



Office for
Nuclear Regulation

ONR policy

ONR's pro-innovation approach to AI regulation



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1. Background

His Majesty's Government (HMG) has established a principles-based framework¹ for regulators to interpret and apply to AI within their remits. The following five values-based principles look to guide and inform the regulation of AI in all sectors of the economy:

- Safety, security and robustness;
- Appropriate transparency and explainability;
- Fairness;
- Accountability and governance; and
- Contestability and redress.

The five principles build on and reflect HMG's commitment to the Organisation for Economic Co-operation and Development (OECD) values-based AI principles². UK regulators are expected to demonstrate that they meet the intent of the five principles.

The Secretaries of State for Science, Innovation and Technology, and Work and Pensions, wrote to the Office for Nuclear Regulation's (ONR) Chief Nuclear Inspector (CNI) requesting that ONR publish an update detailing how our regulatory approach aligns with the five principles outlined in the AI Regulation White Paper.

The purpose of this document is to outline how ONR is aligning with the expectations set out in the AI Regulation White Paper.

The scope of the response covers all ONR purposes, namely:

- Nuclear safety;
- Nuclear site health and safety;
- Nuclear security;
- Nuclear safeguards; and
- Safety of transport of nuclear and radioactive materials.

¹ <https://www.gov.uk/government/publications/ai-regulation-a-pro-innovation-approach/white-paper#ministerial-foreword>

² <https://oecd.ai/en/ai-principles>

2. ONR's approach to regulating AI

The UK's goal-setting and non-prescriptive nuclear regulatory regime already provides a supportive environment within which dutyholders can adopt innovative solutions and technologies, such as AI systems, provided that adequate justifications are in place to ensure that nuclear safety and security expectations are met. This goal-setting, outcome focused, risk-based regulatory framework is technology neutral. Therefore, AI is subject to the same regulatory principles as any other technology.

ONR recognises that AI has the potential to improve the safety of current and future nuclear plants and facilities through technologies such as autonomous surveying (e.g., for the clean-up of decommissioning sites and reducing harm to workers), augmented intelligence (e.g., to derive information from plant data to better understand risks), and the optimisation of robotic movements (e.g. to accelerate clean-up and reduce risks to workers and the public).

ONR welcomes the growing appetite from dutyholders for the use of AI, such as for supporting robotics applications in hazardous environments, and in the analysis of maintenance regimes. Examples of this intent are provided in the Nuclear Decommissioning Authority (NDA) group digital strategy³, the Sellafield Ltd AI strategy⁴, and the Nuclear Institute's nuclear white paper on AI⁵. ONR is currently regulating the early use of AI by dutyholders; however, to date, there has been no use of AI in the delivery of critical nuclear safety or security functions within the civil nuclear sector.

We recognise that some stakeholders may have preconceived ideas as to what a regulator will and will not accept. This can result in overly conservative thinking when considering how best to achieve a desired outcome. The risk is that the status quo is maintained, limiting the introduction of new, more effective solutions. As a supportive, enabling regulator, ONR has embarked on a programme of targeted engagement with stakeholders to minimise regulatory uncertainty, convey our open stance to innovation, contribute to the development of relevant good practice, and to encourage safe exploration of the beneficial uses of AI whilst ensuring that risks are managed.

As outlined in ONR's Approach to Regulating Innovation strategy paper (2020)⁶, we have been building our internal capacity and assessing the adequacy of current

³ [The NDA Group Digital Vision and Strategy 2022 to 2025](#)

⁴ [The Sellafield Ltd AI Strategy](#)

⁵ [Empowering the future of UK nuclear industry through AI](#)

⁶ [ONR – Approach to regulating innovation – September 2020](#)

regulatory approaches for the growth in the use of AI. We have established an AI-focused team made up of open-minded specialist safety and security inspectors.

We also commissioned research in 2021 which assessed the suitability of our current regulatory approach to manage risks arising from AI.⁷ This report found that ONR's approach to regulating AI is fundamentally sound, but suggested some enhancements which could make our regulatory approach more targeted and effective. Following targeted improvements informed by these recommendations, ONR has commissioned phase two of this research, which will begin in April 2024. This will explore what regulatory approaches need to be developed to further enable, and respond to, the use of AI in safety, protective security, and cyber security functions. The outputs of this research will be publicly available.

