



Royal United Services Institute  
for Defence and Security Studies



Conference Report

# The 2017 UK PONI Papers

Edited by Cristina Varriale



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Conference Report, September 2017



**Royal United Services Institute**  
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# **Editor's Note**

At the 2017 UK Project on Nuclear Issues (UK PONI) Annual Conference, held at RUSI in June 2017, emerging experts gave presentations on contemporary civil and military nuclear issues. These presentations were then adapted by the experts for this publication. The information contained in the publication is current at the time of writing in July 2017. The views expressed are the authors' own, and do not necessarily reflect those of the authors' institutions, UK PONI or RUSI.



# I. The Collapsing Battlespace: NATO–Russian Nuclear Stability in an Era of Technological Upheaval

Alexander Velez-Green

THE MILITARY-TECHNOLOGICAL ENVIRONMENT has always been in a state of flux. But today, it is changing faster and in more ways than ever before. A series of new military technologies appear poised to enter the battlespace in the next few decades, including in systems such as cyber, anti-satellite and autonomous weapons, hypersonic missiles, electromagnetic railguns and directed-energy weapons. The arrival of these technologies threatens to destabilise NATO's nuclear relationship with Russia by shortening decision-making timelines, heightening ambiguity and undermining first-strike stability.

Cyber weapons are not a 'magic bullet'. Cyber attacks must be tailored to the target's attack surface, which can change rapidly and unexpectedly, thereby nullifying or mitigating the expected effects of a given cyber operation.<sup>1</sup> Yet, strategists in nuclear-armed states have expressed concern that they might not be able to fully defend strategic networks against cyber attack during a crisis.<sup>2</sup> This means that NATO and/or Russian policymakers might feel pressured to act quickly in a crisis – because if they wait, the attacker might be given just enough time to sabotage their strategic systems. The newness of cyber weapons also raises the risk of inadvertent escalation. If an enemy presence is detected in strategic systems, for instance, it may be difficult to quickly ascertain whether it was an attack or just an act of cyber espionage. This might trigger unintended escalation as the aggrieved party acts to get ahead of a perceived attack.

'Use or lose' dynamics are also present in the outer space domain. The US – and by extension its NATO allies – relies heavily on vulnerable satellites to conduct military operations.<sup>3</sup> At the same time, Russia, the US and others are investing in anti-satellite weapons. Weapons such as anti-satellite lasers or 'kamikaze' satellites might be used to rapidly disable enemy satellites.<sup>4</sup>

1. For an illuminating discussion of the implications of cyber weapons for strategic stability, see Michèle Flournoy et al., 'Cyber Weapons and Strategic Stability', panel discussion at Carnegie International Nuclear Policy Conference 2017, Washington, DC, 20 March 2017.
2. James N Miller Jr and Richard Fontaine, 'A New Era in US–Russian Strategic Stability: How Changing Geopolitics and Emerging Technologies are Reshaping Pathways to Crisis and Conflict', Center for a New American Security, September 2017 (forthcoming).
3. Elbridge Colby, 'From Sanctuary to Battlefield: A Framework for a US Defense and Deterrence Strategy for Space', Center for a New American Security, January 2016, pp. 4–8.
4. US officials assess that Russia has deployed kamikaze satellites – known as Kosmos 2499 – designed to ram enemy satellites. See, for example, Jim Sciutto, Barbara Starr and Ryan Browne,

Russia might one day calculate that if it can swiftly disable key US satellites, it would be relatively safe from retaliation, since Washington relies heavily on military satellites for strike and expeditionary operations. This dynamic would raise the likelihood of rapid escalation at the outset of a future NATO–Russian conflict. It also introduces a new risk of inadvertent escalation. As many of the US’s strategic satellites are comingled with non-strategic ones, Russian anti-satellite operations might unintentionally implicate US strategic assets. This could trigger strategic escalation.

The US and Russia are also developing hypersonic weapons, such as hypersonic boost-glide weapons and scramjet-powered hypersonic missiles.<sup>5</sup> These missiles might allow states to strike targets so quickly that the enemy is barely forewarned and has little time to respond. Large hypersonic weapon arsenals might therefore be seen as ideal tools for conducting a surprise, disarming first strike against an enemy’s strategic forces. Moreover, even a small number of hypersonic weapons might be used for disarming attacks on a target’s nuclear command-and-control infrastructure. In either case, they could raise use-or-lose pressures.

In addition, the US and Russia are both investing in electromagnetic railgun technology, which use magnetic fields to hurl shells at speeds above Mach 5.<sup>6</sup> Russia and NATO are also investing in directed-energy weapons, which would use concentrated electromagnetic energy to disable or destroy enemy targets.<sup>7</sup> Strategists on both sides of the Atlantic recognise that both types of systems – if they do mature – might be used to augment ballistic missile defences. If these weapon systems prove as cost effective as many hope, they might enable states to fill the air with enough lead or energy to more reliably intercept incoming missiles – especially if the number of enemy missiles in the sky has already been depleted by a successful disarming first strike. Russian strategists are very concerned about this possibility.<sup>8</sup>

NATO and Russia are investing in a range of autonomous military systems. On the conventional side, a combination of highly automated sensors and data-processors, uninhabited vehicles and swarming protocols could give the first user a decisive conventional military advantage.<sup>9</sup>

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<sup>5</sup>Sources: ‘Russia Tests Anti-Satellite Weapon’, *CNN.com*, 21 December 2016; for a fuller overview of developments in anti-satellite technology, see Lee Billings, ‘War in Space may be Closer Than Ever’, *Scientific American*, 10 August 2015.

