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| ONR Report  ONR’s response to the fourth round of climate adaptation reporting in accordance with the Adaptation Reporting Power (ARP) |



ONR Report

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**Submitted:**  December 2024

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# Executive summary

This report has been produced in line with the [strategy for the fourth round of reporting of the adaptation reporting power](https://assets.publishing.service.gov.uk/media/64ba74102059dc00125d27a7/The_Third_National_Adaptation_Programme.pdf#page=129&zoom=100,92,136) (ARP) [1], under the [Climate Change Act 2008](https://www.legislation.gov.uk/ukpga/2008/27/contents) [2]. The ARP invites organisations with functions of a public nature or statutory undertakers to report against the current and future projected impacts of climate change, and their adaptation proposals. The government, in particular the Department for Environment, Food and Rural Affairs, intends to use the information to feed into the UK’s Climate Change Risk Assessment.

This report is ONR’s first submission under the ARP. It focuses on the aspects of the nuclear industry in Great Britain (GB) we regulate, summarising its state of preparedness. It also explains how we are able to effectively influence proportional adaptation measures across the licensed sites which we regulate, in relation to those aspects which fall within our regulatory purposes. The report provides details of the measures we are taking as a public corporation to identify and manage climate-related adaptation measures which may adversely impact the delivery of our mission to protect society by securing safe nuclear operations.

From a safety and security perspective, **GB nuclear assets are currently highly resilient to the near-term potential effects of climate change** because they can demonstrate resilience to extremely severe weather and climatic effects, such as storm events, tidal surges and prolonged drought. This includes nuclear materials that fall within our safeguards and transport purposes.

To help ensure that this remains the case, we continue to:

* Proactively engage with the GB nuclear industry to ensure dutyholders are considering climate change so that their activities remain safe and secure, both through routine and targeted interventions (such as the ongoing Chief Nuclear Inspector’s (CNI’s) themed inspection[[1]](#footnote-2));
* Work collaboratively with other regulators, ensuring a consistent, non-contradictory position in relation to climate change resilience. We also collaborate with international stakeholders to ensure relevant learning and practices are incorporated into our regulatory position;
* Retain an experienced team of specialist technical inspectors who consider the potential effects of climate change;
* Actively engage with the scientific and academic community and other knowledgeable organisations to ensure we remain fully up to date with the latest developments in the understanding of climate science and its potential effects on GB infrastructure;
* Review and improve our processes and guidance for maintaining a dynamic, responsive and proportionate regulatory approach in relation to climate change challenges within our purposes; and
* Follow up on the industry’s commitments to update its safety and security cases in light of the rapidly changing climate, ensuring resilience into the medium and longer term. We are also currently developing a targeted regulatory strategy to provide assurance to all stakeholders as the effects of climate change continue to manifest.

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# Introduction

## About ONR

We are the UK’s independent nuclear regulator for safety, security and safeguards. Our mission is to protect society by securing safe nuclear operations.

We were formally established by [Part 3 of the Energy Act 2013](http://www.legislation.gov.uk/ukpga/2013/32/part/3) [3], and a [Commencement Order](http://www.legislation.gov.uk/uksi/2014/251/contents/made) [4] brought the relevant sections of the Act and the Office of Nuclear Regulation into being. We deliver five statutory purposes to ensure safe nuclear operations now and in the future. These are:

* Nuclear safety;
* Nuclear site health and safety (also known as conventional health and safety);
* Nuclear security;
* Nuclear safeguards; and
* Safety of transport of nuclear and radioactive materials.

In accordance with the Energy Act 2013, we have the legal authority to regulate nuclear safety, nuclear security and conventional nuclear site health and safety at the 36 licensed nuclear sites in Great Britain (GB). This includes the existing fleet of operating reactors, fuel cycle facilities, waste management and decommissioning sites, as well as licensed and, in part, authorised defence sites[[2]](#footnote-3), together with the regulation of the design and construction of new nuclear facilities, including the supply chain.

Our nuclear security regulation ensures the adequacy of security arrangements for dealing with special nuclear material and special nuclear information within the civil nuclear industry. We also regulate the safety and security of the transport of civil nuclear and radioactive materials by road, rail and inland waterway, extending our regulation across a large number of dutyholders.

We are the UK nuclear safeguards regulator for the domestic standards regime and operate the UK State System of Accounting for and Control of Nuclear Materials.

## Purpose and scope of this report

This report has been produced in line with the [strategy for the fourth round of reporting of the adaptation reporting power](https://assets.publishing.service.gov.uk/media/64ba74102059dc00125d27a7/The_Third_National_Adaptation_Programme.pdf#page=129&zoom=100,92,136) (ARP) [1], under the [Climate Change Act 2008](https://www.legislation.gov.uk/ukpga/2008/27/contents) [2]. The ARP invites organisations with functions of a public nature or statutory undertakers to report against the current and future projected impacts of climate change, and their adaptation proposals. The government, in particular the Department for Environment, Food and Rural Affairs, intends to use the information to feed into the UK’s Climate Change Risk Assessment, which is produced every five years.

This report is our first submission under the ARP. It focuses on aspects of the GB nuclear industry we regulate, summarising its state of preparedness, and how we are able to effectively influence proportional adaptation measures across the licensed sites which we regulate. The report provides details of the measures we are taking as a public corporation to identify and manage climate-related adaptation measures which may adversely impact the delivery of our mission. The report provides an overview of the relevant considerations and plans for the development of a proportionate, targeted regulatory strategy in relation to potential climate change effects.

# Governance, management, strategy and resources

The primary responsibility to ensure safety in law for the sites we regulate is placed on the holder of the nuclear site licence (referred to herein as the licensee). The licensee and others such as organisations in the nuclear supply chain are referred to more generally as dutyholders. Climate change is a critical consideration for us when seeking confidence in the future safety and security of nuclear installations.

We expect licensees to design nuclear facilities to withstand the effects of climate change, including risks from flooding, increased air temperature and coastal erosion. The expectation is that the effects of reasonably foreseeable climate change are taken into account over the lifetime of a facility. This expectation is included in our [Safety Assessment Principles](http://C://Users/ldunning/Downloads/saps2014%20(1).pdf) [5], with further guidance provided in our [Technical Assessment Guide (TAG) on external hazards](https://www.onr.org.uk/media/x4xd1p2w/ns-tast-gd-013.docx) [6] and our [joint regulatory guidance on climate change](https://www.onr.org.uk/our-work/climate-change/working-with-the-uks-environment-agencies/) [7, 8].

We have a specific team dedicated to the consideration of external hazards (including the potential impacts of climate change) within our Civil Engineering and External Hazards specialism. These specialist inspectors make judgments in relation to the adequacy of licensee safety cases and associated arrangements, define regulatory expectations in relation to our purposes and identify relevant good practice for potential climate change effects. Regulatory decisions made by our specialist inspectors are subject to our routine governance and oversight arrangements.

