Office for Nuclear Regulation

Approach to regulating innovation

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1 Foreword

In 2018, government and industry signalled their ambitions for the nuclear sector through the Nuclear Sector Deal, placing a keen emphasis on innovation. More recently Government's White Paper on Regulation for the Fourth Industrial Revolution set out the need for regulation that supports innovation, while protecting citizens and the environment. We recognise that as a regulator, we have an important role in minimising regulatory uncertainty and burden around innovation. It's why our Strategy 2020-25 sets out our intention to embrace innovation, new approaches and technologies in how and what we regulate, share best practice, and encourage dialogue by engaging widely to promote awareness and understanding.

The UK's goal-setting regulatory regime, which is technology-neutral and does not seek to prescribe design solutions, already provides a constructive, but safe environment within which innovation can thrive. Underpinned by our enabling regulatory philosophy, we can support industry to realise the benefits of new technology and novel approaches by providing a stable, yet progressive, regulatory environment that enables the delivery of cost-effective safety and security. From next year, this will include nuclear safeguards too, when we become the nuclear safeguards regulator.

This publication sets out our approach to innovation, building on our enabling philosophy so that we regulate using practices and behaviours that embrace new ideas where it is safe to do so. It describes how we are open-minded and responsive and how we will continue to engage with a wide range of stakeholders, both nationally and internationally, to facilitate the implementation of inventive solutions.

It provides case studies where we have implemented new and novel approaches ourselves, and where we have enabled the adoption of innovation in industry to help deliver positive outcomes. It also highlights the steps we will now take to ensure we remain effective and do not become a barrier to future innovation, while maintaining high standards of safety and security.

Industry, government and regulators all have roles to play in creating and sustaining the conditions where innovation can flourish. Engaging actively and constructively with stakeholders enables us to properly consider the needs of industry, so modernisation and innovation can enhance safety and security.

That requires us to work together in a way that is agile and flexible to achieve successful outcomes. But that cannot be at any cost. While innovation is important to realise government and industry ambitions, we will – as an independent regulator – continue to act objectively to ensure people and society are properly protected.

Mark Foy
Chief Nuclear Inspector

2 Background and context

Innovation in design and technology has been a significant feature of the civil nuclear sector, with the UK often at the forefront of developments that have enhanced nuclear safety and security. The Nuclear Sector Deal makes clear that the industry has a role to play in its clean growth strategy.

It outlines a vision for a UK nuclear sector that generates reliable, secure, low-carbon power, but which achieves significant reductions in the cost of new build projects to ensure it remains competitive with other sources of low-carbon technology, and secures major reductions in the cost of decommissioning projects. Innovation is crucial in enabling the industry to meet these challenges and maintaining the high standards of safety and security performance we expect.

Our Strategy 2020-25 pledges our commitment to embrace innovation, new approaches and technologies in how and what we regulate. Over the next five years we will engage industry bodies, supply chain and potential investors to promote consistent awareness and understanding of our enabling approach and regulatory innovation. We will also strengthen our relationships with academic institutions to inform our capability, research and decisions.

Regulatory processes are often cited as a barrier to innovation, with a perception that regulators are naturally risk-averse and reluctant to accept novel techniques or approaches, or that the regulatory processes associated with new technologies must be long and complex. Rather than being a barrier to innovation, as a modern progressive regulator, we are committed to regulating in a way that facilitates technological advancements, providing adequate justifications are in place to protect society by securing safe nuclear operations.

We have a significant role to play in helping to support and advance innovation across the sector and our goal-setting, technology-neutral regulatory regime positions us well for this. We believe that we have broken ground with our enabling approach on this, as illustrated by the case studies in Appendix 1.

Building on this positive start, there is more that we can do to support innovation. Through our regulatory approach, we intend to provide an environment that will foster creative thinking and solutions by focusing our practices and behaviours on four principles:

- being enabling, accessible, open-minded and providing stimulating challenge;
- working collaboratively;
- being adaptable and responsive to our environment and the needs of others; and
- horizon scanning, so we better understand future demands and technologies.

These are discussed further in Section 3.

What do we mean by innovation?

Our definition of innovation is broad and goes beyond just technical innovations, to cover any new initiatives or novel approaches that address a specific need that can bring benefits. This may encompass new ideas associated with financing, how we consider risk, the role of nuclear energy (eg in heat, hydrogen and isotopes), how safety cases are produced and how organisations and the supply chain are positioned to build capacity and capability.

We have made important strides in recent years to help progress developments in areas such as these. We now want to be more proactive in how we work to open up the innovation debate. We hope this publication will begin building that momentum.

Nuclear Sector Deal

Many of the changes and initiatives prompted by the Nuclear Sector Deal will be the responsibility of industry to deliver, but regulators also have a key role to play. We are therefore open to discuss creative or new ideas so that our regulation, processes, procedures and behaviours do not stifle creative thinking or create unreasonable barriers.