5. For a seminal account of hypersonic weapons and their implications for nuclear stability, see James M Acton, ‘Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike’, Carnegie Endowment for International Peace, 3 September 2013.
6. Sam LaGrone, ‘Navy Wants Rail Guns to Fight Ballistic and Supersonic Missiles Says RF’, *USNI News*, 5 January 2015; and Tom Batchelor, ‘Russia Developing Laser, Electromagnetic and Plasma Weapons, Kremlin Says’, *The Independent*, 22 January 2017.
7. Jason D Ellis, ‘Directed-Energy Weapons: Promise and Prospects’, 20YY Series, Center for a New American Security, April 2015; TASS, ‘Russia Develops Directed-Energy Weapons’, 16 September 2015; *Sputnik*, ‘The Future is Here: Russian Army Already Uses Several Types of Laser Weaponry’, 2 August 2016.
8. Robert O Work, ‘Army War College Strategy Conference’, speech given at US Army War College, Carlisle, PA, 8 April 2015.
9. Robert O Work and Shawn Brimley, ‘20YY: Preparing for War in the Robotic Age’, Center for a New American Security, January 2014; Paul Scharre, ‘Robotics on the Battlefield, Part I: Range,

Such a conventional military imbalance might increase the likelihood of the weaker state relying more heavily on nuclear weapons to deter enemy aggression. Indeed, this was the basis for NATO's Flexible Response doctrine early in the Cold War. It is also one of the reasons why many Russian strategists are calling on Moscow to adopt a doctrine of pre-emption today.<sup>10</sup> Uninhabited aerial vehicles might also be used as nuclear delivery vehicles, introducing a new risk of unintentional escalation.<sup>11</sup>

Additionally, there is the possibility that autonomous weapons might one day be able to threaten nuclear systems directly. For instance, highly automated data-processors might allow one side to more reliably target mobile missiles.<sup>12</sup> Some strategists are concerned that seaborne robotic swarms might do the same thing for enemy nuclear submarines by allowing states to more readily track and target their movements.<sup>13</sup> If any of these threats materialised, states would face severe use-or-lose incentives. But, even if they did not materialise, the very possibility that they seemed likely to could cause states to undertake destabilising action, such as heightening alert statuses or delegating nuclear launch authority. This theme – that a threat need not materialise for it to be destabilising – is true for all the technologies discussed here. As long as a state perceives itself to be under threat – whether it is or not – it may be incentivised to behave in destabilising ways.

NATO policymakers must undertake now to manage the escalation risks posed by these technologies. They should focus first on mitigating new ambiguity in the strategic environment. This would include dialogue with Russia to establish 'rules of the road' for cyber and anti-satellite operations, in particular. Such dialogue would help each side to better understand the other's perception of escalation in cyber or outer space. This is critical if states are to craft red lines that are both intelligible and credible to their adversary. Likewise, all parties should take steps to promote the responsible use of military autonomy. Particular attention should be given to preventing the deployment of unmanned nuclear delivery vehicles. Policymakers must also give special attention to emerging threats to the US, the UK, French and Russian nuclear deterrents. Both NATO and Russia have an interest in preventing technological shocks from undermining 'mutually assured destruction' and triggering first-strike and crisis instability.

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'Persistence and Daring', Center for a New American Security, May 2014; Paul Scharre, 'Robotics on the Battlefield, Part II: The Coming Swarm', Center for a New American Security, October 2014.

10. Alexander Velez-Green, 'The Unsettling View From Moscow: Russia's Strategic Debate on a Doctrine of Pre-Emption', Center for a New American Security, 27 April 2017.
11. Alexander Velez-Green, 'The Nuclear Mission Must Stay Manned', *Bulletin of the Atomic Scientists*, 9 August 2016.
12. Paul Bracken, 'The Cyber Threat to Nuclear Stability', *Orbis* (Vol. 60, No. 2, 2016).
13. Jonathan Gates makes a strong argument for why they are unlikely be able to do this. He argues that even an uninhabited undersea vehicle-supported sensor web would have a hard time finding an enemy submarine, given the size of the target area. In addition, information transmission is notoriously slow in the undersea environment. As a result, undersea sensors would have a hard time disseminating real-time intelligence on an enemy submarine's location to the broader sensor web, making it difficult to coordinate web-wide tracking and targeting. It remains to be seen, however, whether advances in operational concepts, sensing or communications technology, or both, might offset some of these limitations. See Jonathan Gates, 'Is the SSBN Deterrent Vulnerable to Autonomous Drones?', *RUSI Journal* (Vol. 161, No. 6, 2016).

Finally, NATO should prioritise improved force resilience. This means raising investments in cyber resilience to ensure that NATO's battle network can absorb and recover from a Russian cyber offensive. Among other things, it also means distributing NATO military space missions across a greater number of cheaper satellites, supported by back-ups, such as drones serving as communications relays. Enhanced resilience can give NATO policymakers additional time to assess the veracity of perceived threats during crisis and respond proportionately. Improved NATO resilience may also help to dissuade Moscow from an attempt at pre-emption by decreasing the likelihood of a successful disarming first strike.

NATO and Russia have entered a period of intensified competition. As that competition heats up, it is imperative that policymakers on both sides take steps to mitigate the escalation risks posed by emerging military technologies. To do otherwise would be to relinquish escalation control to forces other than human judgement, setting all parties on a path to a collision that no one wanted.

## II. Examining Deterrence Measures in the Republic of Korea in an Unpredictable Alliance

Matt Korda

EXTENDED DETERRENCE IS underpinned by both credibility and leverage: the recipient state must believe that its stronger ally will come to its aid if threatened, and in turn the ally must maintain a degree of influence over the recipient's conventional and nuclear policies. Extended deterrence has long formed a major part of the US–South Korean alliance, and it succeeded in regulating South Korea's nuclear posture in the 1970s. However, the viability of US extended deterrence on the Korean Peninsula is under threat today, as the decay of US credibility weakens its leverage over South Korean military posture.