We recognise that a [managed adaptive approach](https://www.onr.org.uk/our-work/climate-change/frequently-asked-questions/) [9] is an appropriate strategy for addressing the significant uncertainties surrounding climate change. The aim of this approach is to build flexibility into options selected and decision-making. This flexibility allows adjustments in response to future developments in climate change, ensuring that nuclear sites remain safe but avoiding a disproportionate burden on the industry today. Details of this approach are included in section ‎5.2 of this report.

We work collaboratively with external stakeholders and other regulators to ensure that nuclear sites remain safe from the impacts of climate change.

We maintain links with organisations involved in climate change research and engage with GB’s environmental protection agencies on cross-cutting matters such as climate change. Further information on our expectations with regards to flood and coastal erosion risk management is available in a joint [Advice Note](https://www.onr.org.uk/media/gsrb1k1p/principles-for-flood-and-coastal-erosion-risk-management.pdf) [7], coauthored by ONR and the Environment Agency (EA).

We regularly convene an [Expert Panel on Natural Hazards](https://www.onr.org.uk/our-expertise/expert-panels/onr-expert-panel-on-natural-hazards/) [10], which includes independent academics and specialists who provide authoritative technical expertise on meteorological and coastal flood hazards, including climate change effects.   
The panel provides our external hazard inspectors with a valuable source of authoritative technical and independent expertise. The panel has authored a series of panel papers underpinning our TAG on external hazards [6] and its supporting annexes. Whilst the papers do not present formal ONR guidance, they provide extensive technical input to the annexes of the TAG [6]. The papers are regularly reviewed and updated to reflect developments in science, such as updated climate information or methodologies. This supports our mission to protect society by securing safe nuclear operations, now and into the future.

In February 2024, we hosted a [meeting with fellow international regulators](https://www.onr.org.uk/news/all-news/2024/02/onr-hosts-climate-change-meeting-with-international-regulators/) [11] to discuss the implications of climate change on the nuclear sector. The meeting provided opportunities to share learning and discuss how each regulator considers climate change when regulating their industries. The ongoing [Chief Nuclear Inspector’s (CNI's) themed inspections on climate change](https://www.onr.org.uk/news/all-news/2023/05/licensee-representatives-gather-for-onrs-chief-nuclear-inspector-themed-inspection-engagement-day/) [12] – a key deliverable of our [2023/24 Corporate Plan](https://www.onr.org.uk/media/ymrbsh1h/onr-corporate-plan-2023-24.pdf) [13] – will also help to ensure effective regulation in this area, and meeting with our international counterparts helps build greater knowledge to inform planning for the future challenges.

The scale of our organisation means it would be disproportionate to adopt a climate change adaptation standard, but our regulatory expectations are benchmarked against international standards such as ISO 14090:2019 – ‘Adaptation to climate change – Principles, requirements and guidelines’ [14].

In summary, we integrate climate change considerations into our regulatory decision-making processes, collaborate with experts, and emphasise adaptability to address the challenges posed by climate change across the nuclear industry.

Further information on [how we gain confidence that nuclear licensed sites will remain safe subject to climate change effects](https://www.onr.org.uk/our-work/climate-change/frequently-asked-questions/) can be found on our website [9].

# Understanding the risks and challenges

We consider the potential risks to GB nuclear facilities resulting from climate change. This includes the direct effect of individual natural hazards and natural hazards acting in combination (for example, a storm resulting in high winds, intense rainfall, and a tidal surge), and the consequential industrial hazards resulting from simultaneous events occurring to adjacent facilities. Our inspectors consider whether dutyholders have taken all potential challenges into account, have considered adequately conservative scenarios (including combinations of hazards), and that lines of defence have been identified to prevent unacceptable or disproportionate consequences as a result of the challenges.

We accept that, while our specialist inspectors and expert panel on natural hazards provide extensive knowledge of the topic, collaboration with other organisations is essential to keep informed of the rapidly evolving risks and challenges associated with climate change. Such collaborations include:

* [Meeting with fellow international regulators](https://www.onr.org.uk/news/all-news/2024/02/onr-hosts-climate-change-meeting-with-international-regulators/) [11];
* Technical engagement with the International Atomic Energy Agency;
* Participation with the [Meteorological Office Hadley Centre Climate Programme](https://www.metoffice.gov.uk/weather/climate/met-office-hadley-centre/climate-programme/index) User Group;
* Engagement with the environmental protection agencies on areas of joint interest and production of joint guidance (for example, [7] and [8]);
* Attendance at the [Safety Directors Forum](https://www.nuclearinst.com/safety-directors-forum?gad_source=1&gclid=EAIaIQobChMI28umzdH7hQMVdY9QBh2bNQhvEAAYASAAEgLclvD_BwE) and supporting industry-wide approaches to safety;
* Participation in the Institution of Civil Engineers-sponsored [Hazards Forum](https://hazardsforum.org/); and
* Sponsorship or steering committees for relevant PhD research projects via UK universities. [Examples of the output of our research](https://onr.org.uk/our-expertise/our-research/) can be found on our website.

We also engage broadly in order to further our understanding of the potential challenges created by climate change and relevant good practice for mitigating the potential effects. Examples include consideration of the International Panel on Climate Change (IPCC) Sixth Assessment Report 2023 [18], engaging with groups developing new design standards and hazard maps (for example, The Engineering Design Institute and Eurocode Panels) and inviting presentations from organisations responsible for considering vulnerable UK assets (for example, Channel Coastal Observatory) to our [technical meetings](https://www.onr.org.uk/our-expertise/expert-panels/onr-expert-panel-on-natural-hazards/).

We do not define, both for expectations on the industry and for our own purposes, specific scenarios such as those included in section 3.1.3 of the Climate Adaptation Reporting guidance [15]. Indeed, the latest evidence suggests a global temperature rise of 1.5oC, compared with pre-industrial levels, may have already been reached. Instead, we expect dutyholders to consider a sufficiently conservative scenario in the design of all new nuclear facilities and to justify the operation of existing facilities.

For example, a planned facility has proposed basing its a definition of reasonably foreseeable climate change on the UK Climate Projections 2018 (UKCP18) representative concentration pathway (RCP) 8.5, defined at the   
50th percentile (refer to [16] and [17] for more information on UKCP18 and RCPs). This climate change consideration is applied to relevant external hazards at relevant time periods for the facility. Other scenarios may be appropriate for different facilities, depending upon their operational life and the nature of the activities on the site. Note that we accept using UKCP18 may not be the only approach to demonstrating sufficient conservatism and we are already considering what might supersede this as relevant good practice as climate science evolves.

## Scope of consideration

The range of external hazards we expect the industry to consider is presented in Table 2 of our TAG on external hazards [6], many of which could be affected by climate change (predominantly flooding and hydrological, meteorological and biological hazards). We consider that combined events, such as storms where different natural challenges may coincide, or a series of extreme events in comparatively rapid succession (for example, compound events) are likely to be the most challenging for nuclear facilities to defend against. We also recognise that climate change effects could adversely affect workers and their ability to undertake safety and security actions, as well as physical assets.