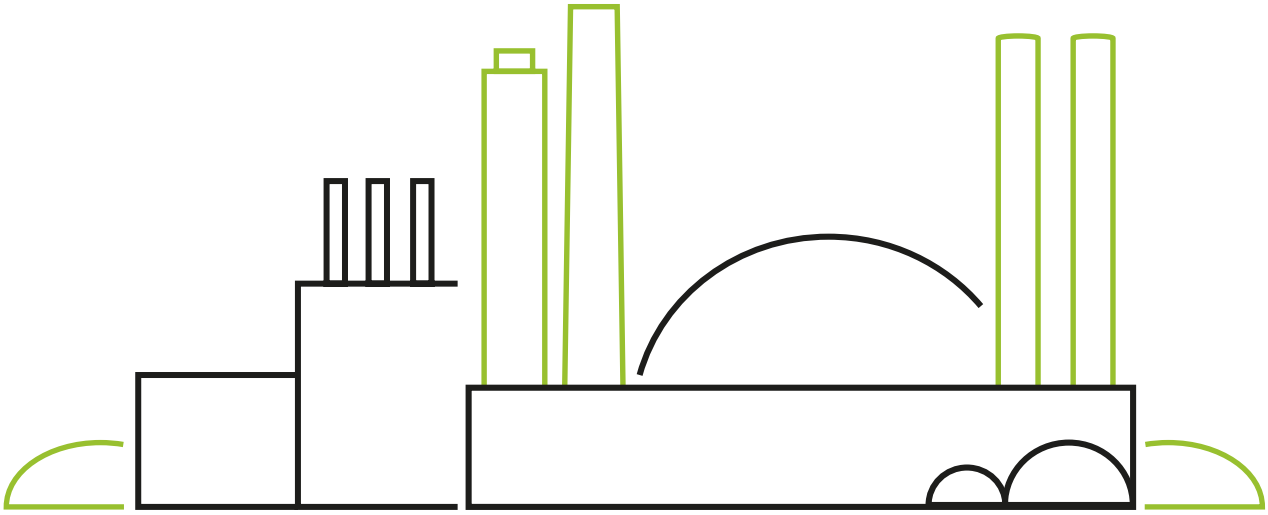
Early engagement with industry and the supply chain is a priority for us, to foster an environment that facilitates innovation through clear understanding of common goals and what is required to achieve them. We will also look at ways in which our assessment processes can be accelerated, removing unnecessary bureaucracy, while remaining fit for purpose, robust and independent.

Regulation of the Fourth Industrial Revolution

The Government's White Paper 'Regulation for the Fourth Industrial Revolution' acknowledged the powerful impact regulation has on innovation. It identified the need for the UK to reshape its regulatory approach so that it supports and stimulates innovation that benefits citizens and the economy, and set out the following six challenges to address:

- to be on the front foot in reforming regulation in response to technological innovation;
- to ensure that our regulatory system is sufficiently flexible and outcomes-focused to enable innovation to thrive;
- to enable greater experimentation, testing and trialling of innovations under regulatory supervision;
- to support innovators to navigate the regulatory landscape and comply with regulation;
- to build dialogue with society and industry on how technological innovation should be regulated; and
- to work with partners across the globe to reduce regulatory barriers to trade in innovative products and services.

Through our enabling approach, we are already responding to many of these challenges, but we want to go further. We intend to adopt a more agile approach to regulation through practices and behaviours, alongside practical steps, which can support innovation while continuing to protect society.



3 Practices and behaviours for innovation

Our goal-setting, technology neutral, regulatory regime already provides flexibility to encourage innovation, and is supported by our enabling approach. Over recent years that approach has demonstrated how we can adapt to different ways of working to deliver successful outcomes.

We intend to take a leading role in meeting the six challenges set out in 'Regulation for the Fourth Industrial Revolution' by focusing our practices and behaviours across four principles:

i) Being enabling, accessible, open-minded and providing stimulating challenge

Published in 2018, our 'A Guide to Enabling Regulation' places essential behaviours at its core that will serve to provide a positive environment to encourage innovation. Importantly, all of our inspectors are expected to act with a willingness to address barriers, distractions and unnecessary bureaucracy.

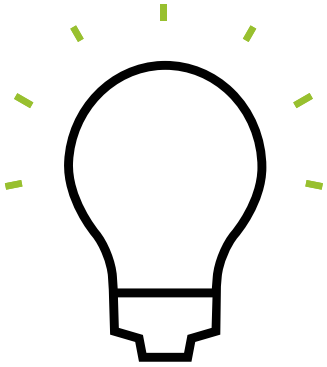
Being outcome-focussed, ensuring solutions are fit for purpose, and undertaking constructive, open and early engagement to avoid surprises and build trust, will all be prominent in our approach to considering innovative methods and solutions to address problems and deliver benefits. We'll also continue to take a 'programme or holistic' approach to reducing risks to as low as reasonably practicable (ALARP).