Whether a deliberate measure or simply a product of his turbulent personality, President Donald Trump appears to have taken Richard Nixon's 'madman theory'<sup>1</sup> to heart in his relations with the Korean Peninsula. Since his emergence on to the American political stage, Trump has suggested that US troops should be removed from South Korea;<sup>2</sup> encouraged South Korea to pursue the development of nuclear weapons;<sup>3</sup> demanded that Seoul pays \$1 billion for the Terminal High Altitude Area Defense (THAAD) missile defence system;<sup>4</sup> and threatened to 'solve' the North Korea problem once and for all.<sup>5</sup> Trump's signalling has left South Korea in the dark as to the credibility of his commitment to the alliance.

With alliance credibility in doubt and a ratcheting up of tensions on the peninsula, a visible change in the South Korean deterrence posture can be tracked. This shift centres on the recently announced defence expenditure of a record \$210 billion over the next five years for the expedited development of three indigenous deterrence systems:<sup>6</sup> Kill Chain; Korean Air and Missile Defence; and Korean Massive Punishment and Retaliation Plan. Although South Korean officials publicly cite the increased threat from North Korea as a justification for these

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1. Charles Krauthammer, 'Trump and the "Madman Theory"', *Washington Post*, 23 February 2017.
  2. Gene Gerzhoy and Nick Miller, 'Donald Trump Thinks More Countries Should Have Nuclear Weapons. Here's What the Research Says', *Washington Post*, 6 April 2016.
  3. Gerzhoy and Miller, 'Donald Trump Thinks More Countries Should Have Nuclear Weapons'.
  4. Alex Macfarlane and Taehoon Lee, 'Trump: South Korea Should Pay for \$1B Missile Defense System', *CNNMoney*, 28 April 2017.
  5. Nina Hachigian, 'Trump's Tweets About North Korea Are Making Bad Matters Worse', *Foreign Policy*, 13 April 2017.
  6. Yonhap, 'S Korea to Fully Reinforce Defense System in 5 Years', 14 April 2017.

systems,<sup>7</sup> and it follows a longer trend of increasing defence spending, the shortening of delivery timelines<sup>8</sup> since Trump's election cannot be ignored.

Each of these systems is designed to occupy a different temporal role in the event of a North Korean attack. Kill Chain is a left-of-launch system that would pre-emptively respond to indications of a Democratic People's Republic of Korea (DPRK) attack through counterforce targeting; Korean Air and Missile Defence is designed to shoot down missiles as they approach South Korean targets; and, as the name suggests, the Korean Massive Punishment and Retaliation Plan is a post-launch system, targeting Kim Jong-un and other key leadership positions in the event of a DPRK first strike. Given the relative stasis of the latter system, this analysis focuses mainly on the changes to the first two systems, each of which carries significant policy implications and technical challenges.

As a system designed to pre-emptively target North Korean launchers, Kill Chain must pick up DPRK launch signals and determine their precise locations within minutes. Accurate surveillance is incredibly important in order for this system to function effectively, and North Korea's recent focus on theatre missiles, solid fuel, and tracked transporter erector launchers (TELs) has shown a clear intention to frustrate these efforts. Solid fuel allows for a quicker launch initiation process and requires a much smaller ground crew than liquid-fuelled missiles, thereby making a launch much harder to detect. Given that the most recent CIA data indicates that fewer than 3% of roads in North Korea are paved,<sup>9</sup> this new emphasis on tracked TELs will increasingly allow DPRK launch units to travel off-road and hide missile launchers under trees or in caves.

These capabilities will pose a significant challenge for Kill Chain, given that South Korea lacks an indigenous recon satellite or a significant drone capability. South Korea has overwhelmingly relied on US surveillance assets up to this point, but is currently pursuing an independent satellite capability to mitigate this.<sup>10</sup> In the meantime, Seoul plans to lease satellites from an ally (potentially Israel) until its five military satellites can be deployed in 2022.<sup>11</sup>

Additionally, in response to North Korea's increased emphasis on road-mobile launchers, South Korea is pursuing more precise missile capabilities, including the purchase of 260 Taurus air-launched cruise missiles for 2017 deployment,<sup>12</sup> as well as recent tests of the Hyunmoo family of ballistic and cruise missiles.<sup>13</sup>

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7. Oh Seok-min, 'S Korea to Raise Defense Spending by 2020', *Yonhap*, 20 April 2017.
  8. *Yonhap*, 'S Korea to Fully Reinforce Defense System in 5 Years'.
  9. See CIA World Factbook entry for North Korea, <<https://www.cia.gov/library/publications/the-world-factbook/geos/kn.html>>, accessed 1 August 2017.
  10. Jun Ji-hye. '3 Military Systems to Counter N Korea: Kill Chain, KAMD, KMPR', *Korea Times*, 1 November 2016.
  11. *Yonhap*, 'S Korea to Fully Reinforce Defense System in 5 Years'.
  12. Gabriel Dominguez and Neil Gibson, 'South Korea to Buy Additional Taurus Missiles,' *IHS Jane's Defence Weekly*, 5 October 2016.
  13. Choe Sang-hun, 'South Korea Tests Missile Capable of Striking Any Part of the North', *New York Times*, 23 June 2017.

As a pre-emptive and time-sensitive system, Kill Chain is inherently hindered by South Korea's lack of operational control over its own forces. All wartime defence and military decisions must go through the US-led Combined Forces Command under an agreement that has been in place since the Korean War. The Operational Control (OPCON) transfer to South Korea was supposed to take place in April 2012, but has been continuously postponed by previous conservative South Korean administrations amid rising tensions on the peninsula.

The election of President Moon Jae-in in May could prompt a shift away from this conservative policy of over-reliance on the US. Moon has emphasised the OPCON transfer as a primary policy goal, stating, '[w]e will take charge of our defence ourselves'.<sup>14</sup> However, one of the previously agreed conditions of an OPCON transfer is that it can take place only if South Korea has the capacity to shoot down incoming missiles.<sup>15</sup> To that end, South Korea has made great strides towards completing its second indigenous deterrent: Korea Air and Missile Defense (KAMD).