Our approach for individual nuclear sites is informed by their geographic location   
(for example, what type of challenge could it experience) and the remaining operational timescale for the site (for example, how long nuclear materials will be on the site). For new build power stations or long-term waste storage sites, this horizon extends out to and beyond 2150. We are currently engaging with the Meteorological Office and other appropriate organisations to obtain climate projection information for a range of climate scenarios out to 2300. We recognise there is significant uncertainty with such scenarios; hence, we advocate for dutyholders to use a managed adaptive approach to plan for, and manage, such risks (refer to section ‎5.2‎).

Key expectations in relation to climate change include:

* Nuclear facilities should remain safe and secure when subject to infrequent natural hazards with an annual probability of exceedance of 1 in 10,000   
  (i.e., a 0.01% chance of being exceeded in any one year) (SAP Engineering principle, EHA.4 [5]);
* The reasonably foreseeable effects of climate change over the lifetime of the facility should be taken into account (SAP, EHA.11 [5]);
* The design of sea defences should make provision for future modification in response to developments in climate change predictions (SAP, ECE.9 [5]); and
* The design should consider the potential consequences of credible maximum scenarios such as H++ included in UKCP09 [6, 7].

## Consideration of uncertainty

We highlight the large potential uncertainties associated with the environmental response to climate change drivers and the potential for rapid, irreversible change should environmental tipping points be reached. These uncertainties include the severity of the change and the timescales over which it might manifest.

The uncertainties are potentially greatest when considering sea level rise, where realisation of tipping points could result in substantial and rapid changes. Since many existing and proposed new nuclear facilities are in coastal locations, we have worked with the EA to develop specific guidance on this topic [7].

We also recognise that it is difficult to predict the severity of infrequent meteorological events for non-stationary hazards (those which are likely to be changing due to climate change). Thus, we expect operators of nuclear facilities to monitor for evidence of changing hazards and to update their hazard definitions accordingly at appropriate intervals. We also expect a sufficiently conservative methodology is adopted when predicting infrequent meteorological events, to provide confidence that safety and security can be achieved.

Where we identify a gap in the current understanding of climate change effects which is unlikely to be addressed by other means, we can (and have) initiated research projects to ensure we understand either the risk or the level of uncertainty (for example, extreme value analysis).

We are working with the Meteorological Office and others to ensure that the needs of the nuclear industry are met with regard to emergent climate issues.

## Hazard identification and risk screening

Typically, the dutyholder provides evidence that their operations are safe by creating a safety case. This safety case is expected to consider all potential challenges to safety, including those resulting from natural hazards. Hence, the dutyholder is responsible for developing and maintaining a facility-specific hazard identification and risk screening process, applying the principles provided in our regulatory guidance and other relevant good practice. This is undertaken during the planning stage for a new project and at a maximum of ten year intervals for existing facilities as part of the periodic review of safety, as required by Licence Condition (LC) 15[[3]](#footnote-4).

While we are a targeting and sampling[[4]](#footnote-5) organisation, we undertake an external hazards consideration of all significant new build nuclear facilities, and all existing facilities where we believe the challenge created by natural hazards might have significantly changed since it was last considered. It is important to note that, due to their age, most GB nuclear facilities were not designed with climate change in mind. Hence, we have initiated an industry wide initiative – the CNI’s themed inspection on climate change – to ensure we understand the preparedness of the industry and the actions planned by dutyholders to ensure they remain safe and secure subject to the potential effects of climate change.

We have a range of primary powers in law available should our specialist inspectors consider dutyholders have not satisfied our published expectations. However, we do not expect this situation will arise during our consideration of climate change, as the industry generally addresses any identified shortfall without needing to fall back upon our primary powers.

We do not have a pre-identified list of climate change criteria that must be considered (beyond the SAPs [5] and guidance provided in [6]). However, we do expect that all hazards that cannot be screened out on the basis of low frequency of occurrence and/or low consequence should be considered in the safety case. Sufficient protections must be provided to demonstrate that the safety and security consequences of the hazard occurring are acceptable and safety is assured so far as is reasonably practicable.

We expect facilities to remain safe and secure subject to events with an annual probability of exceedance of 1 in 10,000. This severity of event is often termed   
the ‘design basis event’ (SAP, EHA.3). Dutyholders must consider the potential effects of less frequent (more severe) events (often termed as ‘beyond design basis events’ (SAP, EHA.18)) and demonstrate that a small change in the severity of an event does not result in a disproportionate change in the consequence. We refer to this as consideration of ‘cliff-edge’ effects (SAP, EHA.7). Risks that have an annual probability of exceedance less frequent than 1 in 10,000,000 may be screened out and do not need to be explicitly considered by dutyholders in their safety cases   
(SAP, EHA.1).

We do not subdivide environmental challenges into acute (short-term events such as storms) and chronic (long-term effects such as sea level rise) because the expectation for facilities to remain safe and secure when subject to very extreme acute events tends to make chronic risks manageable. The exception to this situation may be for sites undergoing decommissioning, where the vast majority of the nuclear material has already been removed. In this situation, the consequences of an extreme (acute) event may be tolerable, but the chronic challenges become the dominant consideration when demonstrating operator safety.

## Risk analysis and evaluation

Each GB nuclear facility will be subject to unique, local geographic factors which could influence how climate change manifests for the site. However, there are likely to be common, UK-wide climate change effects that dominate most dutyholders’ consideration. From our own experience and understanding of the science, the primary challenges likely to be faced by GB nuclear operators are listed below.

* Coastal flooding, combining the effects of sea level rise, shoreline change, storm induced waves, storm surge (atmospheric pressure or wind direction), high tide and contributions from local precipitation or watercourses. If this is not sufficiently mitigated, it could inundate facilities, with subsequent challenges to safety systems and/or restricting operator access;
* High air temperature, both daytime peak and elevated minimum overnight temperatures for an extended period. If this is not sufficiently mitigated, it could result in unreliability of safety systems or activation of monitoring alarms due to overheating. This could also adversely affect non-safety-related systems such as transformers supplying the electricity distribution grid, resulting in loss of output and/or loss or instability of off-site power;
* Pluvial and/or fluvial flooding, combining the effects from local precipitation, watercourses, groundwater level, ground porosity and saturation. If this is not sufficiently mitigated, it could inundate facilities, with subsequent challenges to safety systems and/or restrictions to operator access;
* Intense localised precipitation, including hailstorms. If this is not sufficiently mitigated, it could overwhelm roof and ground level drainage systems. Localised standing water could penetrate inside facilities, with subsequent challenges to safety systems and/or restricting operator access; and
* In the medium to longer term, changes to the coastal geomorphology through coastline erosion and retreat or near-shore seabed change. If this is not sufficiently mitigated, it could increase vulnerability to coastal storms and related events. The potential effects are not limited to those outlined for flooding, as this could encroach upon the nuclear licensed site itself, physically undermining safety- and security-significant structures and equipment or damaging access routes.

Note that the effects of any of the above events could be exacerbated if further events follow in rapid succession before the effects of the preceding event can be fully recovered. A series of severe storms following in close succession is judged the most likely type of multiple event to potentially challenge GB nuclear facilities.