We'll also improve our accessibility and visibility. We know that **regulators** are often asked to become involved in projects late in the process, when much of the thinking and design has been done. This can lead to delays and potentially increase costs if changes have to be made to meet safety and security requirements.

Early access to regulatory advice in the design of innovative solutions can help industry and the supply chain to have a better understanding of what is required to demonstrate that appropriate standards can be met, and enable us to identify where we may need to adapt our approach.

We recognise that some stakeholders have preconceived ideas of what a regulator will and will not accept. This can result in overly conservative thinking when considering how best to develop a design solution or achieve a desired outcome. The risk is that the status quo is maintained, limiting the introduction of new, more effective solutions. In some instances it may even lead to a solution being overly designed. Early discussion with the regulator helps to clarify expectations.

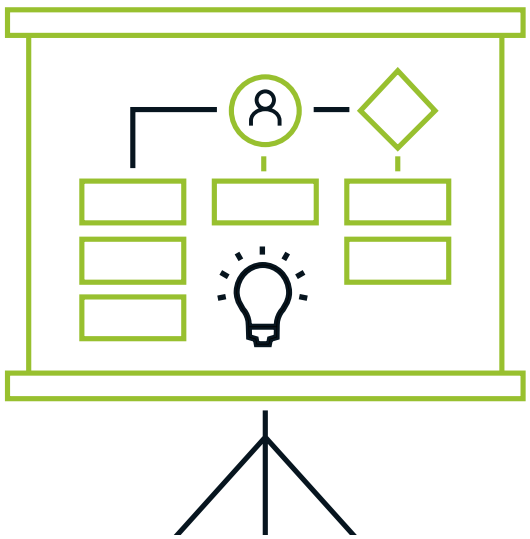
Greater proactivity by us to engage early and open minded with industry, the supply chain, research institutions, professional bodies and academia, means we will better communicate how effective technologies, products, processes and services can be introduced successfully. We want to help reduce uncertainties and costs and encourage the development of innovative solutions that meet the safety and security standards required. By being more accessible at an earlier stage in development, we'll be able to better understand the challenge and guide the development of demonstrations. We can also provide challenge and encouragement to stimulate greater consideration of unique and inventive, fit for purpose solutions.



We acknowledge that for some stakeholders there isn't always a clear and easy route to approach regulators to test initial thinking and ideas. For this reason we will establish an 'Innovation Cell' within ONR, whereby stakeholders can have access to us to freely discuss their innovative ideas with experienced, open-minded inspectors, able to provide advice and guidance, without any prejudice to our regulatory position.

We also see benefits in sharing innovation case studies more widely, notwithstanding commercial confidentiality requirements, to provide stakeholder confidence that we are open to innovation. We want to increasingly be recognised as a regulator that actively encourages innovation and enables creative thinking.

That means engaging with other regulators and other sectors to identify and share good practices, innovative approaches and proven solutions that could potentially benefit safety and security in the nuclear industry. We will explore the benefits of deploying the 'sandbox' concept, which is used in the financial sector for testing ideas and design solutions. Such an initiative would allow stakeholders to test technical developments safely and securely, before committing significant effort to their deployment.



ii) Working collaboratively

Many organisations across the industry are considering how best to develop and adopt innovation, engaging widely and developing individual strategies. Many are directly supporting the ambitions of the Nuclear Sector Deal.

We will work collaboratively with these organisations to improve access to early regulatory advice, and to increase co-operation and deliver successful outcomes, without compromising our independence.

We will continue to work with domestic and international organisations, connecting widely across the regulatory community, on how we can improve consistency of approach, reduce regulatory burden and achieve common positions on technical matters. This could help to reduce risks in deploying innovative approaches on a global scale.

The Global Nuclear Innovation Forum held in South Korea in 2019 prioritised what it considered to be the industry's four most critical innovation technologies or processes, namely:

- making better use of 'big data', data analytics and artificial intelligence already available in the nuclear power sector to optimise maintenance;
- using more innovative frameworks for information exchange, to share data on research and development, operations and maintenance;
- digital twinning – the virtual recreation of a process into a computer-based model – to improve nuclear power plant performance, safety and to reduce costs; and
- utilising advanced manufacturing, including 3D printing, to address supply chain challenges.

We recognise the potential benefits each of these can bring to the industry, and importantly to nuclear safety and security performance. Our professional leads and technical specialists will continue to work with industry groups to facilitate the development of these approaches and aid their successful introduction, helping to overcome barriers that could prevent their benefits being realised.

iii) Being adaptable and responsive to our environment and the needs of others

As the nuclear landscape continues to evolve and change, we will need to be even more agile in our response by enabling innovation while protecting society.

In our Strategy 2020-25, we have committed to better consider the economic impact of our regulatory decisions on those we regulate. This is in response to **independent advice** and will enable us to reinforce how we adopt a targeted and proportionate approach to the decisions we take and what we ask of licensees and other dutyholders. It also provides a sound basis for our interactions with industry on innovation and the need for optimised, fit for purpose solutions.

