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Nuclear Security in a Time of Crisis: Lessons from UK Nuclear Industry's Experience of the Covid-19 Pandemic

Dr Sarah Tzinieris
King's College London

Professor Christopher Hobbs
King's College London

Abstract

Having faced crises and unprecedented events in the past, nuclear energy is today one of the world's most resilient and secure industrial sectors. Nevertheless, the Covid-19 pandemic has severely complicated operations, including in the delivery of nuclear security. Nuclear facilities around the world have faced significant pressure to maintain business continuity, ensure the health and wellbeing of staff, and provide protection against potentially evolving threats. This paper explores the challenges faced by the nuclear industry in the area of nuclear security, with a focus on the United Kingdom's experience of the Covid-19 pandemic. It employs empirical evidence gathered from interviews conducted with key stakeholders in UK government, the regulatory body, a range of nuclear operators and the national armed response capability. In so doing, the paper provides practical examples of how dutyholders – working with government and the regulator – have devised solutions to challenges such as absenteeism, supply chain management and remote working. Several of these innovations have in fact increased efficiencies in the delivery of nuclear security – and may be maintained even after the effects of the pandemic dissipate.

Introduction

The Covid-19 pandemic has forced the nuclear industry to implement significant changes and at speed across operations, and this has included the delivery of nuclear security. While the situation has inevitably varied from country to country, there are a number of common challenges faced by nuclear organisations around the world owing to the pandemic's rapid and largely unanticipated onset, extended duration and direct impact on human behaviours and health.[i] Consequently, while this paper is focused on exploring the United Kingdom response to the Covid-19 pandemic, it is anticipated that many of the lessons learnt will be applicable to nuclear security in other countries. Some insights will be less applicable, for example, with respect to the application of nuclear security regulation under the UK's unique 'outcome-focused' framework; nonetheless, the study provides new insights about the regulatory aspect of nuclear security when dutyholders face a crisis.

In many ways, the nuclear industry is well-placed to respond to what may be considered a 'crisis' – defined here as a novel situation that confronts an organisation with a challenge, urgency or surprise[ii] While the rapid transmission of SARS-CoV-2 is not the first major crisis that the nuclear industry has faced, the Covid-19 pandemic has been unprecedented in terms of its rapid onset, global reach, extended duration and direct impact on human behaviours and health.[iii] To date, the industry has not suffered any major security-related (or safety-related) incidents during the pandemic. While that attests to the nuclear industry's ability to respond effectively to a crisis, the pandemic is expected to endure for some time. Taking stock of the delivery of nuclear security at this phase of the pandemic sheds light on the wider industry's capacity to maintain this core function during a crisis.

Employing an empirical approach, the paper explores how the Covid-19 pandemic has affected the delivery of nuclear security around the world, with a particular focus on the United Kingdom's

nuclear industry. The paper begins by providing a high-level overview of how the pandemic has impacted nuclear operations on a global level, before focusing on its disruptive effects on nuclear operations in the UK. The paper draws on a series of semi-structured interviews conducted in the spring of 2021, with representatives from government, the regulator and industry. The key challenges encountered as a result of Covid-19 are identified, as are the practical solutions developed in response – the efficacy of which is central to this study. The paper concludes by outlining steps that can be taken to ensure the effective and uninterrupted delivery of nuclear security in potential future crises.

Global Impacts of the Pandemic on Nuclear Security

The rapid onset of the Covid-19 pandemic in early 2020 prompted alarm across the global nuclear industry. Dutyholders were initially focused on ensuring business continuity but became increasingly concerned about how to operate in a safe and secure manner that protected the health and welfare of their staff.[iv] Prior to the pandemic, many civil nuclear operations around the world had in place contingency plans and emergency response mechanisms for extreme events, including for a pandemic scenario. Nevertheless, like other industries, most nuclear dutyholders and their regulators could not foresee the scale and implications of the events that unfolded in early 2020 – and accordingly, had not tested and exercised an appropriate response framework in advance. In the face of the enveloping crisis, nuclear organisations were forced to make tough decisions under significant time pressure and, crucially, without accurate data about the novel coronavirus to inform the delivery of nuclear security. While pre-existing contingency plans served as useful anchoring points, in some cases dutyholders and regulators needed to implement new or modified nuclear security measures.