⁷ [ONR-RRR-121- Research into the potential uses of Artificial Intelligence and Machine Learning on UK nuclear licensed sites, and approaches to their substantiation – Phase 1](#)

3. HMG's AI regulatory principles

3.1. Safety, security and robustness/transparency and explainability

Safety, security and robustness: AI systems should function in a robust, secure and safe way throughout the AI life cycle, and risks should be continually identified, assessed and managed.

Transparency and explainability: AI systems should be appropriately transparent and explainable.

3.1.1. Overview

ONR's regulatory framework is outcome-focused and technology-neutral and responsibility lies with the dutyholder to transparently explain how any regulated system operates in a safe and secure way. Explainability and transparency are central to all our regulatory functions, and are prerequisites for credible claims concerning safety and security. ONR has therefore chosen to address these two principles together.

A core function of a regulator such as ONR is to protect the public by ensuring that dutyholders meet required safety and security standards. Our routine regulatory assessments, inspections, and permissioning regime ensure that dutyholders identify, assess and manage safety and security risks on an ongoing basis. Where non-compliance is identified, ONR may take proportionate enforcement action to ensure that dutyholders deal with serious risks immediately, and, going forward, maintain sustained compliance with the law. More information on our approach to enforcement can be found in our Enforcement Policy Statement⁸.

Where safety and security claims are made, dutyholders are expected to substantiate these clearly and transparently. The level of transparency and explainability required for any system or technology is proportionate to the significance of the safety or security claim made against it. For example, where AI systems are used in parallel with conventional measures which can effectively control risk, the level of explainability required would be limited to an expectation that the dutyholder demonstrate that, if the AI failed to perform as expected, it could not lead to a negative safety or security outcome. If an AI system performed a safety or security critical function, the level of explainability expected would be correspondingly higher.

⁸ <https://www.onr.org.uk/documents/enforcement-policy-statement.pdf>

It is crucial that dutyholders understand and are able to explain the potential impact of the failure of AI systems which affect safety and security. There is an important trade-off between constraining the application of AI to such an extent that its usefulness is limited, and recognising when failure can be tolerated and when it cannot.

ONR expects that concepts already used by dutyholders in ensuring nuclear safety for non-AI technologies, such as hierarchy of control, defence in depth, and the use of an independent system, are applied when AI systems are deployed in safety and security functions.

3.1.2. Stakeholder engagement

ONR has an important role in supporting and advancing innovation across the nuclear sector. To this end, we actively pursue a collaborative and open relationship with industry, research institutions, professional bodies, academia and other regulators as an essential aspect of our approach to enabling the safe deployment of new technologies, including AI.

Through targeted engagement with these key stakeholders, ONR works to minimise regulatory uncertainty, contribute to the development of relevant good practice, and encourage safe exploration of the beneficial uses of AI whilst ensuring that the risks are managed. This engagement also serves to build our internal capability through shared learning and constructive challenge.

Highlights from our proactive programme of engagements are provided below:

- Participation in a five-year, UK Research and Innovation (UKRI)-funded research project, 'Robots and Artificial Intelligence in Nuclear' (RAIN). Through a consortium of ten UK universities, multiple nuclear licensees and UK regulators, the project sought to accelerate the development of UK robotics for the nuclear industry, with a focus on demonstrating quantitative benefits against real-world use cases. This enhanced dutyholders' understanding of how best to deploy AI and robotic systems, and how to structure safety arguments. Robots developed through RAIN have been deployed in nuclear facilities in the UK and internationally.
- Participation in the Control and Instrumentation Nuclear Industry Forum (CINIF), a dutyholder funded and operated research group. Through our involvement, ONR has steered independent research into the substantiation of AI for a range of nuclear applications.
- Piloting regulatory sandboxing alongside the Environment Agency to explore the deployment of AI solutions to radioactive waste remediation on the Sellafield nuclear licensed site.
- Provision of advice to the Robotics and AI Collaboration (RAICo) programmes, which explore remote handling, nuclear waste size reduction, robotics and AI data (RAID), and digital infrastructure tools for safer, faster

and more cost-effective decommissioning. RAICo is a collaboration between the UK Atomic Energy Authority (UKAEA), NDA, Sellafield Ltd and the University of Manchester.

- Provision of advice and challenge on the Institution of Engineering Technology's (IET) guidance on the application of functional safety and AI. This guidance, applicable to a wide range of industry sectors involving safety risks, will influence equipment designs which may be used in the nuclear sector.
- Participation in industry events, such as those hosted by the Alan Turing Institute AI Standards Forum, the Nuclear Institute and the Nuclear Decommissioning Authority (NDA). These highlighted the benefits and challenges of AI, and outlined approaches that, under existing regulatory frameworks, are likely to result in successful regulatory outcomes.