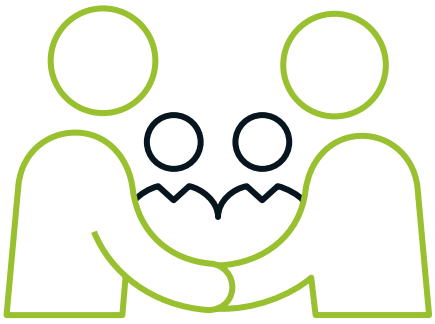
The positive progress in hazard and risk reduction projects at Sellafield over recent years was made possible by adapting our approach, adopting creative thinking and enabling innovative solutions to the many challenges the site faced. Our innovative regulatory strategy-influenced programme acceleration and dramatic progress in the remediation of its legacy facilities (see Case Study 2). This mindset will characterise how we'll approach innovation:adapting and responding to the environment and circumstances around us to achieve safety and security outcomes that protect society.

iv) Horizon scanning so we better understand future demands and technologies

More effective horizon scanning will be fundamental, so we can better assess the future demands from the industry, including technological developments that we need to prepare for. This will enable us to enhance our skills base where necessary, or consider any adjustments to our regulatory processes. Our refreshed guide for **Generic Design Assessment** is an example of how we've developed our assessment processes for varying maturities of reactor technologies. We've also shown recently how we develop our internal capability to complete meaningful technical reviews on a whole range of advanced modular reactor designs.

Through our professional leads and technical specialists we will engage via stakeholder networks, in and outside the industry, to share information, learn, advise and consider future regulatory capability and processes.

Where networks are not readily available, we will work with the nuclear sector, at national and international levels, to foster opportunities to promote wider discussion on innovation and how it can drive improvements in safety and security.



4 A plan for innovation

Turning our ambition into action, we propose to address the challenges in 'Regulation for the Fourth Industrial Revolution' by taking the following steps over the next five years:

i) Be on the front foot in reforming regulation in response to technological innovation

We will address this through routine regulatory engagements with licensees and other dutyholders, but importantly also through our proactive horizon scanning and engagement with stakeholders. We have established links with industry, but we are also developing closer cooperation with National Nuclear Laboratories, the Nuclear Advanced Manufacturing Research Centre , other research establishments and academia to enable early identification of reform or adjustments that may be required to our existing regulatory framework.

ii) Ensure that our regulatory system is sufficiently flexible and outcomes-focused to enable innovation to thrive

We will further enhance our training to ensure that our enabling regulatory approach, which is critical to individual inspectors being receptive and open to innovation, is adopted and embedded consistently across ONR. Specific training will be supplemented with appropriate guidance and instruction to ensure all are fully capable and confident to support the development of innovative approaches in line with UK law. We will also provide members of our 'Innovation Cell' with bespoke training to ensure they are well positioned to work effectively with innovative businesses, provide stimulating challenge and able to foster and promote innovative regulation within ONR, where it is safe to do so.

We will actively seek feedback from industry on our approach as it evolves, and will work closely with other regulatory bodies to share good practice and develop common approaches to innovation, if appropriate.

iii) Enable greater experimentation, testing and trialling of innovations under regulatory supervision

Our 'Innovation Cell' will provide stakeholders with access to a safe space in ONR where they can freely discuss their innovative ideas and seek advice and guidance. This may involve identifying an appropriate project that could be progressed via a 'sandbox' approach to enable safe and secure trialling and testing with ONR oversight.

There are many decommissioning and new build activities under development where we will consider this approach and the benefits it would bring. We will work with industry to develop the details of the methodology needed to test and trial proposals, providing advice and guidance regarding modifications needed to ensure that it can be deployed effectively and operate safely.

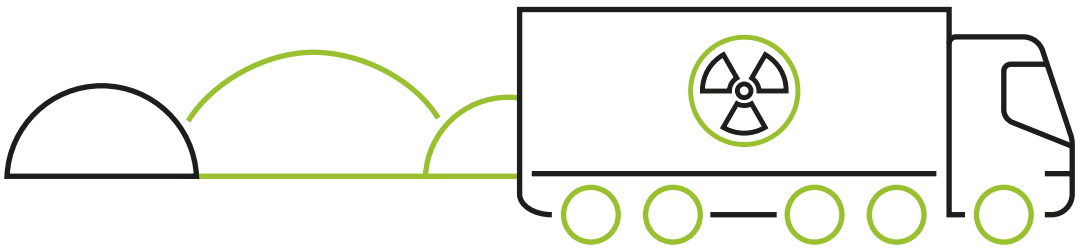
iv) Support innovators to navigate the regulatory landscape and comply with regulation

The following bodies have pledged their support to encourage innovative ideas and approaches:

- **Nuclear Industry Council (NIC):** a joint forum between government and industry that has been charged with driving forward change across the industry to realise the opportunities presented by the Nuclear Sector Deal. A major part of this work is being undertaken by specific working groups looking at finding new and innovative ways of doing things.
- **Nuclear Industry Association (NIA):** the trade association for the civil nuclear industry in the UK, representing more than 250 companies across the UK's nuclear supply chain.