Due to the obvious need to prevent transmission of the virus through reducing human contact, from its inception the Covid-19 outbreak forced nuclear dutyholders to make significant alterations to working patterns, including reducing onsite staff numbers and enabling remote (home) working. For the same reasons, regulators were required to reduce physical site visits which complicated regulatory oversight and, accordingly, reduced visibility of safety and security issues. Meanwhile, the nuclear industries of many countries postponed scheduled maintenance work and outages related to refuelling or refurbishment.[v] In unfortunate cases where workers were infected, whole shifts were forced to quarantine and work was temporarily halted, even to the extent of reactors being kept offline.[vi] Thankfully, to date there have been no cases of enforced shutdowns.[vii] However, in the UK the Magnox reprocessing plant at Sellafield underwent a controlled shutdown after more than 8% of its workers self-isolated in March 2020.[viii] The construction of the Hinkley Point C nuclear reactor has also faced delays.[ix]

Looking back a year-and-a-half later, the nuclear industry has the benefit of hindsight about lessons learnt in responding to a crisis. It is therefore imprudent to analyse what occurred during the early days of the Covid-19 outbreak through the lens of perfect foresight; equally, given the pandemic is expected to persist for some time to come, there are likely to be ongoing challenges for the industry. But what is clear even at this point is the pandemic has resulted in significant adjustments to a substantial number of arrangements related to nuclear security – and, significantly, some of these such as remote working are expected to remain embedded in working practices in the longer term.[x] Meanwhile, where planned refuelling or maintenance outages have been deferred, the impacts will continue to play out as operators catch up with overdue activities.[xi] There are also concerns about increased operating costs, associated with implementing Covid-secure measures, and a shortfall in electricity demand from consumers which intersects with a broader reduction in reliance on conventional electricity sources.[xii]

Despite the still considerable challenges faced by the industry, there are already some signs of a positive outlook. There are no incidents to date of the prolonged shutdown of a nuclear power plant due to worker absenteeism or the cancellation of a major construction project. Most importantly,

Covid vaccination programmes are playing a crucial role in decreasing levels of absenteeism in the workplace. In some countries, such as China,[xiii] the vaccination of critical infrastructure workers has been prioritised. Such optimism, however, should be tempered by the inequities in global vaccination distribution. According to latest data,[xiv] countries with the highest incomes are receiving vaccinations more than 30 times faster than those with the lowest.[xv] Moreover, the emergence of new variants of the SARS-CoV-2 virus could diminish the efficacy of vaccines and result in further 'lockdowns', where aspects of society are shut down to prevent disease transmission. Against these challenges, the sector is learning to adapt to new ways of working; no longer in crisis mode, nuclear dutyholders and regulators are largely forging ahead with new and existing projects, while pre-pandemic priorities such as responding to climate change are returning to the fore.

The UK's Experience of Delivering Nuclear Security during the Covid-19 Pandemic

The Covid-19 pandemic has had a severe impact on the UK as a whole, whether viewed in terms of deaths and long-term illness, in damage to the national economy and livelihoods, or in the huge disruption to daily life.[xvi] In the UK nuclear sector, the key challenges faced have included high levels of absenteeism, heightened cyber security risks, securing remote working, delays to external assurance, interruptions to supply chains and higher operating costs. Here follows a discussion of the UK experience of delivering nuclear security during the Covid-19 pandemic.

i. Government Level Engagement

At the onset of the Covid-19 outbreak there was some expectation on the part of the nuclear industry that central government would provide high-level guidance and communicate changes to policy in light of the impacts from disease transmission.[xvii] According to nuclear stakeholders, no specific guidance was initially forthcoming from central government, though generic guidance was issued for industry broadly with an emphatic message about enabling remote working. Meanwhile, the Department for Business, Energy and Industrial Strategy (BEIS) – the government ministry responsible for the nuclear industry – took proactive steps at an early stage of the crisis with regard to the UK's design basis threat (DBT). The DBT was brought to the ministerial level for consideration, with the conclusion that no adjustments were required as there were insufficient intelligence indicators to suggest the threat had in any way changed substantively.[xviii]