3.1.3. International stakeholder engagement

ONR regularly leads on engagements with international partners to build open and constructive relationships, share learning, and to support the development of AI RGP. We do this through active membership of cross-regulator working groups and bilateral agreements.

Examples of our international engagement include:

- Membership of a trilateral working group with the United States' Nuclear Regulatory Commission (USNRC) and the Canadian Nuclear Safety Commission (CNSC) targeting innovation and AI. This group, which focuses on the sharing and comparison of international good practice, is authoring a common paper establishing high-level principles for the regulation of AI. This is scheduled for publication later in 2024.
- Participation in the OECD Nuclear Energy Agency's (NEA) expert group on the application of robotics and remote systems (EGRRS). This group advises member countries on how they can facilitate the implementation of robotic and remote systems (RRS) in radioactive waste management, decommissioning and legacy management at the national and international strategic levels.
- ONR chaired a week-long International Atomic Energy Agency (IAEA) working group in Vienna in October 2023, involving 67 participants from 25 countries. This identified factors relevant to the use of AI in nuclear safety applications and the potential benefits and challenges of deploying AI. This led to an IAEA Technical Document (TECDOC), "Safety Implications of the Use of Artificial Intelligence on Nuclear Power Plants". ONR is taking a leading role in the drafting and editing of this document which will be published in late 2024.

- ONR has been asked to jointly present our approach to the regulation of AI with the USNRC and CNSC at the G7 countries Nuclear Safety and Security Group (NSSG) in May 2024.

3.1.4. Engagement with UK regulators

ONR regularly engages with UK regulators bilaterally, and through regulatory fora, to share best practice and regulatory approaches, and, where appropriate, to collaborate on projects which aim to build our capability in regulating AI systems.

Examples of our engagement with UK and international regulators include:

- Membership of the National Cyber Security Centre's (NCSC) cyber security regulators' AI working group, which focuses on sharing good practice in the identification and regulation of AI-related security risks to critical national infrastructure (CNI).
- Active leadership and participation in the UK Health and Safety Safety Regulators Network which brings UK health and safety regulators together to learn and share best practices across industrial sectors. The UKHSRN has tasked its innovation subgroup to focus on AI, to develop processes, skills, frameworks for better regulating AI and other innovative technologies.
- Active engagement in the Regulator's Innovation Network (RIN), which enables UK regulators from different industries to share learning and approaches for regulating innovative technology, including AI.

3.1.5. Regulatory sandboxing

ONR views regulatory sandboxing as an invaluable tool which allows dutyholders to test and trial new innovative technologies, whilst participants explore the applicability and suitability of the existing regulatory framework. This process supports dutyholders in making informed decisions on the deployment of new technologies, and helps ONR better understand how we can best regulate, and enable the safe deployment of, AI systems.

Supported by the Regulators' Pioneer Fund, ONR partnered with the Environment Agency to pilot a groundbreaking sandboxing exercise which was applied to two potential uses of AI in the nuclear sector. A diverse panel of experts from inside and outside the nuclear industry developed outline safety cases for the application of AI within the sector. The sandbox is the first applied to nuclear regulation anywhere in the world. The outcomes of this sandboxing were published in November 2023⁹.

⁹ [Outcomes of nuclear AI regulatory sandbox pilot published | Office for Nuclear Regulation \(onr.org.uk\)](https://www.onr.org.uk/news/2023/11/outcomes-of-nuclear-ai-regulatory-sandbox-pilot-published)

ONR has shared the outcomes of our AI regulatory sandbox through multiple cross-government networks and fora, such as the UKHSRN innovation subgroup, and the Regulator's Innovation Network (RIN). We have presented our sandbox findings at the USNRC Regulatory Information Conference (RIC), to the Canadian Nuclear Association, and to the IAEA.

In addition to our sandbox, ONR has convened two wider expert panels to determine the potential uses of AI and how these can be realised within the civil nuclear sector.

3.1.6. Guidance

We recognise the vital role that written guidance plays in supporting dutyholders deploy innovative technologies, such as AI, in a safe and secure way.

ONR provides dutyholders with information on the regulatory principles against which their safety and security provisions will be judged in our safety assessment principles (SAPs¹⁰), security assessment principles (SyAPs¹¹), and supporting guidance documents. Although this guidance is targeted at ONR inspectors, it is published on ONR's website for the benefit of all stakeholders

ONR will update our guidance in response to the emerging and maturing use of AI to minimise regulatory uncertainty. This will be supported by open and early engagement with dutyholders to foster open dialogue, learn about intended applications, explain our regulatory expectations and consider how we may have to adapt.