South Korea's missile defence capability is currently composed of entirely foreign hardware: second-hand US PATRIOT PAC-2 and PAC-3 systems; two Israeli Green Pine radars; six US Aegis naval BMD systems;<sup>16</sup> and the controversial US deployment of a THAAD battery, agreed to by previous conservative governments.

This may change under Moon, who has been pushing for the expedited development of a home-grown Korean missile shield to supplement the deployed foreign hardware. The deployment timelines of three lower-tier, surface-to-air missile systems have been pushed forward to 2018–19, up to three years ahead of schedule in some cases.<sup>17</sup> One such system, the M-SAM, was cleared for mass production in June after passing an initial operating capability test two months earlier than planned.<sup>18</sup> Additionally, the Cheolmae 4-H, currently under development, is modelled after the capable Russian S-400 air defence system and is estimated to operate at twice the performance capability of the PATRIOT batteries.<sup>19</sup> These systems are all meant to supplement, and in some cases replace, foreign-made air and missile defence systems. Extended deterrence will only survive if the stronger ally's resolve is credible, and if the recipient cannot deter adversaries unilaterally. As demonstrated, both of these criteria are currently under threat amid Trump's erratic behaviour and Moon's willingness to pursue independent deterrence systems.

By implementing this series of indigenous deterrence measures, South Korea is eroding its patron's strategic leverage. The US had the influence to dictate South Korean nuclear and

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- 14. Lee Chi-dong, 'Moon Seeks to Adjust US Alliance, Reinforce Independent Defense Capability', *Yonhap*, 10 May 2017.
  - 15. Benjamin David Baker, 'South Korea Goes Indigenous for its Missile Defense Needs', *The Diplomat*, 7 November 2015.
  - 16. Karen Montague, 'A Review of South Korean Missile Defence Programs', George C Marshall Institute, March 2014.
  - 17. Gabriel Dominguez, 'South Korea "in Final Phase" of Developing Cheongung M-SAM', *IHS Jane's Defence Weekly*, 19 April 2017.
  - 18. *Yonhap*, 'S Korea Set to Mass-Produce New Missile Interceptor', 17 June 2017.
  - 19. Baker, 'South Korea Goes Indigenous for its Missile Defense Needs'.

conventional defence policy in the 1970s, but the trends explored in this analysis indicate that this leverage may not exist for much longer.

# III. Forging the Vision: Opportunities and Challenges of the Next Nuclear Posture Review

Michaela Dodge

THE US DEPARTMENT of Defense is currently conducting a Nuclear Posture Review (NPR), which will guide US planning for and investments in its force posture. Nuclear weapons' policy issues are increasingly salient on both sides of the Atlantic, and not entirely for good reasons. These are the only weapons that can quickly end the US and the world as we know them. At the same time, their sheer destructiveness has deterred direct superpower conflict and contributed to an unprecedented period of peace between the great powers. The NPR will offer many challenges and opportunities for the reassessment of the US nuclear posture. A triad of challenges – strategic, fiscal and human – is of particular interest due to these issues' significant potential to limit the scope and the policy space within which the NPR is conducted.

## The Strategic Challenge

'Strategic' in this context refers to how we think about the modernisation of nuclear weapons, which are comprised of warheads and their delivery system. Thinking about nuclear weapons deterrence requirements today is akin to being in the 1920s and coming up with a defence posture that would keep us safe from an existential attack throughout the 1980s and perhaps even the 2000s. In the 1920s, we did not know about the internet or radars, for example, among a great many other technologies that have changed the way we wage and think about warfare. The next nuclear weapons will be in service for many decades, during which their operating environment could change drastically.

The past two decades illustrate just how fast these changes can happen and how off guard we can sometimes be caught. For example, after the end of the Cold War, Russia was expected to become a constructive member of the broader international community.<sup>1</sup> Even as late as 2010, the US government did not see Russia as an adversary, arguing that 'prospects for military confrontation have declined dramatically'.<sup>2</sup> In this context, Russia's 2014 invasion of Ukraine was unexpected.

Due to unpredictable and unanticipated future national security developments, the NPR should prioritise flexibility and adaptability in the US nuclear force posture. Chinese nuclear

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1. Keith B Payne et al., 'A New Nuclear Review for a New Age', National Institute for Public Policy, April 2017, p. 19.
  2. US Department of Defense, 'Nuclear Posture Review Report', April 2010, p. 4.

capabilities remain opaque, but Beijing is developing more advanced nuclear systems in greater numbers.<sup>3</sup> Both Russia and China have active nuclear production complexes that are more capable of producing nuclear weapons than the US. This means that even if all nuclear weapons disappeared tomorrow, the US would be at a strategic disadvantage in terms of nuclear deterrence. Furthermore, the US also cannot afford to disregard other adversaries or potential adversaries, such as North Korea and Iran. US Secretary of Defense James Mattis recently argued that North Korea is ‘the most urgent and dangerous threat to peace and security’.<sup>4</sup> US allies worry about negative security developments in their vicinities and care about Washington’s commitments to their security. This is understandable as the US extends its nuclear umbrella over them. The NPR will have to take that dynamic into account and work collaboratively to find credible options vis-à-vis emerging threats while keeping US allies assured.

The US has a perfect track record of getting future wars wrong. In February 2011, then Secretary of Defense Robert Gates told West Point cadets:

[W]hen it comes to predicting the nature and location of our next military engagements, since Vietnam, our record has been perfect. We have never once gotten it right, from the Mayaguez to Grenada, Panama, Somalia, the Balkans, Haiti, Kuwait, Iraq, and more – we had no idea a year before any of these missions that we would be so engaged.<sup>5</sup>

The US president needs to have a diverse set of options available to respond to rapidly changing international developments. Because the only constant in predicting the future is surprise, the US should refrain from assuming that future deterrence requirements can necessarily be predicted with certainty.