BEIS also expanded its reporting channels for the civil nuclear sector, working closely with the Office for Nuclear Regulation (ONR).[xix] Every UK nuclear dutyholder was obliged to provide data to BEIS and the regulator regarding their site status using a RAG (red, amber, green) model – encompassing absenteeism rates, number of Covid cases, cyber security controls, remote working arrangements, security assurance and other relevant information. A key objective of this information gathering exercise was to ascertain the levels of operational sustainability across the UK nuclear estate. This would help to enable the identification of potentially concerning trends so that interventions could be made proactively in order, for example, to maintain the continuous supply of electricity across the UK or avert the potential degradation of safety or security systems.[xx] While the frequency of data reporting has been scaled back somewhat since the initial crisis phase, it is notable that the government and regulator may maintain the heightened levels of reporting, even beyond the pandemic, in order to retain high-level oversight of potential risks to business continuity.

ii. Regulatory Approach and Security Assurance

Over the past two decades the UK has transitioned from a prescriptive rules-based approach to nuclear security regulation, to one built on higher-level objectives, known as Security Assessment Principles (SyAPs).[xxi] Within this new framework, dutyholders are given increased flexibility in their development of security systems which are then assessed by ONR as the regulator.[xxii] One of the

major perceived benefits of this new goal-setting approach to regulation is that it seeks to empower industry to develop innovative and effective nuclear security solutions – with the operator taking greater ownership of their legal responsibilities for security and developing new capabilities in this area. Studies have indicated that such an approach can also serve to strengthen security culture at the organisational level through greater management buy-in and staff engagement.[xxiii]

In the context of the Covid-19 pandemic, operating under this new regulatory framework meant that changes to security implementation were largely developed by the dutyholders, rather than specified by the regulator. Dutyholders have noted the useful flexibility this conferred in developing bespoke solutions that efficiently met the needs of individual sites, helping to ensure security was maintained and the health of personnel protected.[xxiv] Furthermore, the detailed assurance mechanisms developed under this framework, through which security arrangements are validated, meant that ONR was able to reduce the frequency of onsite inspections – helping minimise the risk of infection. Greater emphasis was placed on desk-based assessments and the internal assurance processes set up by individual dutyholders.[xxv] As the effects of the pandemic abate, ONR will continue to conduct an increased proportion of its nuclear security assessment work remotely, due to the already observable efficiencies this offers. Onsite visits will still continue but will be focused on sites which require more intervention and where ONR can add greatest value.[xxvi]

iii. Risk Management

All nuclear dutyholders in the UK have developed their own risk-informed management systems, as mandated by the regulator, and these are regularly revised, tested and updated.[xxvii] Under the UK's regulatory framework, nuclear site licensees are legally required to reduce risks where 'reasonably practicable' to 'an acceptable level'.[xxviii] Prior to the crisis, a pandemic scenario was included as one of the potential risks facing dutyholders in many licensee risk management assessments, with corresponding mitigation strategies set out.[xxix] Yet while dutyholders were aware that a pandemic represented an existential threat, in general this was not considered a likely scenario (typically ranking outside the top-10 in company risk registers). As such, pre-existing mitigation strategies for this specific risk were relatively undeveloped. Indeed, more conventional scenarios were used during the routine testing of crisis management systems.[xxx] Like many sectors around the world, the UK nuclear industry thus initially found itself 'on the back foot' facing the enveloping crisis in early 2020.[xxxi]