Inundation of a site or individual facilities by floodwater was extensively considered by the GB nuclear industry following the nuclear accident at the Fukushima Dai-ichi site in 2011. This resulted in enhancements at some GB facilities to increase resilience against flooding hazards. Such enhancements have proven beneficial against the effects of climate change on flooding hazards. Details of [the actions following this event](https://www.onr.org.uk/publications/regulatory-reports/fukushima-and-the-uk-nuclear-industry/) can be found on our website [19]. Note that this work included all potential causes of flooding, including all those highlighted above.

Solar weather, while considered by ONR and dutyholders, is not included within this report as it is not related to human-induced climate change.

Unlike the situation in some other countries, warming of the intake cooling water is not considered to be a significant problem for GB nuclear facilities. This is because all operating power reactors take their cooling water from the sea, and the predicted temperature changes would not undermine any safety functions. This situation could change if GB were to deploy a new fleet of reactors with an alternative cooling method. Moisture-induced ground movement (settlement, shrinkage, swelling, etc.) due to changes in rainfall patterns is unlikely to affect key nuclear safety-related structures as the foundations to such structures are massive and deeply embedded, taking them beyond the influence of moisture-induced movement. However, it is possible that such movement could damage ancillary and non-nuclear safety structures, which are typically supported upon comparatively shallow foundations. Below groundwater mains (including firefighting mains) and drainage systems could be adversely affected.

The nuclear safety consequences of this damage should be minimal, due to the expectations established by SAPs such as EDR.2, EDR.3 and EHA.5, which demand multiple, diverse safety measures. However, these effects could lead to increased operational costs in addressing the resultant defects or interruption of outputs (considered below). Note that geohazards such as ground instability, liquefaction or running sands are exclusionary criteria for a new nuclear development or existing nuclear operations and hence are not considered a threat to GB nuclear facilities.

Similarly, changes in groundwater levels that adversely affect earthing systems can be anticipated but, for the reasons outlined above, the nuclear safety consequences will be minimal. Changes in groundwater regimes could mobilise historical contamination or carry contamination in a new direction. While this predominantly falls within the remit of the national environmental protection agencies, we consider aspects that might result in an increase in worker dose uptake. No significant challenges of this type have been identified to date, but we will keep this under review.

Maintaining the continuity of the outputs of the GB nuclear industry is not within our regulatory purposes and hence is excluded from this report. However, it is accepted that climate change could challenge continuity of electricity generation or supply of radiological materials. Hence, it is in the interests of the industry and of the UK to ensure the industry is also resilient in terms of outputs.

The requirement to remain safe and secure subject to the most extreme of natural challenges provides some intrinsic level of resilience when considering continuity of outputs. While short-term interruption of outputs should be anticipated during severe meteorological events, post-event recovery should be rapid. Contrary to this general expectation, specific facilities might need to temporarily stop production   
pre-emptively when an extreme event is forecast to ensure safety. For example, if a period of very high air temperature were anticipated, a power reactor may   
pre-emptively shut down to mitigate against the consequences of unreliability of electrical and mechanical safety systems.

We accept that that an extended drought could disrupt the water supplies which are used to maintain reserves of water required to assure safe operations. If these safety-critical water supplies were to be challenged, the facility would need to be put into a safe (non-operational) state. Once in a non-operational state, safety can be ensured using alternate sources of water.

## Emissions reduction

ONR has no statutory purposes in relation to emissions reduction from the GB nuclear sector. While we would recommend adherence with relevant good practice in this regard, this topic is excluded from this report.

# Resilience of the GB nuclear industry to the potential effects of climate change

## Nuclear safety and security

In addition to the requirement for GB nuclear dutyholders to consider the potential challenges resulting from infrequent extreme natural events, including the reasonably foreseeable effects of climate change, nuclear safety and security cases should:

* Provide a multi-legged demonstration of safety or security;
* Include diverse systems which are resistant to common cause failure (such as storms); and
* Demonstrate the absence of cliff-edge effects and beyond design basis margin.

LCs place a high expectation upon dutyholders to ensure their assets are subject to suitable and sufficient examination, inspection, maintenance and testing regimes, so they remain free from defects or deterioration which could potentially undermine safety or security.

As a result, we can provide a comparatively high level of confidence that climate change will not have a consequence for the nuclear safety and security of GB nuclear facilities in the short term. However, it must be noted that our assurances are based on a sampling approach, and we have not undertaken climate change-related interventions to all dutyholders.

Note that a number of legacy waste storage facilities have been identified which do not satisfy our expectations in several regards, including their resilience to some potential climate change effects. Retrieval of waste from these facilities is being prioritised, and reasonably practicable measures to enhance their resilience to potential climate change effects have been undertaken or are underway. However, as these facilities cannot be practicably improved to satisfy the regulatory expectations placed upon modern facilities, plans have been developed and equipment made ready to mitigate the consequences of any event adversely affecting them.

## Dependencies upon external services and supplies

Operating nuclear facilities demand a myriad of services and supplies provided by external parties (for example, water, fuel and off-site electrical supplies). Any of these could be interrupted by an extreme natural event made worse or more frequent due to climate change. We expect sites to remain safe following any event for an extended period without any off-site support. Typically, this might constitute safety essential water or gas supplies held within on-site tanks. In addition, dutyholders must adopt at least one of the following approaches to demonstrate safety beyond this period of self-reliance:

* Demonstrate the ability to reach a passively safe state (for example, by ceasing operations);
* Ensure the service or supply can be restored within the period of self-reliance   
  (for example, using vehicles with a substantial wade capability to deliver the material); or
* Demonstrate that failure to restore the service has no material safety consequence.

We consider that it would be acceptable for multi-facility sites (for example, Heysham 1 and Heysham 2) to share resources where this is practical and does not undermine resilience to a common cause fault.

We assess the most likely potential challenges for nuclear safety result from loss of continuity of an externally provided service. Many are classed as ‘frequent faults’ and hence dutyholders need to have well developed lines of defence to ensure safety.

The services which are judged to have the greatest likelihood of interruption due to a natural hazard are:

* Loss of off-site power connection – mitigated by back-up generators, uninterruptible power supplies and passive safety measures. Note that operational GB nuclear facilities feature on the National Grid’s schedule of priorities for reconnection in the event of a widespread and prolonged outage;
* CO2 and other inert gases – mitigated by minimum reserves held on site and the requirement to shut down operations and make them passively safe if supplies run low;
* Off-site workforce unable to reach site for shift change – mitigated by the definition of minimum staffing levels for all activities and the requirement to shut down operations if these are challenged;
* Piped potable water – mitigated by minimum safety reserves held on site and the requirement to shut down operations and make passively safe if supplies run low;
* Off-site response to major incident because the responders are already fully occupied with more immediate tasks or unable to reach the site – mitigated by the development of local authority emergency plans, designation of priority routes and equipment held on site or specifically for the dutyholder; and
* Loss of telecommunications facilities – mitigated by the requirement for facilities to remain safe in the absence of external telecommunications facilities.

## Cascading risk

Within the guidance on Climate Adaptation Reporting [15], cascading risks are defined as ‘one event or trend triggering others, where disruptions or failures caused by an extreme weather event cause a chain of impacts across multiple organisations and/or sectors’.