- **Nuclear Advanced Manufacturing Research Centre (NAMRC):** a collaboration of academic and industrial partners from across the nuclear supply chain, with the mission of helping UK manufacturers win work at home and internationally.
- **Nuclear Skills Strategy Group (NSSG):** accountable for developing a Nuclear Skills Strategic Plan to address the key risks to skills and resources facing the industry. Having the right skills and capability across the industry is fundamental to the success of innovation.
- **Nuclear Innovation and Research Advisory Board (NIRAB):** in partnership with the **Nuclear Innovation and Research Office (NIRO)** provides independent, expert advice to government on the research and innovation needed for nuclear energy to play a significant role in the UK's future low carbon and secure energy mix.
- **National Nuclear Laboratory (NNL):** a UK Government owned and operated nuclear services technology provider covering the whole of the nuclear fuel cycle. It has hosted a number of regulatory round table events, bringing together regulators and safety directors from a wide range of high hazard sectors, to explore how to drive efficiency into the regulatory system and remove regulatory process barriers to innovation.
- **Nuclear Energy Agency (NEA):** an intergovernmental agency that facilitates co-operation among countries with advanced nuclear technology infrastructures to seek excellence in nuclear safety, technology, science, environment and law. It has developed Nuclear Innovation 2050, which is designed to help set global nuclear fission research and development priorities and foster their implementation, as well as identifying opportunities for enhanced international co-operation.

We have good links with each of these bodies and organisations, and will be more visible to better communicate our positive stance for innovation. We expect this to enable debate and facilitate the adoption of innovative solutions, while building understanding of regulatory expectations and promoting compliance with the regulatory framework. This will be in addition to our ongoing engagement with licencees and other dutyholders directly, as well as through the Safety Directors' Forum, to ensure awareness and understanding of our intentions.



v) Build dialogue with society and industry on how technological innovation should be regulated

We will utilise the networks highlighted in (iv) to identify where there are options to improve our regulation of technological innovations to better effect. We also welcome ideas and feedback from our Chief Nuclear Inspector's Independent Advisory Panel, our Non-Government Organisation (NGO) Forum and other stakeholders on how we should consider and regulate innovation.

We will use our relationships with regulators from other sectors to share experiences about innovations and how they are regulated elsewhere. Membership of the UK's Health and Safety Regulators' Network provides us an opportunity to share regulatory experience and practice already, and we want to continue to foster close working relationships to deliver effective outcomes in an aligned and efficient manner.

Our dialogue with Government's Better Regulation Executive remains important too, especially given its work on how regulators can better facilitate innovation. And, as set out in our Strategy 2020-25, informing UK policy through close working with government remains essential, especially in considering any proposals for regulatory reform that maybe necessary to enable innovation that improves nuclear safety and security performance.

vi) Work with partners across the globe to reduce regulatory barriers to trade in innovative products and services

Through our established links with many other nuclear regulators across the globe and organisations such as the International Atomic Energy Agency (IAEA), we will continue to share ideas and approaches to identify best practices to help support innovation. This activity has been a critical part of our recent work to develop regulatory capability in small modular reactors (SMRs), enabling us to undertake meaningful and objective assessments of a range of reactor technologies on behalf of the government.

An emerging theme internationally is the ambition by a number of prominent national nuclear regulatory bodies to develop harmonised codes and standards that can be used to assess designs and technologies in their respective countries. Applying similar regulatory standards across multiple countries could enable deployment of innovation on a global scale, with minimal design change. We will continue to collaborate with our fellow regulators on this work.

5 Conclusion

Our mission is to protect society by securing safe nuclear operations. That means our overarching approach is to enable innovation, while maintaining high standards of safety and security.