Three crucial factors enabled the UK nuclear industry to respond quickly and effectively at the onset of the pandemic, including in the area of nuclear security. First, while dutyholders' risk management assessments did not contain developed pandemic plans, the industry as a whole had considerable experience in enacting contingency and 'in-crisis' planning. For example, some operators already had nuclear security 'incident manning' teams in place; these could develop response mechanisms across the business at speed, and crucially often reported directly to senior management.[xxxii] Second, the experience of regular stress testing of nuclear security systems and an enabling security culture (see below) has created resilience within the broader workforce, with staff also tending to observe protocol, which was particularly relevant in a pandemic. Third, and perhaps most importantly, the aforementioned skeleton pandemic risk management plans acted as a vehicle for more detailed decision-making – and not as a constraint which might occur in overly-detailed, prescriptive response plans. Indeed, it would seem the adaptability and flexibility of these plans, facilitated by the UK's regulatory approach to nuclear security, proved incredibly useful at a time when events were moving fast and relatively little was known about the disease. Nevertheless, one key learning across the nuclear industry has been the need to appraise and iterate the risk registry more frequently, which will help in recalibrating organisations to future potential risks, which by nature evolve over time.[xxxiii]

iv. Securing Operations, Absenteeism and the Supply Chain

At the onset of the pandemic, UK nuclear dutyholders set up their own internal structures to respond to the fast-developing crisis. The focus was on delivering nuclear security within an environment characterised by a high degree of uncertainty and anxiety, but also within which there existed a relative degree of autonomy – government having not yet issued any specific nuclear security directives. Most dutyholders set up their own Covid-19 response units, which worked across the business and, importantly, often reported directly to the senior leadership team. Approaches to delivering nuclear security inevitably differed across organisations, but common principles included the need to secure operations, strengthen contingency planning and protect supply chains. A particularly effective model used transitional phases, comprising: horizon planning; early contingency planning; enacting and planning; implementation; and recovery. These were essentially linear phases but the model was sufficiently flexible to allow the organisation to revert back to an earlier phase, when appropriate.

One of the most significant challenges for the UK nuclear industry was the impact of absenteeism, either from staff stricken by illness, self-isolation or as a consequence of national travel restrictions. In theory, a Covid-19 outbreak concentrated at a nuclear plant could lead to entire shifts off work and unmanageable levels of absenteeism. In spring 2020, there was a short period when the absenteeism rate was very high across the UK nuclear sector; this was at a critical point of the crisis when dutyholders were in the initial process of responding to the crisis and securing operations. While concerns were raised at the time to the regulator, additional staff capacity ensured sufficient 'redundancy' in the system and, thankfully, at no point was there any threat of a UK reactor being shut down or kept offline.[xxxiv] Absenteeism was also an issue that impacted the supply chain. At an early stage of the crisis, dutyholders recognised that protecting the supply chain and networks of local contractors was vital, in some cases requiring reorganisation of existing procurement frameworks to reduce the risk of Covid-19 contagion.[xxxv] Indeed, nuclear power stations in the UK are all located in rural, coastal areas, meaning they tend to be the main employer of the local community. This brings important responsibilities for protecting the wider community beyond the immediate workforce.

At an early stage in the crisis, many staff working in the civil nuclear industry were classified as 'key workers' and, later when the designation changed, as 'critical workers'. This classification was extremely useful for maintaining productivity as, amongst other assistance, staff were able to access childcare during lockdowns. From December 2020, the National Health Service (NHS) began its successful rollout of vaccinations across the UK, helping to reduce levels of absenteeism across all sectors. And since July 2021, workers in the civil nuclear sector have been exempt from isolation in the event they come into close contact with a positive case, on the proviso they take part in daily testing.[xxxvi] The combination of these measures has helped maintained business continuity in the UK nuclear sector, especially during periods of high disease transmission.