Even where a nuclear facility demonstrates the ability to withstand an extreme natural hazards event, the proximity of another nuclear facility could create challenges when subject to the same event. Potential challenges created by adjacent nuclear operations must be considered in operational safety cases and nuclear dutyholders are required to co-operate. We consider the potential cascading risks from adjacent nuclear facilities to be well understood and adequately controlled. For example, post operational facilities such as the Magnox power stations have limited potential to effect adjacent operational sites due to their fuel-free status. However, there are recognised vulnerabilities at specific legacy facilities (due to the age and close proximity of a multitude of facilities), and actions to reduce both the risk and the hazard are being prioritised.

Nuclear facilities must not depend on a single protective measure that might have multiple demands during an event challenging multiple facilities. For example, sufficient back-up electricity generation must be provided for every safety-critical user, even in the event of a simultaneous demand. Similarly, dutyholders must provide diverse protective measures which are not vulnerable to common cause failure. For example, if adverse weather could lead to loss of off-site power supplies, the on-site back up must be demonstrated to be resilient to the same event.

Adjacent industrial facilities which could affect nuclear plant must be considered within the external hazards safety case for the nuclear facility. For example, the consequences of damage to a wind farm during a storm must be considered in the nuclear safety case if the two are able to affect one another.

We recognise that there could be a cascading risk extending over a considerable geographic area downstream when considering the potential climate change effects on large dam and reservoir structures. Our consideration of such potential off-site challenges is included in [a research paper](https://www.onr.org.uk/media/whimvlxh/defining-distances-consultation-zones.pdf) published on our website [20].

It is acknowledged that new developments in the vicinity of existing nuclear facilities could change some of the hazards that sites might experience (for example, construction of a new water storage reservoir). ONR provides advice to the Planning Inspectorate, Scottish Government and local planning authorities on proposed developments on and around nuclear sites. Hence, we can consider any new challenges created by developments in the vicinity of nuclear facilities and seek assurance that safety cases are updated accordingly [20].

## Regulatory assurance of industry emergency preparedness

In addition to considering external hazard safety cases, our function to assess dutyholders’ emergency and response plans provides assurance that dutyholders have developed responses to potential major natural hazard events that are subject to suitable scrutiny. Major dutyholders are required by the LCs to demonstrate the adequacy of their arrangements by undertaking emergency exercises, which we assess and report upon (for example, LC 11(5)). In recent years, emergency scenarios initiated or compounded by extreme weather or flooding have featured in several exercises.

The [post-Fukushima resilience work](https://www.onr.org.uk/publications/regulatory-reports/fukushima-and-the-uk-nuclear-industry/+) provides a case study of how we consider extreme natural hazard events [19]. This initiative resulted in dutyholders updating their arrangements, including enhancements to both on- and off-site equipment provision and incident response training. While this case study does not specifically relate to climate change, a considerable amount of attention was paid to the consequences of inundation of low-lying facilities by flood water, which has directly contributed toward the industry’s preparedness to some of the more challenging potential effects of climate change.

## Continuity of our functions subject to climate change effects

Business continuity and resilience within ONR is the focus of our Incident Management and Business Continuity team. Their work informs discussions about our organisational preparedness for disruptive events. However, it is worth noting that their efforts are driven by the need to ensure that we fulfil our obligations as a Category 2 responder under the Civil Contingencies Act 2004, as opposed to any climate-specific adaptation or resilience drivers.

## Overview of the risks impacting the nuclear sector

The following sections have been developed for the headings provided within the climate adaptation reportion fourth round guidance [15]. Consideration has been separated between the GB nuclear industry and ONR as a regulator of the industry. Note that we do not provide site-specific details for security reasons. Further details of non-physical challenges are provided in subsequent sections of this report.

### Physical assets

**Industry:** Newer facilities have been designed to be highly robust and are constructed according to high standards. However, safety margins can reduce with ageing and unforeseen deterioration to facilities has been observed for some features. Older facilities were not designed with climate change resilience in mind, but dutyholders have sought to demonstrate that such facilities can withstand design basis events including an allowance for the reasonably foreseeable effects of climate change. Maintenance investment decreases post-operation, reducing the assets’ ability to withstand climate change challenges. However, since most of the nuclear hazard is usually removed post operation, the consequences of an event should be tolerable and can be recovered from. We are aware of the exceptions to this principle (outlined previously). For designs we are currently considering (for example, generic design assessments and current new build projects), futureproofing is a pre-requisite expectation (for example, via the managed adaptive approach).

**ONR:** We own no significant physical assets; instead, we lease accommodation in three widespread locations (Bootle, London and Cheltenham), providing inherent resilience to most weather events.

### Staff

**Industry:** The main challenges relate to the ability of staff to get to their place of work, which is largely outside the control of the dutyholders. Minimum staffing levels and emergency arrangements ensure safety and security in these situations, but not continuous production. Increased regulatory attention on climate change means industry leaders are increasingly focused upon climate resilience, allowing dutyholder technical leads to effect positive change   
(for example, by providing better staff training, staff contingency plans and pre-emptive actions for forecasted events). Significant improvements to the weather protection for guard force personnel have been completed to key sites to ensure security during unfavourable weather conditions.

**ONR:** Site inspections may need to be (and have been) delayed due to extreme weather events to ensure employee safety when travelling or while on site.   
We have a dedicated specialist team focused on the potential challenges of climate change who influence industry improvements. Their knowledge helps inform our arrangements to ensure continuity of our functions.

### Workplace

**Industry** (refer also to section 4.7.1): Process activities cannot relocate due to the nature of the nuclear hazard, so facilities must be adequately protected against potential climate change effects. If it becomes uneconomic to protect a particular facility (for example, due to climate change induced shoreline retreat), then activities must cease and the hazardous nuclear materials relocated to a safe location. Note that we have the power to direct dutyholders, though we do not anticipate having to use this power.

**ONR:** We lease our workplaces and hence could relocate if our office locations became challenged by climate change. Our employees can undertake most of their tasks remotely and we have a policy of flexible working. This provides diversity of location and hence resilience to natural hazard events, although it does increase the probability of minor disruptions occurring to some individual staff members (for example, loss of internet connectivity or phone service provider). We acknowledge our high dependency on telecoms infrastructure and power supplies to remain effective (refer to section ‎4.6).

### Finance

**Industry:** Finance of the nuclear industry is outside of our purposes. The financing of new nuclear facilities is subject to considerable government and Department for Energy Security and Net Zero scrutiny. The Nuclear Decommissioning Authority and defence elements of industry are also largely government-funded. From the perspective of climate change, funded decommissioning plans developed during previous decades may not sufficiently allow for increased costs due to climate change mitigation and are unlikely to consider when sites may become vulnerable to chronic climate change challenges. Decommissioning plans (including care and maintenance periods) for post-operational and currently operational power generation stations are unlikely to adequately reflect the potential challenges of climate change. Power generation sites currently under construction or being designed should fully include climate change effects in their decommissioning plans.

**ONR:** We are largely funded by recoverable cost from the nuclear industry and hence our future financial viability will be resilient to disruption caused by climate change.