The NPR should also prioritise deterring large-scale attacks over non-proliferation. The 2010 NPR elevated non-proliferation to the top item on the US nuclear weapons policy agenda. Non-proliferation will remain an important component of US security policy, but it should not be a starting point for the structuring of its nuclear forces, since with a resurgent and more belligerent Russia, the security environment has changed drastically since the 2010 NPR.

## The Fiscal Challenge

The US has put off needed investments for so long that its nuclear delivery platform modernisation and warhead sustainment bills will be due at the same time. The Congressional Budget Office projects that the cost of sustaining and modernising the nuclear enterprise will be \$400 billion in the next ten years.<sup>6</sup> Many more hundreds of billions of dollars will be spent after that. It will

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3. US Department of Defense, ‘Annual Report to Congress: Military and Security Developments Involving the People’s Republic of China’, 15 May 2017, pp. 60–61.
  4. Idrees Ali, ‘North Korea “Most Urgent” Threat to Security: Mattis’, *Reuters*, 13 June 2017.
  5. Robert M Gates, speech delivered at United States Military Academy, West Point, New York, NY, 25 February 2011.
  6. This figure includes \$189 billion for strategic nuclear delivery systems and weapons, \$9 billion for tactical nuclear delivery systems, \$87 billion for nuclear laboratories and \$58 billion for command

be difficult to implement modernisation as envisioned if sequestration budget caps remain in place. To make matters worse, many of the critical US conventional weapons systems – such as fighter aircraft, ships and munitions – will come to the end of their service lives during the next decade, creating further competition for scarce resources.

Modernisation is not inherently expensive or unaffordable. Even at the peak of planned modernisation spending, the US would be spending less than 7% of the Department of Defense budget.<sup>7</sup> However, the US has previously not prioritised nuclear weapons modernisation in the federal budget. Maintaining the consensus on the need to prioritise the US nuclear triad and its short-range nuclear weapon systems will be one of the Trump administration's biggest challenges.

## The Human Challenge

Even the best and properly funded modernisation plan will fall short if the US does not develop the right human capital to respond to technological and policy challenges that are likely to arise in the coming decades. That is why the US should devote as much thinking to what kind of talent it needs to develop as it does to setting requirements for future nuclear forces.

The Trump administration can take policy steps that would help to reinvigorate the human element of the future nuclear challenge. It should reverse the policy of no new warheads, no new missions and no new capabilities for existing warheads. In addition to creating new technological challenges that would attract new talent to the National Nuclear Laboratories, loosening policy restrictions would reinvigorate a discussion about the best ways to keep the arsenal safe, secure, reliable and militarily effective.

The administration should also re-examine assumptions behind US policies that preclude nuclear weapon testing. This does not mean that the US should restart nuclear weapons tests at the Nevada Test Site tomorrow. Rather, it needs to encourage some creative thinking about the best options for maintaining the nuclear stockpile. The US needs to be better prepared to conduct a nuclear weapon test in the event that urgent circumstances require it, and it must be able to build new warheads if serious national security developments require it.

The NPR faces a critical challenge: maintaining a consensus on the need to modernise the US nuclear triad while developing flexible and adaptable capabilities that would keep the country safe and allies assured. The NPR will have to take into account tight fiscal environment as well as a worsening international security situation. The Trump administration can turn these negative developments into an opportunity: to re-examine newer and older assumptions embedded in the US nuclear weapons policy, including the policy of three 'Nos' and against yield-producing experiments, which would put Washington's nuclear weapons policy on a sounder footing in the long run.

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and control and early warning systems. For more information, see Congressional Budget Office, 'Projected Costs of US Nuclear Forces, 2017 to 2026', February 2017.

7. Congressional Budget Office, 'Projected Costs of US Nuclear Forces, 2017 to 2026'.



# IV. The Indian Ocean and the South China Sea

Michael Broadbent

*This paper is for discussion purposes only and does not necessarily represent the views of AWE or the UK government.*

TENSIONS IN THE South China Sea have often focused on the dynamic between the US and China. Yet there are an increasing number of submarines in both the South China Sea<sup>1</sup> and the Indian Ocean.<sup>2</sup> This increase, along with the development and deployment of less detectable submarines, could potentially lead to an increased chance of collision between these vessels. A collision between submarines of potentially hostile nuclear powers could be a flashpoint that could lead to escalation.

## The South China Sea

Many of the countries surrounding the South China Sea have rapidly expanding populations and are interested in the potential large oil and gas reserves, along with fishing resources within the region.<sup>3</sup> This is a source of tension. In May 2017, the US Navy vessel, USS *Dewey*, conducted a freedom of navigation exercise near Mischief Reef in the South China Sea. This led to protests from China, which has laid claim to the reef.<sup>4</sup> This is one of the latest in an increasing number of incidents between competing powers in the South China Sea, and the growing number of submarines there is making the problem more acute.<sup>5</sup>

China has a particular interest in this ocean as its SSBN (nuclear ballistic missile submarine) base is on Hainan Island, in the north of the South China Sea.<sup>6</sup> A future Chinese deterrence patrol would likely want to leave its home port and transit through the sea to the Western Pacific, where the SSBN would be much harder to detect, thus putting the continental US at risk. The shallow South China Sea is therefore an inherently risky environment for submarine operations, which is increased further by additional, future Chinese deterrence patrols. The sea has only a