Even in normal times, nuclear facilities allow for some limited additional redundancy in the system to safeguard against any potential security threats such as absenteeism. The Covid-19 pandemic has highlighted how the UK nuclear industry tends to build in more contingencies than might be borne out during a crisis – in other words, a 'belt and braces' approach. Thus, the experience of the pandemic has generally affirmed that contingency planning for nuclear security is fit for purpose in the UK. Underscoring the relative resilience of nuclear security arrangements, while absenteeism was seen as a strategic threat – which could even potentially require greater risk being taken on mitigation of the DBT – there was enough flexibility within existing structures for dutyholders to 'flex' their security response.[xxxvii] Indeed, dutyholders were not being required to accept a higher level of risk but rather encouraged to find innovative solutions to deliver nuclear security, in which the UK's regulatory framework was vital in providing an enabling environment.

v. Physical Protection

Despite the pandemic's disruptive impacts across the industry as a whole, the delivery of onsite security generally involved only minor modifications, with fundamental physical protection concepts still being confirmed. The main observable difference was the significantly reduced number of onsite staff, though the overall number of onsite guards was similar to pre-pandemic levels[xxxviii]. At the onset of the pandemic, dutyholders followed through on crisis management protocols by re-assessing the design basis planning, vital areas and vulnerability assessments for their nuclear assets. The most evident change to the risk landscape was that the reduction in onsite staff, which arguably lowered the physical 'insider' threat to nuclear materials. The reduction in onsite staff also simplified patrols as vulnerabilities were more visible, and there was less congestion from vehicles and operations in vital areas.[xxxix] Conversely, there were fewer non-security people present to spot anomalies and potential security vulnerabilities.[xl]

Owing to the inherent dangers in working with nuclear materials, the nuclear industry has some of the strictest safety and security protocols of any sector, with emphasis placed on strict adherence. This approach helped personnel to adapt to the new operating environment with its emphasis on social distancing, enhanced hygiene and personal protective equipment (PPE). Staff were used to working in a highly disciplined and compliant environment, ensuring that PPE and other Covid-19 protocols were complied with throughout.[xli] The requirement for enhanced hygiene has also meant that cleaning became a new focus of nuclear security, with extra cleaning staff being brought onsite to sterilise sensitive items such as security access control touch pads and turnstiles.[xlii]

Early on in the crisis, it became clear that a key priority was protecting facilities and offices from disease transmission, and inevitably safety and security counterparts needed to work closely to solve the practical challenges.[xliii] With significantly fewer staff onsite, dutyholders were able to consolidate some aspects of physical protection, such as reducing the number of entry points, suspending some staff checks and closing onsite car parks.[xliv] While operators did not tend to make substantial alterations to the shifts worked, onsite staff were sometimes placed into 'bubbles' to ensure any potential Covid-19 outbreak could be contained to a single shift; for the same reasons, staff might be rotated less frequently between work stations.[xlv] Meanwhile, there were reductions in the frequency of routine maintenance for some security systems; where maintenance was necessary, this was again often conducted in a 'bubble' structure. Training was another area significantly impacted by the pandemic. In many cases training had to be delayed or its delivery transitioned to digital platforms. Nevertheless, the use of online platforms for training has since been recognised as beneficial by dutyholders, with some aspects of nuclear security training set to continue being delivered via digital platforms in the longer term.[xlvi]

The requirement for social distancing created a number of logistical difficulties for physical protection. In particular, dutyholders needed to find alternative ways to deliver security controls that require proximity between people, such as bag searches and 'pat-downs'.[xlvii] The guard force – which in the UK comprises a Civilian Guard Force (contracted) and the Armed Response Force of the Civil Nuclear Constabulary (CNC) – has encountered more challenges than most in delivering security during the pandemic; guarding by its nature for the most part cannot be conducted remotely. Meanwhile, there have been challenges for nuclear organisations reliant on travel due to the inevitably close proximity between people, especially in the case of car sharing. In fact, the experience of the pandemic has highlighted the inherent vulnerabilities in permitting executive groups and key personnel to travel together in view of the potential risk of a malicious or accidental incident rendering a group of significant decision-makers ineffective.[xlviii]

Despite the ongoing challenges, however, the experience of the pandemic has led to improved efficiencies in some aspects of physical protection.[xlix] Historically, the development of nuclear security in the UK came many decades after the industry itself was established, meaning that physical

protection has tended to be based on a plant's existing operations. But with fewer staff onsite, dutyholders have been able to reassess and streamline a number of nuclear security processes. While the increasing return of onsite staff means some measures will only be temporary, such as relocation of car parks, the situation has triggered internal reviews of such matters on the basis of the benefits identified.[l] With security, safety and human health issues now at the vanguard of dutyholder concerns, it also has proved easier for teams responsible for nuclear security to push through changes to physical protection. In the longer term, the UK nuclear industry is likely to adopt some of these new ways of working where they can be demonstrated to strengthen nuclear security.