### Business processes

**Industry:** Our LCs require dutyholder arrangements to ensure safety and security subject to reasonably foreseeable potential challenges, such as extreme weather events resulting from climate change. Dutyholder arrangements in relation to climate change are currently being assessed in detail as part of our CNI’s themed inspection.

**ONR:** We are currently developing resilience and continuity of service plans. The nature, severity and frequency of weather effects included in these plans will be informed by our specialist external hazards inspectors. These plans will be updated as the effects of climate change manifest.

### Regulatory and policy context

**Regulatory:** We are a mature organisation with a robust regulatory position in relation to climate change. Applying an outcome focused allows us to adapt to evolving challenges where these occur. The Energy Act 2013 provides sufficient legal underpinning to support our purposes and we have memoranda of understanding with our joint regulators (such as the national environmental protection agencies) in relation to climate change. We have not identified a need to adapt our principal regulatory guidance or approach, though the detail is being considered as part of our current CNI’s themed inspection to help ensure it remains suitably targeted and risk informed in the future.

**Policy:** Government aspiration to increase the contribution of nuclear to net zero targets is recognised within our policies and strategies. Several sites identified in the current planning policy document [21] are potentially vulnerable to climate change effects, such as sea-level rise, and hence would need robust protection measures should they be developed for new nuclear facilities.

## Current position of GB industry

The following subsections provide an overview of the current position of the GB nuclear sector in relation to our regulatory purposes. As highlighted in the previous section, the sector has sufficient regulatory oversight to ensure it is and will remain safe and secure subject to the potential challenges from climate change.

### Nuclear safety and security

The industry is currently highly resilient to climate change effects due to the regulatory expectations for nuclear facilities to remain safe and secure when subject to extremely low-frequency natural hazards. Areas for further attention are recognised:

* The industry has made commitments to update hazard definitions and safety and security cases to include the potential effects of climate change. These will need to be followed up to ensure the industry remains resilient into the medium to longer term;
* Post-operational sites which have completed their post-operational clean-out phase may be vulnerable to the effects of climate change, as it may be grossly disproportionate for them to implement additional protection measures. However, the nuclear safety consequences will be tolerable and post event recovery should not be overly onerous or hazardous;
* Some legacy facilities have been identified as having potential vulnerabilities to climate change effects. While reasonably practicable improvements have been made to enhance their resilience, it would not be possible to attain the standards expected for new facilities. Specifically, older waste stores are subject to enhanced regulatory attention, with the intention of reducing the risk and hazard as soon as practicable. This is generally being achieved by relocating the waste to newer, more resilient facilities. However, this process creates risks associated with disturbing and moving the legacy waste, which increases the short-term vulnerability of the facility. Timely completion of waste retrieval is also dependent upon continued funding from the Government; and
* Regulatory strategies to ensure continued resilience against climate change   
  (in collaboration with all regulators of the nuclear industry) will be reviewed and updated once the outcome of the current CNI themed inspection interventions have been considered. For further details, refer to section ‎5.

### Conventional nuclear site health and safety

* For operational facilities, worker safety should be adequately protected by the inherent resilience and by the emergency plans which have been developed to include events initiated by extreme weather. For licensed nuclear sites under construction, worker safety should be adequately ensured by general construction safety regulations (for example, The Construction (Design and Management) Regulations 2015), for which ONR is the enforcing authority.

### Transport

Nuclear materials may only be transported within pre-approved, highly resilient packages. Packages are tested to ensure they will not be compromised by accidents, including exposure to fire and subsequent fire-fighting activities. Hence, should a package be subject to extreme weather while in transit, the package will not be compromised and the material within will remain protected.

It is our expectation that nuclear materials should only be transported when it is safe to do so. Hence, we would expect that nuclear materials will not be transported when a significant severe weather warning is issued or in force. Dutyholders need to demonstrate that transport incident action and recovery plans have been prepared, ensuring materials remain safe and secure in event of unanticipated problems in transit. Transport of materials may be delayed due to acute weather events, but the consequences of the delay should be minor.

### Safeguards

We became responsible for nuclear material accounting following the Nuclear Safeguards (EU Exit) Regulations 2019. Our national and international nuclear material accounting and safeguarding obligations can be satisfied even if interventions are postponed until acute weather events challenging travel have passed. We have sufficient staff and resources to ensure all obligations can be satisfied with the agreed timescales despite near-term climate change.

### Joint regulatory working

As highlighted previously, we are one of several regulators who jointly regulate the GB nuclear industry. We work collaboratively with joint regulatory bodies to produce relevant guidance ([7], [8]), to share dutyholder intelligence (for example, the output from the CNI’s themed inspection self-assessment questionnaires) and to keep up to date with latest developments in climate science (for example, presentations from various informed parties to our expert panel meetings). We are committed to updating joint regulatory guidance as and when appropriate to ensure effective, targeted and joined-up regulation of the industry in relation to climate change, which is aligned with the expectations placed on us by the Regulators’ Code [22].

### Discharges from the GB nuclear Industry

Discharges from GB licensed sites fall within the remit of the national environmental protection agencies. It is acknowledged that climate change effects could result in increases in discharges, particularly as a result of a flooding event. Discharges could increase both during the event, when flood water may carry materials off the site, but also during subsequent recovery and clean-up activities. These discharges are not limited to radiological materials and could also include other toxic and potentially harmful industrial and organic materials.

Our considerations include any potential sources of radiological release off the licensed site which could adversely affect the health of the public. Measures to mitigate against this potential eventuality must be provided so far as is reasonably practicable. However, the challenges presented by some legacy waste facilities are acknowledged and included in the consideration of prioritised dutyholder actions to reduce hazard and risk.

## Potential challenges to ongoing climate adaptation resilience

We have identified some non-physical challenges which could reduce the ability of GB’s nuclear industry to remain resilient to the effects of climate change in the future. These do not undermine our ability to deliver our regulatory purposes and mission of holding the industry to account. There are also several potential physical challenges resulting from climate change that do not undermine confidence in delivery of our regulatory purposes but are nevertheless acknowledged.

1. **Maintaining the resource of suitably qualified and experienced staff with sufficient understanding of the natural hazards or the methods of protecting facilities from the effects of climate change.** Even larger dutyholder organisations have struggled to find suitably experienced personnel with relevant experience to manage the challenges resulting from climate change. This has been partially mitigated by the [nuclear graduates programme](https://energus.co.uk/skills-training/nucleargraduates/) and the more recent Destination Nuclear initiative, but the limited availably of technical expertise across many science, technology, engineering and mathematics (STEM) topics is acknowledged as a national problem. This is a risk for regulators as well as the dutyholders.
2. **Funding to protect facilities against the effects of climate change.** Funded decommissioning plans which were developed during previous decades may not necessarily allow for potential increased costs due to climate change effects. For example, these effects may expedite the need to reduce or demolish facilities, undermining the financial assumptions made in the plans. The chronic effects of climate change are also likely to increase the costs of ongoing maintenance (for example, repairs to drainage systems and the weatherproof envelope).  
     