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1. Howard W French, 'China's Dangerous Game', *The Atlantic*, November 2014.
  2. Indian Navy, *Ensuring Secure Seas: Indian Maritime Strategy* (New Delhi: Naval Strategic Publication, 2013).
  3. Dan Southerland, 'The Real South China Sea Crisis Everyone is Missing', *National Interest*, 27 March 2017.
  4. Idrees Ali and David Brunnstrom, 'US Warship Drill Meant to Defy China's Claim over Artificial Island', *Reuters*, 25 May 2017.
  5. Council on Foreign Relations, 'Territorial Disputes in the South China Sea', 1 August 2017.
  6. Damen Cook, 'A Closer Look at China's Critical South China Sea Submarine Base', *The Atlantic*, 18 March 2017.

limited number of access points for submarines, and is crowded by multiple naval patrols and observation points from many different powers.<sup>7</sup>

India has also been increasing its involvement in the area in recent years<sup>8</sup> to protect trade routes and prevent naval encirclement. There are also concerns from India about the potential impact of combined Chinese–Pakistani operations to blockade Indian ports, which would also extend to the Indian Ocean.<sup>9</sup>

## The Indian Ocean

Despite similar regional tensions that affect the states around the South China Sea, the Indian Ocean is a deep-water ocean with many access points. This creates more room for manoeuvre and reduces the chance of collision between submarines. China's interest in the Indian Ocean focuses on protecting oil supplies from the Middle East and the passage of raw materials from Africa. These supply routes are seen as critical as they support a growing economy and increased standard of living in China, which in turn supports internal political stability.

The control of trade routes across the Indian Ocean is of crucial importance to India as well. Approximately 90% of India's trade by volume (equating to one-third of GDP) is by sea.<sup>10</sup> India's maritime reach is extending further towards the Middle East to provide protection to both oil supplies and its diaspora there.<sup>11</sup> This increased naval activity in this region increases the chances of a collision.

Maritime security is also an issue. The August 2013 terrorist attack in Mumbai was launched from the sea and there are concerns over the possibility of nuclear-armed cruise missiles being deployed on Pakistani ships or submarines.<sup>12</sup> The recent and rare visit of a Chinese submarine in Karachi could suggest a greater degree of naval cooperation with Pakistan that could further complicate matters.<sup>13</sup> This is further evidence of increased submarine activity in the Indian Ocean.

In terms of submarine numbers, the Indian Navy currently has one SSBN, the INS *Arihant*, with another undergoing sea tests and two more under construction. This would increase the number of deployed submarines in the Indian Ocean.<sup>14</sup>

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7. French, 'China's Dangerous Game'.
  8. *Ibid.*
  9. Saima Ali, 'Maritime Security & Pak–China Cooperation', *Pakistan Observer*, 25 July 2017.
  10. Supply and Demand Chain Executive, 'India Requires Infrastructure to Match Growth Forecasts', 7 November 2013.
  11. Indian Navy, Ensuring Secure Seas: Indian Maritime Strategy, (Naval Strategic Publication 1.2, October 2013)
  12. Abhijit Singh, 'Pakistan's Naval Transformation: Dangerous Delusions, Soaring Ambitions', *War on the Rocks*, 7 December 2016.
  13. *Economic Times*, 'Satellite Imagery Reveals Presence of Chinese Nuclear Submarine in Karachi', 9 January 2017.
  14. *Economic Times*, 'Defence Preparedness: 6 Recent Developments that will Boost India's Submarine Fleet', 12 November 2015.

In addition, a number of major powers have deployed SSNs (nuclear attack submarines) to both the Indian Ocean and the South China Sea. The US Navy is currently investing in upgrading the *Los Angeles*-, *Seawolf*- and *Virginia*-class submarines to try to maintain the current technological edge over the People's Liberation Army Navy.<sup>15</sup>

Some regional states are increasing the numbers of SSKs (conventional attack submarines) they have available. For example, Australia is investing AU \$50 billion to replace the *Collins*-class submarine.<sup>16</sup>

## Chance of Collision

The rise in the number of submarines in both oceans increases the probability of a collision although there is a variable element of chance. The volume of the ocean is also a determining factor. The probability of a collision can be approximated by the equation:

$$\text{Chance of Collision} = (\text{bad luck}) \frac{\text{Number of Submarines}}{\text{Ocean Volume}}$$

Of course, the chance – or simple bad luck – cannot really be quantified. Table 1 compares the depth and volume of the Indian Ocean and the South China Sea, along with the North Atlantic for comparison.

**Table 1:** Ocean Depth and Volume

Ocean	Volume (million m <sup>3</sup> )	Average Depth (km)
North Atlantic	150	4
Indian Ocean	260	4
South China Sea	10	1.5

Source: BW Eakins and GF Sharman, 'Volumes of the World's Oceans from ETOPO1', NOAA National Geophysical Data Center, 2010, <[https://www.ngdc.noaa.gov/mgg/global/etopo1\\_ocean\\_volumes.html](https://www.ngdc.noaa.gov/mgg/global/etopo1_ocean_volumes.html)>, accessed 20 July 2017.

It is important to note, however, that this does not take into account the useable volume of the oceans due to the limits of undersea topography. The information identifies that the South China Sea has an order of magnitude lower volume than the other oceans.

In the Indian Ocean, submarine numbers are likely to increase as outlined earlier, but given the large volume, the chance of collision only marginally increases. In the South China Sea,

15. Kris Osborn, 'US Navy Pursues High-Tech Submarine Upgrades', *Military.com*, 18 April 2015.

16. Greg Austin, 'Australia's Submarine Superiority: Strange Strategies and Overspending', *The Diplomat*, 6 May 2016.

however, due to the small volume and projected substantial increase in submarine numbers, the chance of collision increases measurably. This is heightened by the additional constraint of the likely operating area to observe existing trade routes, which further reduces the area in which submarines are likely to be found.

Another factor is that improvements to submarine technology which reduces signatures, making them more stealthy, means they are less likely to detect one another prior to a collision.

Regional states will therefore have to improve communications to reduce the possibility of submarine collisions. There is also a need for trust between states, which could be improved by staging joint submarine crew recovery exercises.