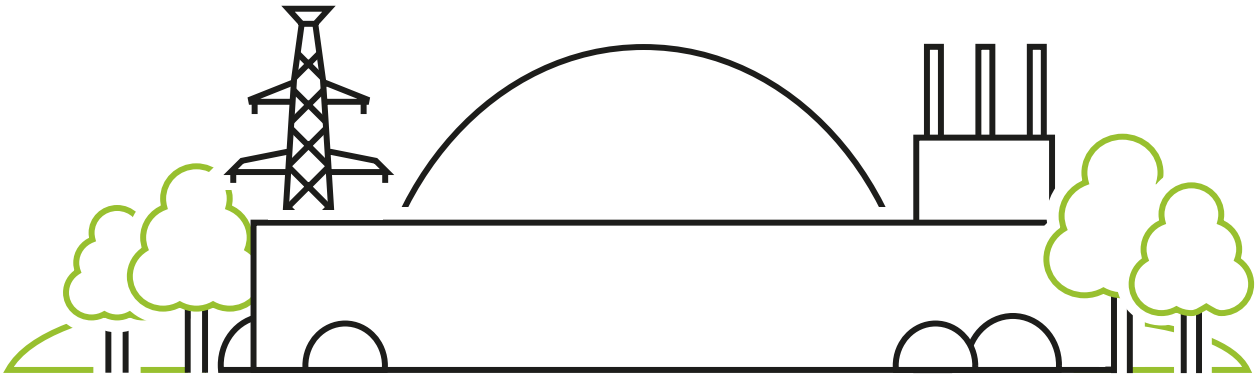
We will be proactive in doing more to communicate our openness to innovation and explain how we see ourselves as an enabler to the industry adopting creative solutions and new ways of working. This includes how more effective technologies, products, processes and services can be introduced successfully across a diverse range of applications to positive effect.

We will ensure that we remain open-minded and impartial, working constructively and collaboratively with a wide range of stakeholders so that new techniques and novel solutions can be properly developed and implemented to the benefit of society.

This will extend to providing meaningful support and early engagement to initiatives under the Nuclear Sector Deal, which we anticipate will promote efficient and effective solutions to more readily satisfy regulatory expectations and standards.

We want to promote a culture that encourages early dialogue with us, allowing us to reaffirm the need for, but also influence the development of, fit for purpose solutions that avoid complexity and over-engineering. This is in no way to diminish standards, but rather to illustrate the benefits that can be secured by focusing on those elements that necessitate the highest standards, and avoiding a 'nuclear premium' where this is not necessary.

By being enabling and accessible, working collaboratively, being more adaptive and responsive and using more effective horizon scanning, we intend to work more effectively with industry and wider stakeholders to foster innovation in a safe and secure way.



Case Study 1 – Adoption of hydrodynamic seals for Reactor Coolant Pumps at Hinkley Point C

Background

Failure of the Reactor Coolant Pump (RCP) seals in Pressurised Water Reactors (PWR) has been a topic researched by reactor vendors, operators and regulators for many years, with various improvements made to reduce the likelihood. The seals are designed to minimize reactor coolant leakage along the RCP shafts, and failure can lead to loss of integrity of the primary coolant system pressure boundary. These faults can occur during both normal operation and off-normal conditions involving loss of seal cooling.

Leak rates resulting from the loss of RCP seal integrity may exceed the capability of the reactor coolant makeup system. This means that the failure of RCP seals can potentially lead to more significant accidents involving the loss of reactor coolant.

The EPR™ reactor design under construction at Hinkley Point C (HPC) initially included hydrostatic (HS) seals in the RCPs, which has been the case for the majority of PWRs, including Sizewell B. However, the EPR™ vendor, Framatome, has been looking to take an innovative approach and adopt hydrodynamic (HD) seals used extensively in non-nuclear applications, and to a limited extent in PWRs. Framatome's preference for using HD seals for new build is because it believes the seals will result in improvements to nuclear safety, lead to more stable and predictable behaviour and result in longer lifetimes, therefore reducing worker exposure during maintenance.

There are however known risks arising from the use of HD seals, for example the increased potential for hydrogen accumulation. Justification for adoption of such technology is therefore not straightforward. Nevertheless, NNB Generation Company (HPC) Limited (NNB GenCo), the HPC new build licensee, is developing the robust safety justification needed to enable it to install the HD seals, which will be a first-of-a-kind for the EPR™ and is a departure from the reference plant, Flamanville 3.

Innovation in practice

Framatome has been working closely with the HD seal manufacturer for a number of years to ensure that adequate qualification testing was completed to demonstrate the robustness of the seals during normal operation and accident conditions. NNB GenCo scrutinised the justification put forward for the HD seals and, through regular engagement with ONR specialists in mechanical engineering and fault studies, discussed the developments.

We instigated an intervention plan to gain confidence in the validity of the licensee's claims for this technical change, given its significant nuclear safety functional requirement. The first phase of the intervention was completed in summer 2019, considering the adequacy of the licensee's arrangements, and those of its supporting organisations, for the development and implementation of the design and safety case modifications for the HD seals. The second phase, still to be completed, will focus on the manufacturing and procurement activities associated with deploying the seals at HPC. Through early, proactive engagements we have been able to examine the innovative solution, review the results of early testing and consider its implications for HPC. This approach has enabled increased regulatory confidence that the solution will have benefits for nuclear safety and reduce maintenance costs at HPC.

Should the development of the technology and accompanying assessments continue to progress satisfactorily, EDF Energy is likely to replicate the use of HD seals for the Sizewell C EPR™. Depending upon early operational experience of HPC, our specialists are forming the opinion that such technology may become relevant good practice for reducing nuclear risk to as low as reasonably practicable.