   Funding for many legacy facilities, including the Magnox reactors, is provided on an annual basis by the Treasury. Spending restrictions for size reduction and demolition projects are likely to result in many ageing assets being subject to the potential effects of climate change for decades to come. Because spending is focused on the prioritised high-hazard reduction activities, only limited funds are available for the lower hazard post-operational facilities. However, the nuclear safety consequences from such facilities are expected to be tolerable with post-event recovery not overly onerous or hazardous.
3. **Coastline retreat, river erosion, near shore seabed change and siltation challenging operations at a nuclear facility.** These processes will not be permitted to undermine nuclear safety or security. Each process will be gradual, with adequate warning that margins of safety are being reduced long before safety and security are challenged. Dutyholders will either need to address the challenge, via additional actively managed defences (such as those historically implemented at Dungeness B) or, if this approach is disproportionate or unfeasible, cease operations and ensure all residual nuclear materials can be secured. Hence, these potential effects of climate change can be considered commercial challenges. Note that excessive sea level rise that can no longer be practically mitigated falls within this category.
4. **Coastal management policies to adjacent land.** The actions (or inactions) of landowners adjacent to nuclear facilities, as well as responsible land or coastline management authorities, could affect coastline retreat, river erosion, near shore seabed change and siltation at or around those facilities. It is important to note that, for some coastal and river systems, the causal factors may be occurring at some distance from the nuclear site. As outlined above, this is treated as a commercial challenge.
5. **Saline contamination and increased corrosion rate of above and below ground assets from sea water or atmospheric salt.** GB nuclear facilities are expected to be protected by multiple diverse barriers that are subject to high levels of inspection and maintenance. Saline contamination and corrosion could reduce margins of safety. As above, if these factors cannot be practicably mitigated by the facility, operations would have to cease and residual nuclear materials be secured; this is treated as a commercial challenge.
6. **Changes in groundwater level or direction of flow.** While groundwater is discussed primarily in section ‎3.4, issues such as increase of ingress to below ground structures and services have not yet been explicitly mentioned. Again, the direct (flooding) and indirect (increased corrosion or deterioration) effects will not be permitted to reduce safety margins below expectations; hence, this can also be considered a commercial challenge.
7. **Changes in vegetation growth, prevalence of vermin and other changes to organic systems.** This includes changes in marine life which could increase the frequency and severity of blockage to water intakes, resulting in interruptions of outputs. As these factors are expected to be actively managed, they too can be considered commercial challenges.
8. **Interruption to information technologies and communication systems.** (Note that the potential for space weather is outside the scope of this document as it will not be affected by climate change, but it is considered within our regulatory purposes.) Interruption to power supplies, both on- and off-site, or storm damage to communications infrastructure, has significant potential to interfere with effective communications and other information technologies employed by nuclear dutyholders. Our expectation is that all critical safety and security systems should withstand such challenges and continue to operate or fail to a safe and secure position. Hence, the challenges considered as a result of IT disruption relate to loss of operational efficiency and interruptions to outputs. Our regulatory activities would be likely to be paused until communications systems can be restored, but this will not adversely affect GB nuclear safety or security and our recovery plans are in place to mitigate against these events.

# Adaptation plan implementation and the managed adaptive approach

## Adaptation plan implementation

It is fundamental to recognise that individual licensee and dutyholder organisations are responsible for developing, maintaining and implementing appropriate adaptation plans that respond to the challenges their facilities may be exposed to. However, ONR and other GB regulatory bodies have an important role in considering the adequacy of these plans and, when necessary, influencing improvements.

To ensure GB’s nuclear industry remains resilient in the future, we will continue to collaborate with other regulatory bodies, international stakeholders and organisations, UK academia and learned institutions to ensure we remain cognisant of the emergent challenges. We will also continue to collaborate with other regulatory bodies to share intelligence and avoid contractionary expectations in relation to climate change.

In relation to our regulatory purposes, we are using the current CNI’s themed inspection on climate change to develop a risk-informed, targeted and proportionate future regulatory strategy. The following principles have been established based on our regulatory activities to date, with indicative timescales for implementation provided. These principles may evolve as the CNI’s themed inspection progresses.

### Short-term (to 2030)

* Monitor the industry’s progress against their assurances to incorporate climate change into safety and security cases for applicable hazard definitions;
* Pursue closure of all shortfalls identified to existing dutyholder assets and arrangements that protect against the effects of natural hazards;
* Enhance the nuclear industry’s response to climate change by facilitating and supporting industry wide technical engagements. These forums will discuss relevant good practice, experience, regulatory expectations and related information;
* Undertake risk-informed, targeted climate change interventions with licensees with whom we have had limited engagement of this type to date;
* Pursue and support initiatives with appropriate organisations to develop future relevant good practice for climate change in view of observed changes; and
* Embed the regulation of climate change within our regular multifaceted regulatory engagements, such as systems-based inspections or relevant licence condition compliance inspections.

### Medium-term (beyond 2030 to 2050)

* Gain confidence that periodic reviews of safety and security (typically undertaken at ten-yearly intervals) identify and address the potential challenges resulting from climate change in an adequate manner. Where regulatory expectations are not met, either influence improvements or use our regulatory powers to ensure legal standards of safety and security are satisfied;
* Seek assurance that all new build GB nuclear facilities and facilities that will continue to contain significant nuclear materials adequately incorporate climate change in their designs and operational arrangements, including during their post-operational stage. This is likely to include arrangements to monitor localised effects of climate change that could adversely affect the facility;
* Promote our enabling regulatory approach to high-hazard risk reduction initiatives at legacy facilities where resilience shortfalls have been identified and cannot be practically mitigated; and
* Review the effectiveness of our climate change regulatory strategy and enhance our approach where necessary. This is likely to involve comparison with and learning from other national and international organisations.

### Longer-term (beyond 2050 to end of operations)

* Continue to proactively deliver our mission to protect society by securing safe nuclear operations against climate change, in a manner consistent with the growth duty;
* Promote understanding of the potential challenges resulting from climate change to facilitate improved decision-making and planning across the whole lifecycle of nuclear facilities;
* Review the effectiveness of managed adaptation approaches in ensuring the ongoing safety and security of GB’s nuclear industry; and
* Consider the potential implications on the design, operation and post-operation of a potential future geological disposal facility and other long-term waste storage facilities. Note that current waste disposal facilities do not fall within our regulatory purposes.

## The managed adaptive approach

Considering the long timescales involved in the operation of a nuclear facility, the need for conservative assessment of the potential challenges created by climate change, and the large uncertainties in the nature, scale and timings of the changes, it would be uneconomic and disproportionate for dutyholders to provide mitigation now for all possible eventualities. Hence, we consider the managed adaptive approach as an acceptable methodology for ensuring safety and security in the face of climate change. This is discussed in our joint guidance [7].

The aim of the managed adaptive approach is to build flexibility into options and decisions today so that they can be adjusted depending on what happens in the future. The approach allows the detailed design, construction and commissioning of measures that will be required to protect facilities, activities, people and nuclear materials from the future potential effects of climate change to be deferred until shortly before they are required. One of the most significant examples of the application of the managed adaptive approach is the ability to enhance defences required to maintain a suitable level of protection against sea level rise.