# V. How We Talk about ‘The Bomb’

Ben Stanley

*This paper is for discussion purposes only and does not necessarily represent the views of AWE or the UK government.*

THE WORLD TODAY is different to the one in which the ‘atomic bomb’ and the concept of deterrence were conceived and matured. The world has developed into a multipolar and globalised community, where technology has advanced at a pace, and policy has had to mature in parallel, or play catch-up; rarely does it advance in anticipation. The UK’s nuclear deterrence posture has not changed much since the first submarine went on patrol in 1969, giving Britain a second-strike capability.<sup>1</sup> Has the dialogue on nuclear weapons in the UK been similarly frozen, and what effect will this have on the nuclear industry?

The UK, as a symptom of a larger lack of public conversation on nuclear matters,<sup>2</sup> does not talk about the bomb unless in a political debate related to a major decision or vote, such as the 2016 parliamentary vote on the renewal of Trident.<sup>3</sup> Outside such voting cycles, the public has limited exposure to the deterrent,<sup>4</sup> in the same way as engineers and scientists have a lack of exposure to the process of policy decisions which govern their work, unless directly involved in decision making. Unless engagement between the public, engineers and policymakers is increased, there is a risk in the nuclear industry of a loss of knowledge.

In addition to this disconnect between the technical, policy and public spheres, there is also a generational divide. The nuclear workforce can be split into three main generations: The Old Guard, aged 50–70, who gained professional experience during the Cold War; Transitional, aged 35–50; and the New Generation, aged 18–35. As in any workplace, those with more experience pass on their knowledge to those with less, and this is vital for areas such as safety and security, where the cost of failure may be high. Any interruption to this transfer of knowledge and experience to those early in their career could result in a loss of information.

The Nuclear Energy Institute has found that the workforce in the nuclear industry is getting younger.<sup>5</sup> In 2003, there was a risk that skills and knowledge would peter out as those in their

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1. BBC, ‘A Guide to Trident and the Debate about Replacement’, 23 May 2017.
  2. International Studies Association, ‘What We Talk About When We Talk About Nuclear Weapons’, H-Diplo Forum (No. 2, 2014).
  3. Hansard, House of Commons, ‘UK’s Nuclear Deterrent’, Debate, 18 July 2016, Column 559.
  4. Andrew Futter (ed.), *The United Kingdom and the Future of Nuclear Weapons* (London: Rowman & Littlefield, 2016), p. 153.
  5. Nuclear Energy Initiative, ‘Nuclear Industry Workforce Getting Younger’, 21 October 2015, <<https://www.nei.org/News-Media/News/News-Archives/Nuclear-Industry-Workforce-Getting-Younger>>, accessed 24 August 2017.

30s to 50s moved towards retirement. However, the trend ended when industry leaders realised the risk and adapted the age distribution.

While the figure may suggest that the age disparity is changing favourably, it cannot be inferred that the knowledge and understanding is transferred both internally to the new generation and externally to the public.

The impact of improper knowledge transfer can lead to a lack of technical understanding. This may affect engineers', policymakers' and public understanding of the issue.<sup>6</sup> The public's lack of understanding could affect the 'support for the mission', as witnessed by a poll which suggested that one in five of the public was opposed to Trident's renewal and 29% were in favour of submarines without warheads.<sup>7</sup> This could diminish the UK's commitment to its nuclear deterrent.

There has been a historic 'need-to-know' policy in the defence sector, where workers do not discuss their work with each other and have limited, if any, engagement with the public. This was intended to prevent proliferation and was used to limit terrorist access to information. In recent years, however, there has been a change of direction. There are now 'nuclear graduate' programmes, which have increased the opportunity for knowledge capture and development for those who are starting out in, or are in the early stages of, their career.

A person's understanding of nuclear issues is dependent on the environment in which they live. A policymaker from the Cold War era who experienced a world dominated by the US and the Soviet Union, and saw the Cuban Missile Crisis unfold, will see things differently from someone who lives in today's multipolar world.

Wider engagement and at all levels through academia, industry and government is required to mitigate a loss of knowledge and understanding. The nuclear industry can work with universities sending visiting lecturers, running open days or supporting industry placements for students so that they can see available career pathways. Facilities – such as the UK's Atomic Weapons Establishment's Orion laser<sup>8</sup> – could show members of the public how nuclear technology is developing, how it affects them and what contribution they can make. Policy writers and governments can show members of the public how policy is written, enacted and responded to, explaining the procedure and why a certain process is used. All these things are happening, and are growing in scale as time progresses, but to bridge the gap in understanding between the industry, policymakers and the public, they need to be further accelerated.

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6. Ken Booth and Frank Barnaby (eds), *The Future of Britain's Nuclear Weapons: Experts Reframe the Debate* (Oxford: Oxford Research Group, 2006), p. 68.
  7. Andrew Grice, 'Trident: Majority of Britain's Keep Backing Nuclear Weapons Programme, Poll Shows', *The Independent*, 24 January 2016.
  8. Atomic Weapons Establishment, 'Orion Laser Facility', <<http://www.awe.co.uk/what-we-do/science-engineering-technology/orion-laser-facility>>, accessed 3 August 2017.

# VI. Disarming Without the Armed: The Subversive Arms Control Model

Jennifer Knox

**A**FTER SEVERAL WEEKS of negotiations, 122 states have recently voted to adopt the text of a treaty to comprehensively prohibit nuclear weapons.<sup>1</sup> None of the 122 states actually possesses nuclear weapons, so the initiative to ban a type of weapon without the involvement of its major users and producers defies conventional wisdom on how to achieve arms control.

The nuclear ban process is not the first of such initiatives, but was directly preceded by the Convention on Cluster Munitions (2008)<sup>2</sup> and the Anti-Personnel Mine Ban Convention (1999).<sup>3</sup> These were ‘humanitarian’ initiatives that reframed the normative context of the relevant weapons’ classes and were heavily resisted by major users and producers.