Case Study 2 – Innovative strategy for regulation of hazard and risk reduction at Sellafield

Background

In 2014, we introduced a new and innovative regulatory strategy to facilitate and encourage hazard and risk remediation while maintaining adequate safety standards. This strategy aimed to identify the key barriers to success, and, by working collaboratively with stakeholders, developed innovative ways of working that led to unparalleled levels of progress in remediation of the legacy storage facilities at the site.

Although this approach was first developed a number of years ago, it is still used today and attracts positive feedback nationally and internationally. The strategy was based around a number of themes that included effective prioritisation of activities to help focus attention, removing unnecessary bureaucracy to allow work to proceed at pace, removing unnecessary demands that have the potential to divert attention away from the overriding priorities, and the development of fit for purpose solutions, to ensure that work was not over-complex and achieved maximum value in terms of delivery, reliability and operability.

Innovation in practice

Collaborative working was at the heart of the success. Six key stakeholders had a high interest in reducing the significant off-site risk posed by a number of legacy facilities at site. Too often though stakeholders had their own individual objectives and goals and worked separately to achieve them, creating conflicts and stifling progress. The group that came together was informally known as the 'G6' and included: Department for Energy and Climate Change, (predecessor to Department for Business, Energy and Industrial Strategy); Nuclear Decommissioning Agency (NDA); Sellafield Limited; Environment Agency; UK Government Investments and ONR. This group worked together to identify and agree the strategic drivers and innovations that led to the adoption of a mutually agreed common purpose that was to accelerate risk and hazard reduction at the Sellafield site.

Supporting this group was the 'G6 Engine Room' to help work through some of the cultural and behaviour attributes that were hindering prioritisation of projects and activities. The Engine Room attempted to address this problem by identifying a number of specific, short-term activities to illustrate a different mindset from all G6 stakeholders and put into practice the themes that had been initially set out in our strategy. Within a matter of months, successful delivery of projects was beginning to have the desired effect. One example involved the removal of used fuel from one of Sellafield's legacy ponds. Some issues arose regarding the export route out of the pond, but with constructive working from all G6 stakeholders, these were addressed and the export of fuel from the pond began for the first time in many decades.

The impact of this innovative collaboration is evident, with progress across the site, especially in hazard and risk reduction of the legacy ponds and silos.

We have since used the innovative 'G6 format' for other high-profile and challenging projects to foster constructive working between stakeholders. By agreeing at the most senior levels a common purpose, we've seen tangible progress that benefits nuclear safety.

Case Study 3 – Implementing Proportionate Regulatory Control

Background

Since 1960, we have de-licensed 14 nuclear sites in Great Britain. The current site clean-up standard to enable de-licensing is set out in the Nuclear Installations Act (NIA) 1965 (ie 'no danger from ionising radiations'). This has not changed in decades and the process delivers a very clean site radiologically which can be re-used for any purpose. But this exacting standard does not take into account the significant conventional health and safety risks associated with intrusive site clean-up activities. Nor does it consider the off-site environmental impact of removing and transporting virtually all radioactive material, including low-level and very-low-level radioactive waste, from the site for disposal elsewhere in another part of the country.

There was general consensus from government and industry that an alternative approach was needed and an innovative project entitled 'Proportionate Regulatory Control' (PRC) was established in 2016.

Innovation in practice

It was recognised that parties involved in de-licensing had not been acting disproportionately but within the constraints of the legislation. So working with government, NDA and other regulators, we've sought through the PRC project to use innovative thinking to improve the legislative and regulatory framework for the final stages of decommissioning and clean-up of nuclear sites. The intention is to allow these sites to de-license earlier by taking a more proportionate approach that recognises the residual risks on the sites in the final stage of their lifecycle are relatively small and thus don't require the full controls and requirements of the nuclear site licensing regime. In practice, this would mean regulation at that stage could be passed to more appropriate bodies, such as the health and safety and environmental regulators.

A change in the law will be needed to implement PRC, but if the policy is implemented, it could provide licensees with an alternative two-stage route out of the nuclear licensing regime. First, we will be able to end the licensee's period of responsibility when radioactive inventory and safety risks have been reduced in line with a new limit, based upon levels outlined in the Paris Convention on nuclear third-party liability. After that, when the licensee has demonstrated to our satisfaction that nuclear safety and security matters on site have been fully resolved, we will be able to decide whether to accept the licensee's application to surrender its licence. We will have a new duty to consult the relevant health and safety and environmental regulators before revoking a licence, to ensure that any concerns are fully addressed before the handover.

Three of the NDA's sites at Winfrith, Trawsfynydd and Dounreay have been participating in a 'Lead & Learn' project to anticipate and plan how they might benefit from the proposed changes. Initial results have been very encouraging with particularly good progress being made towards identifying optimised site end states that meet a single set of environmental standards and regulations, with no concerns for nuclear safety. Over the same period, the UK Government has consulted on the proposals and has advised it now intends to make the necessary changes to the Nuclear Installations Act. In ONR, we are now developing new guidance on how we will apply these new arrangements.