From a regulatory perspective, the following principles need to be applied when adopting this approach:

* The full range of potential challenges need to be understood (for example, the entire range of factors which could contribute to flooding on a site, and how these might be related to one another);
* The timescales for which protection will be required needs to be defined   
  (for example, to the end of the period where the nuclear hazard is no longer present). Note that the nature of the hazard may change when facilities transition from operational to post-operation, and hence the nature of the required protection might also change;
* A sufficient range of climate change scenarios should be considered, adopting sufficient conservatism in any assumptions made (for example, ranging from most likely to credible maximum scenario). The consideration needs to include sensitivity studies to ensure the analysis is not disproportionately sensitive to the assumptions made;
* The most up-to-date information is considered at each point the plan is revisited, including for any emergent trends or observations local to the facility;
* The future defences or lines of protection proposed should be practicable   
  (for example, there is sufficient land to extend sea defences or space and access has been provided to allow ventilation plant to be uprated). Reliance upon future technologies which have not yet been developed is not acceptable, and outline proposals should be provided at the outset;
* Clear trigger points are identified where the actions identified in the plan need to be started (for example, an increase in observed still sea water level that triggers a contract to undertake the detailed design and construction of enhanced sea defences). The timescales identified in the plan need to be conservatively derived, with sufficient margin allowed for a rapidly worsening scenario; and
* The effects of climate change need to be actively monitored, both local to the site and over a wider regional, national or global area (for example, frequency, severity and duration of heatwaves).

It is important to highlight that the adoption of this approach does not result in a reduction in safety or security. At no point should the level of protection fall below the expectation that safety and security must be ensured when subject to an infrequent natural event with an annual probability of exceedance of 1 in 10,000. This expectation should be maintained throughout the construction of any additional physical defences. If the construction requires the removal or reduction of any extant defences, then activities on site need to be modified to ensure the minimum expectation is maintained. This could include temporary cessation of operation, temporary relocation of materials or additional temporary lines of defence.   
Enhanced event monitoring during this period of vulnerability would not be considered an acceptable approach.

It must also be noted that it may not be practicable to adopt this approach in every situation. For example, it is unlikely to be practicable to plan for below-ground services to be enlarged at some future date due to the difficulties in accessing the services or the probability that something might have been built over the service. It would also be unacceptable to assume an action will be undertaken (or not undertaken) by a party outside the direct control of the dutyholder (for example, by an adjacent landowner).

# Summary

ONR’s fourth round climate adaptation report highlights the current resilience of GB’s nuclear assets to severe weather and climatic effects, while also outlining the proactive measures we are taking to ensure ongoing safety and security in the face of evolving climate risks.

**Resilience of the GB nuclear industry**

GB’s nuclear facilities are currently well prepared to handle extreme weather events, demonstrating resilience to hurricanes, tidal surges, and prolonged droughts with a high level of safety and security. This resilience is attributed to robust design standards and proactive regulatory oversight. ONR ensures that dutyholders update their safety and security cases to reflect the latest climate projections and potential hazards.

**Governance, management, strategy, and resources**

We expect nuclear facilities to be designed to withstand climate change effects, including flooding, increased air temperature and coastal erosion. This report emphasises a managed adaptive approach to address uncertainties and build flexibility into decision-making. This flexibility allows adjustments in response to future developments in climate change, ensuring that nuclear sites remain safe while avoiding a disproportionate burden on the industry today.

**Understanding the risks and challenges**

We do not define specific climate scenarios, but expect dutyholders to consider conservative scenarios in their safety cases. We collaborate with various organisations to stay informed about evolving climate risks and integrate this knowledge into regulatory practices.

We actively engage with the nuclear industry to ensure climate change effects are considered in safety and security measures. This includes routine and targeted interventions, such as the Chief Nuclear Inspector’s themed inspection on climate change. We also collaborate with other regulatory authorities and international stakeholders to incorporate best practices and scientific advancements into regulatory frameworks.

**Adaptation plan implementation**

It is fundamental to recognise that it is the responsibility of individual licensee and dutyholder organisations to develop, maintain and implement appropriate adaptation plans that respond to the challenges that their facilities may be exposed to. However, we and other GB regulatory bodies have an important role in considering the adequacy of these plans and, when necessary, influencing improvements.

Our strategy under development includes short-term (to 2030), medium-term (2030–2050), and long-term (beyond 2050) actions to ensure the nuclear industry’s resilience to climate change. This includes monitoring industry progress, facilitating technical engagements, and ensuring new facilities incorporate climate change considerations.

**Conclusion**

Our report underscores the value of climate change considerations being integrated into the regulatory framework for the nuclear industry. By adopting a managed adaptive approach and collaborating with various stakeholders, we aim to ensure that GB’s nuclear facilities remain safe and secure in the face of climate change. Our report calls for continuous improvement and adaptation to emerging climate risks, highlighting the need for robust regulatory oversight and proactive industry engagement.

The report concludes that, while climate change poses potential risks to the GB nuclear industry, the scope of those risks are understood across the wider UK policy and legislative framework. Where the risks are to the established robust regulatory regime, this reports seeks to demonstrate that regulation can evolve and adapt to ensure those risks are actively met.

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# Glossary

| Term/acronym | Description |
| --- | --- |
| ARP | Adaptation Reporting Power |
| CNI | Chief Nuclear Inspector |
| EA | Environment Agency |
| GB | Great Britain |
| LC(s) | Licence Condition(s) |
| RCP | Representative concentration pathway |
| SAP(s) | Safety Assessment Principle(s) |
| SDF | Safety Directors Forum |
| TAG(s) | Technical Assessment Guide(s) |
| UKCP18 | UK Climate Projections 2018 |

1. Chief Nuclear Inspector’s themed inspections are intended to raise awareness of important issues and highlight our regulatory activities and expectations to a wider audience. The ongoing themed inspection on climate change commenced during 2023 and is due for publication during 2025. Further information relating to Chief Nuclear Inspector’s themed inspections can be found at CNI themed inspections | Office for Nuclear Regulation [↑](#footnote-ref-2)
2. On authorised defence sites we regulate the [Health and Safety at Work etc. Act 1974](https://www.legislation.gov.uk/ukpga/1974/37/contents) [23], including [Radiation (Emergency Preparedness and Public Information) Regulations 2019](https://www.legislation.gov.uk/uksi/2019/703/contents) [24] and [Ionising Radiation Regulations 2017](https://www.legislation.gov.uk/uksi/2017/1075/contents) [25]. [↑](#footnote-ref-3)
3. Licence Conditions (LCs) are applicable provisions under the Energy Act 2013 and therefore ONR may decide to take enforcement action in the case of a breach of LCs. [↑](#footnote-ref-4)
4. Targeting is used to focus regulatory attention on areas of interest. Sampling is used to gain confidence in dutyholder compliance in those areas. We target so we can use our finite resources appropriately, making timely judgements and decisions without placing an unnecessary burden on dutyholders, in accordance with our Enforcement Policy Statement [27]. It is impractical and disproportionate for ONR to examine all aspects of a dutyholder’s undertakings. Instead, we sample evidence within the areas being targeted and compare this to applicable standards and guidance [28]. [↑](#footnote-ref-5)