¹⁰ [Safety Assessment Principles \(SAPS\) - Office for Nuclear Regulation \(onr.org.uk\)](https://onr.org.uk/saps)

¹¹ [Security Assessment Principles \(SyAPs\) | Office for Nuclear Regulation \(onr.org.uk\)](https://onr.org.uk/syaps)

3.2. Accountability and governance

Governance measures should be in place to ensure effective oversight of the supply and use of AI systems, with clear lines of accountability established across the AI life cycle.

3.2.1. Dutyholder obligations

ONR has clear regulatory expectations that proportionate governance arrangements, and associated accountability defined within those arrangements, must exist within dutyholder organisations to ensure that all systems, including AI systems, remain safe and secure throughout their life cycle. This expectation is reflected in our SAPs, SyAPs, and licence conditions.¹²

We expect that effective oversight is facilitated through structured, integrated and diverse means such as self-assessments at facility and department level, internal independent oversight, sophisticated governance structures, external assessments and peer reviews. Dutyholders may wish to discharge some governance responsibility to supply chain organisations; however, legal accountability remains with the dutyholder. We have published guidance on corporate governance for safety¹³, safety leadership¹⁴, and security governance and leadership¹⁵.

ONR assesses the adequacy of governance arrangements, including in the supply chain, through routine regulatory assessments and inspections and through our permissioning regime. Where it is identified that dutyholders do not operate adequate governance frameworks, ONR may make the regulatory judgement that the dutyholder is not meeting their legal duty to reduce risk so far as is reasonably practicable (SFAIRP), or that it is not meeting their licence conditions. In such cases, ONR will take proportionate enforcement action to bring the dutyholder into compliance.

¹² [ONR - Licence Condition Handbook](#)

¹³ <https://www.onr.org.uk/media/odmh3hrv/ns-tast-gd-104.docx>

¹⁴ <https://www.onr.org.uk/media/kzzahmy2/ns-tast-gd-107.pdf>

¹⁵ <https://www.onr.org.uk/media/vczjnfro/cns-tast-gd-11.pdf>

3.3. Contestability and redress

Where appropriate, users, impacted third parties and actors in the AI life cycle should be able to contest an AI decision or outcome that is harmful or creates material risk of harm.

3.3.1. Concerns

ONR uses every possible source of information in driving positive safety and security outcomes across our regulatory purposes, including those that involve the application of AI. One valuable source of intelligence is the raising of concerns by industry professionals and third parties during routine regulatory interactions. These concerns could relate to the planned application, or non-adoption of AI or innovation. They could also involve their exposure to AI where it has been deployed. As appropriate, ONR investigates reported concerns, and feeds back relevant information to the reporting party.

3.3.2. Whistleblowing

ONR also operates a whistleblowing process as a 'prescribed person' under the Public Interest Disclosure Act 1998. This allows for concerns, whistleblowing ("protected disclosures") or complaints to be raised, reviewed, and, if appropriate, acted upon in accordance with our published policies, procedures and guidance.

Concerns can be raised by anyone and can involve the application of AI, but they must relate to a wrongdoing in a workplace in relation to a matter that ONR regulates (nuclear safety, nuclear security, radioactive materials transport, safeguards or health and safety on a nuclear site). Under this framework, individuals are able to raise concerns with ONR under the protection of anonymity.

3.3.3. Complaints and ONR Victims Right to Review Scheme

In line with our obligations under the Regulator's Code¹⁶, ONR operates a process for complaints¹⁷ which relate to ONR or the services it provides. Through this process, third parties can complain where they are unhappy with a regulatory judgement made by ONR which relates to the use of AI.

¹⁶ [Regulators' Code \(publishing.service.gov.uk\)](https://publishing.service.gov.uk)

¹⁷ [Concerns, whistleblowing and complaints | Office for Nuclear Regulation \(onr.org.uk\)](https://onr.org.uk)

In addition, ONR's Victims' Right to Review Scheme¹⁸ (VRR) allows victims to apply for a review of an ONR decision either to not prosecute or to terminate prosecution proceedings. This reflects obligations found in the Code for Crown Prosecutors.

3.4. Fairness

AI systems should not undermine the legal rights of individuals or organisations, discriminate unfairly against individuals or create unfair market outcomes.