Through collaborative working and sharing of ideas, this proposed change could deliver significant improvements to our safety and environmental protection regulatory frameworks, and has the potential to drive cost reductions that could enable funds to be supporting other decommissioning priorities in the future.

Case Study 4 – Use of intumescent coating on transport packages

Background

We regulate the safety and security of radioactive materials transportation by road and rail in Great Britain. In this role, we grant approvals for package designs, after examining the safety submission from the dutyholder and being satisfied that the design complies with the applicable International Atomic Energy Agency (IAEA) transport regulations.

Our routine regulatory work includes assessing transport packages that are being used to transport cans of Special Nuclear Materials (SNM) within the UK. The SNM contents are heat-generating and contain polyvinyl chloride (PVC) bagging that, at elevated temperatures, could degrade at a rate which may challenge the integrity of the package containment. For both package designs, PVC degradation is minimised by limiting the heat outputs of the SNM contents and/or transporting the packages in refrigerated International Organisation for Standardisation (ISO) containers.

One type of transport package incorporates an intumescent coating on its outer walls. This design means that should a fire occur, the coating swells up to provide an effective insulating barrier between the fire and the package.

Intumescent coating is used internationally and extensively in the oil, gas, petrochemical and power generation industries to protect steel structures from the effect of fires. It has also been used in the aerospace industry to protect spacecraft during re-entry. However, it had not been used widely in the nuclear industry when it was proposed to us. From early discussions with international counterparts, it was clear that the use of intumescent coating as thermal protection for transport packages would be novel.

Innovation in practice

Given the innovative use of intumescent coating as thermal protection, we embarked on a series of activities to provide confidence in the applicability of the design. Our open-minded approach characterised our key actions, which included

- early and proactive engagement with the package design authority to explain our regulatory expectations in respect of the safety function requirements for the coating;
- seeking assurance, through review of plans and attendance at prototype testing, that the package would meet transport regulations; and
- inspecting the facilities and management system arrangements for the manufacturer of both the intumescent coating and the organisation that applied the coating to the packages. This inspection was to ensure that there would be no regulatory concerns about the consistency in the manufactured quality of the intumescent coating, or about the procedures for applying the coating to the packages.

Our regulatory oversight enabled the successful introduction of intumescent coating into transport package design. Furthermore, supporting this innovative engineering design has led to an improvement in nuclear safety for the transport of certain high heat generation SNM in the UK. Early acceptance of this design by us, as an internationally respected regulator, may now provide confidence that it can be used to enhance nuclear safety elsewhere.

Case Study 5 – Development of nuclear safety significant ventilation extract systems that use complex commercial off-the-shelf variable speed drives in motor control applications

Background

Sellafield Limited was required to enhance the condition of a ventilation extract system to one of its legacy storage facilities, as there was an unacceptable risk of a loss of containment of radioactive material. The proposed modifications included replacing the fans' electrical supplies, the motors and their associated control gear (including the mechanical drive equipment) with innovative variable speed drive (VSD) controllers. This was instead of the direct-on-line (DOL) controllers that had operated the fans at fixed speed. Whilst VSDs for motor control are well-established in non-nuclear industrial applications, as an 'off the shelf solution', their application here was considered to be novel. Although Sellafield Limited identified clear benefits for using VSDs, it also acknowledged the introduction of new failure modes: for example, a fan running faster than it is designed for could potentially cause catastrophic failure of the fan and/or damage the containment boundary. Appropriate measures to prevent these faults were considered essential by ONR.

Innovation in practice

Our early engagement with Sellafield Limited Electrical Control & Instrumentation (EC&I) and ventilation teams allowed proactive discussion on the challenges this innovative solution would bring, in particular the potential fault conditions and impact to nuclear safety systems. Careful consideration was given to the design evidence to substantiate performance claims of the new product. This allowed Sellafield Limited, with our oversight, to methodically work through the identified fault conditions and develop the necessary protection systems. The introduction of simple supplementary safety systems allowed Sellafield Limited to protect against the most onerous fault condition (over-speed of the fan), and in doing so demonstrated that commercial off-the-shelf equipment can be used in novel situations.

Sellafield Limited has derived significant learning from this project, which is now being applied to other projects where VSDs are being integrated into new or refurbished ventilation extract systems. Furthermore, Sellafield Limited is applying the learning gained to develop guidance for VSD-driven ventilation systems. This guidance has the potential to provide benefits across the UK nuclear industry, as VSDs offer many advantages in these types of application. The industry's supply chain partners for electrical and automation equipment, including equipment vendors and system integrators, may also benefit from better understanding the regulatory expectations associated with the use of commercial off-the-shelf equipment in the nuclear sector. In this example, as well as significant advantages to nuclear safety, the application also avoided the need to deploy more expensive and potentially complex alternatives.

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