly because of its radioactivity. The design of waste storage or disposal facilities has to take this into consideration. Less than 1% of all radioactive wastes (by volume) are in the HLW category. HLW is produced as a by-product from reprocessing spent fuel from nuclear reactors.

Terminology	Definition
The International Nuclear and Radiological Event Scale (INES)	Introduced in 1990 by the International Atomic Energy Agency (IAEA) in order to enable prompt communication of safety significant information in case of nuclear accidents.
Intermediate Level Waste (ILW)	Waste that exceeds the upper boundaries for low level waste (see Low level waste below) but does not generate a significant amount of heat. About 6% of all radioactive wastes (by volume) are in the ILW category. The major components of ILW are nuclear reactor components, graphite from reactor cores and sludges from the treatment of radioactive liquid effluents.
Keyway root cracking	This phenomenon will ultimately limit the lifetime of most of the AGRs. The origin of keyway root cracking is caused by the graphite at the outer surface of the bricks moving into tension due to changes in the internal stress of the brick. This mechanism can only occur later in life as it is dependent on the total amount of irradiation received by the graphite. It can consequently progressively crack many bricks across the core.
Low Level Waste (LLW)	Waste that contains relatively low levels of radioactivity. Most comes from the operation and decommissioning of nuclear facilities. This waste includes items such as scrap metal, paper and plastics. Some smaller amounts of LLW also come from hospitals and universities. About 94% of all radioactive wastes (by volume) are in the LLW category.
Nuclear concrete	Terminology used in the construction of new nuclear power stations, referring to the concrete used to construct them being of the very highest quality.
Operating Experience (OpEx)	A valuable source for learning about – and improving the safety and security of – nuclear facilities and activities. It involves collection of information from incidents and events occurring in nuclear facilities.

Terminology	Definition
Special Nuclear Material (SNM)	Plutonium-239; Uranium-233; Uranium enriched in the isotopes 235 or 233; any material containing one or more of the foregoing but excluding radioactive source material.
Structures, Systems and Components (SSCs)	Structures, systems, and components important to safety in nuclear power plants.
Stress Corrosion Cracking (SCC	The growth of crack formation in a corrosive environment. It can lead to unexpected sudden failure of normally ductile metal alloys subjected to a tensile stress, especially at elevated temperature. SCC is highly chemically specific in that certain alloys are likely to undergo SCC only when exposed to a small number of chemical environments.
Thermal fatigue	Thermal fatigue is a specific type of fatigue failure mechanism that is induced by cyclic stresses from repetitive fluctuations in the temperature of equipment. The degree of damage is affected by the magnitude and frequency of the temperature swings.
Vitrification	Vitrification is used in disposal and long-term storage of nuclear waste. Waste is mixed with glass-forming chemicals in a furnace to form molten glass that then solidifies in canisters, thereby immobilising the waste.