vi. Information Management and Cyber Security

The large-scale shift to remote working is arguably one of the most significant operational changes ever experienced by the UK's nuclear industry. In early 2020, organisations faced very short lead-in times and minimal preparation to transition large numbers of staff from nuclear facilities and offices to remote working arrangements. This transition was unprecedented for an industry in which staff were previously overwhelmingly based in nuclear facilities or shared offices owing to stringent safety and security measures. Almost overnight, nuclear organisations needed to implement rigorous security controls on remote networks; just as important, nuclear organisations faced a seismic cultural shift with many of their workers being entrusted to work securely and alone. As in other industries, there were some 'teething problems' with a small minority of staff initially not fully complying with new computer security protocols.[li] Fortunately, most such irregularities were flagged up automatically by network computer security controls.[lii] Owing to the nature of their work, UK nuclear organisations are highly cognisant of the risk of cyber-attacks and accordingly stepped up internal communications regarding cyber security best practice, such as changing passwords regularly, avoiding insecure video conferencing platforms and restricting email messages to work email accounts. At the same time, the rapid upsurge in cyber-attacks on a global level during the pandemic[liii] forced UK nuclear organisations to scale up their security controls.

Despite the upheaval, the interviews conducted by the authors found the UK nuclear industry has broadly found the transition to remote working a positive experience. In particular, some of the bureaucratic obstacles have been removed through increased use of electronic systems, while many staff have enjoyed spending more time at home. Many organisations have signalled plans to maintain some remote working even when the pandemic abates.[liv] In addition, some of the assurance and assessment work by the regulator may continue to be conducted remotely.[lv] Organisations have also observed greater awareness at all levels of security risks related to information management and generally of the vital importance of data.[lvi] Indeed, the nuclear industry's increased dependency on technology was not perhaps fully appreciated in the past. The experience of remote working has also meant that digital communications, information management, cyber security and internet connectively are more fully embedded in organisations' risk assessments and business continuity models.[lvii] The way that the nuclear industry has embraced remote working highlights the transformational impact of a major crisis on organisations – and not only in the nuclear sector – by driving forward changes to working arrangements that may otherwise have taken much longer without such a catalyst. In this respect, crises, although often detrimental to organisations, can also force innovation and strategic change through a shift in risk perceptions.

vii. Insider Threats and Human Reliability Programmes

Across most industries, the risk of the insider threat has increased as a result of the Covid-19 pandemic – a combination of vast numbers of people working remotely and the financial and emotional pressures that can lead to worker disgruntlement. In particular, there are inherent challenges in maintaining oversight of staff with a more dispersed workforce. The UK's Centre for the Protection of National Infrastructure (CPNI) is working with industry to develop training and monitoring in this area, including for when staff return to the workplace after the pandemic abates.[lviii]

In particular, the CPNI has highlighted the importance of providing a duty of care to staff through investing in their wellbeing and professional development, which in turn mitigates against the insider threat.[lix] Recognising the heightened risks, nuclear organisations in the UK have stepped up awareness-raising of the insider threat through internal Human Reliability Programmes.[lx] However, monitoring the use of devices by staff working remotely has to be balanced with issues of confidentiality and the UK's Data Protection Act, in force since 2018. Essentially, organisations have needed to ensure that any increased monitoring is proportional to the perceived risks.