ONR recognises the potential for the use of AI, in certain domains, to lead to unfair or discriminatory outcomes. We do not anticipate that the use of AI systems in delivering nuclear safety or security functions within the civil nuclear sector is capable of undermining the legal rights of individuals or organisations, discriminating unfairly against individuals, creating unfair market outcomes or breaching general consumer protection laws. ONR will continue to monitor this, and will revisit this position if appropriate.

¹⁸ <https://www.onr.org.uk/media/kfxh3cl4/onr-enf-in-031.pdf>

4. Summary and forward look

ONR welcomes HMG's principles-based, context-sensitive approach, and are supportive of the proposition that regulation can enable responsible innovation, increase public trust and strengthen the UK's position as a global leader in AI. We look forward to continued engagement across government to learn, share case studies, information on our regulatory approach to AI and, where appropriate, our views on future cross-sector proposals.

As outlined in this response, ONR is already well-aligned to the applicable AI principles set out in the White Paper. However, we understand that further work is needed to ensure we remain adaptable and responsive to the fast-changing AI landscape and the needs of our stakeholders.

Over the next twelve months and beyond, we will continue our programme of targeted stakeholder engagement to support the safe deployment of AI systems, without compromising our independence. We will continue to work with industry, academia and domestic and international organisations to improve consistency of approach, reduce regulatory uncertainty and achieve common positions on technical matters relating to AI.

We will deliver additional sandboxing exercises, along with additional innovation enabling tools, including expert panels and internal innovation cafés to enable open conversations about new technologies and approaches within ONR.

We will continue to build our internal capabilities in relation to AI and will, when appropriate, deploy suitable training through the ONR Academy to ensure that our inspectors are equipped to regulate the use of AI in a consistent and proportionate way. We will also further build the capability of our AI-focused team of specialist safety and security inspectors. We will also, in the next twelve months, release new guidance on regulating AI for our inspectors.

These activities form part of ONR's wider AI regulatory objectives, as developed and set by our innovation hub (Figure 1).

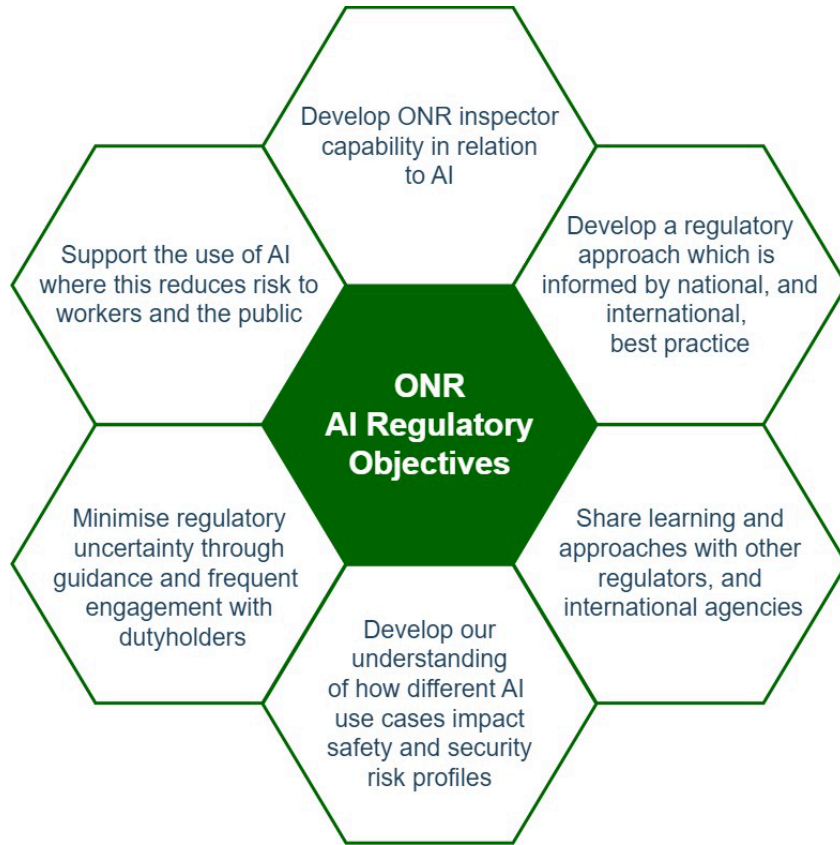


Figure 1: ONR AI regulatory objectives.

ONR is making good progress against these objectives, and we will continue to monitor our performance against these objectives, and our soon-to-be-published 2024 Corporate Plan.