All staff in the UK nuclear industry undergo security checks as part of routine controls. While levels of new recruitment dipped at the onset of the pandemic, especially for contracting staff, there were inevitably additions and changes to the workforce throughout the period – and this still required vetting and personnel screening. Even prior to the pandemic, many aspects of vetting and personnel screening were conducted electronically; now almost all checks take place digitally, which has made the overall process more efficient.[lxi] Another challenge facing the industry at the onset of the crisis was that existing staff had undergone screening premised on them being based in onsite facilities or offices. In consultation with the regulator, nuclear dutyholders were able to extend vetting arrangements for various categories of staff to enable the rapid transition to remote working.[lxii] Organisations increasingly recognise the vital importance of staff wellbeing as part of their duty of care, but the pandemic has highlighted the centrality of this issue for nuclear security too.

viii. Nuclear Security Culture

The Covid-19 pandemic has once again underscored the crucial significance of security culture in the delivery of nuclear security. Early on in the crisis, the majority of staff not working in operational or construction roles were required to work remotely – a hugely transformational shift for an industry where almost all work traditionally had taken place onsite. With a very short lead-in time, nuclear organisations needed to provide the necessary equipment, access arrangements and computer security to enable their staff to work from home.[lxiii] It also required staff to be extremely resilient in order maintain productivity and professionalism during what was an extremely challenging period affecting all aspects of life. Drawing on the IAEA's pyramid model for security culture, derived from Edgar Schein's work on organisational culture, it is useful to reference the fundamental building block of nuclear security – the belief that a 'credible threat exists'.[lxiv] Maintaining cognition amongst the workforce of ongoing security risks was evidently a challenge with a large proportion of staff out of the office. Nuclear dutyholders thus stepped up online communication about nuclear security, even despite inherent security risks not generally being elevated, in order to maintain awareness and alertness among all staff.[lxv]

At the mid-level of the IAEA's pyramid for security culture are 'principles for guiding decisions and behaviours.'[lxvi] These principles include 'professionalism and competence', 'commitment and responsibility' and 'learning and improvement'. Many staff – and not only in the nuclear industry – found the full transition to remote working a challenge due to the lack of human interaction, including the relative lack of oversight. Characteristics such as professionalism, responsibility and competence have been crucial for business continuity but also have provided extra redundancy to protect operations where, for instance, fellow colleagues have been off work with sickness or caring responsibilities. At the top of the IAEA's pyramid are leadership and management systems. As highlighted by previous crises afflicting the nuclear industry, the role of decision-making can be crucial in preventing a situation from escalating.[lxvii] In the UK, the nuclear security functions of organisations benefitted from direct access to senior decision-makers during the pandemic. For instance, teams responsible for nuclear security reported being able to overcome some bureaucratic obstacles in the early phase of the pandemic because senior managers took a largely pragmatic approach, empowering staff to make independent decisions as the crisis rapidly evolved.

Longer-Term Implications

The global nuclear industry as a whole has absorbed a number of lessons from the ongoing experience of the Covid-19 pandemic, and many dutyholders are already integrating these learnings into revised contingency planning arrangements. This process will no doubt ensure that the sector is more resilient to cope with another potential future pandemic. However, while these responses are reassuring, the application of lessons learnt to avert or minimise future crises is often driven by the 'availability heuristic', referring to the tendency in human behaviour to estimate the likelihood of an event based on the ability to imagine or remember an event.[lxviii] Accordingly, humans are much less capable of anticipating potential crises that do not have a precedent in living memory or familiar social discourses. As Toby Ord argues in his work on existential risk, 'Even when experts estimate a significant probability for an unprecedented event, we have great difficulty believing it until we see it.'[lxix]

In order for the global nuclear industry to be adequately prepared for the next future crisis, stakeholders will need to constantly re-appraise their risk registers and ensure that contingency planning and emergency preparedness are fit for purpose. They will also need to ensure that existential risks hitherto deemed extremely unlikely or even negligible are at least reflected within this framework. Equally important, those organisations that focus on building resilience, developing agility and flexibility, and nurturing an effective organisational culture will be much better placed to cope with future crises.[lxx] As shown by the UK case, the regulatory regime can also provide an enabling environment in which dutyholders have the autonomy to respond in a flexible manner consonant with the specific threat being encountered. It is often all too easy for dutyholders and regulators to focus on the more pressing priorities rather than existential threats that can always be left for 'tomorrow'.[lxxi]

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