Existing models are not sufficient to analyse arms control initiatives that do not rely upon, and often openly disregard, the participation of the major users and producers of the weapons they seek to prohibit. This paper presents a new framework for examining this emerging arms control model, of which the nuclear ban is the latest example: subversive arms control.

Subversive arms control diverges from traditional arms control both in its aims and in the mechanisms by which it seeks to achieve those aims. By examining the outcome of existing subversive arms control agreements, it is possible to better understand the nuclear ban and make predictions about its efficacy.

The characteristics of traditional arms control make a stark comparison to subversive arms control. The aim of the traditional approach is to change or constrain the behaviour of parties within a common agreement. Treaties are adopted exclusively by states that are to be affected by restrictions, resulting in bilateral or narrowly multilateral agreements among users and producers. Usually justified on the basis of common security interests, the mechanisms towards implementation are formally defined, establishing rigorous enforcement and

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1. UN, ‘Conference to Negotiate Legally Binding Instrument Banning Nuclear Weapons Adopts Treaty by 122 Votes in Favour, 1 Against, 1 Abstention’, DC/3723, press release, 7 July 2017.
  2. Convention on Cluster Munitions, <<http://www.clusterconvention.org/the-convention/convention-text/>>, accessed 17 August 2017.
  3. UN Office for Disarmament Affairs (UNODA), ‘Anti-Personnel Landmines Convention’, <<https://www.un.org/disarmament/geneva/aplc/>>, accessed 17 August 2017.

verification regimes. An example is the Intermediate-Range Nuclear Forces Treaty (1987), or INF. Although the treaty was highly relevant to the security of European states, only the US and the Soviet Union joined the agreement that stipulated specific qualitative reductions to their nuclear arsenals. The INF Treaty established the Special Verification Commission to monitor compliance and embraced measures such as on-site inspections for verification purposes.<sup>4</sup>

In contrast, subversive arms control initiatives tend to emerge after failed attempts to come to an agreement within traditional forums dominated by major users and producers of the relevant weapons type. Negotiating parties seek to change or constrain the behaviour of parties that are *external* to the treaty process, often tacitly acknowledging that they hold no expectation that they will join the resulting agreement. The aim instead is to create or strengthen a normative standard that will influence the behaviour of states regardless of treaty participation. Subversive arms control is therefore broadly multilateral and open to all states, not just those with capabilities that the resulting treaty seeks to affect. Because the aim is normative, its mechanisms are the existence of the treaty itself and broad, international participation in the agreement. As a result, enforcement and verification measures are nominal or non-existent. Instead, flexible provisions and low thresholds for entry-into-force maximise state engagement with the treaty.

The Ottawa process<sup>5</sup> that established a prohibition on landmines in 1999 and the Oslo process<sup>6</sup> that established a prohibition on cluster munitions in 2006 are examples of subversive arms control used successfully to constrain conventional weapons use and production. Initially prompted by stalled efforts to achieve progress on weapons limitations in the Conference on Disarmament and the Convention on Conventional Weapons,<sup>7</sup> both treaties focused on a normative reframing of the weapons in question around humanitarian concerns. Both processes were rejected by the major users and producers of the weapons in question,<sup>8</sup> and both proceeded nonetheless with broad multilateral support: as of 2017, 162 states are party to the Anti-Personnel Mine Convention, and 102 are party to the Convention on Cluster Munitions.<sup>9</sup>

Most major users and producers of the weapons in question continue to boycott these two agreements. Nevertheless, state behaviour has changed markedly in the short time since these treaties have come into force. Since 1999, there has been a major decline in the use and production

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4. Arms Control Association, 'The Intermediate-Range Nuclear Forces (INF) Treaty at a Glance', June 2017, <<https://www.armscontrol.org/factsheets/INFtreaty>>, accessed 3 August 2017.
  5. Jim Wurst, 'Closing In On a Landmine Ban: The Ottawa Process and US Interests', *Arms Control Today*, 1 June 1997.
  6. Steve Goose, 'The Oslo Process: Ending Cluster-Bombs', Human Rights Watch, 19 November 2007.
  7. John Borrie, *Unacceptable Harm: A History of How the Treaty to Ban Cluster Munitions Was Won* (New York and Geneva: United Nations Institute for Disarmament Research, 2009), pp. 30–31, 160–161, 190.
  8. The major users and producers of landmines at the time were China, India, Israel, Pakistan, Russia and the US. The major users and producers of cluster munitions at the time were Brazil, China, India, Israel, Pakistan, Russia and the US; Borrie, *Unacceptable Harm*, pp. 32, 149.
  9. UNODA, 'Disarmament Treaties Database', <<http://disarmament.un.org/treaties/>>, accessed 15 June 2017.

of landmines, as well as the destruction of 51 million stockpiled mines.<sup>10</sup> Notably, this progress is not limited to parties to the landmine ban. Since it came into force, the US introduced a moratorium on landmine production, sharply cut existing stockpiles, and announced a policy of non-use except in the Korean Peninsula – all despite not being a signatory to the treaty.<sup>11</sup> Landmine use has almost disappeared among state actors, including major users and producers.<sup>12</sup> Results are slightly more mixed for the Convention on Cluster Munitions. There have been episodes of significant use of cluster munitions in Syria and Yemen, both non-parties since the convention entered force.<sup>13</sup> Nevertheless, there has been a decline in use and production of cluster munitions among some non-signatories, especially the US, and 93% of global stockpiles have been destroyed.<sup>14</sup>

Overall, these treaties demonstrate that subversive arms control has an impressive track record when traditional forums are dominated by the users and producers of a specific weapons class. The influence of these agreements on state behaviour is not limited to participation or formal verification and enforcement regimes; instead, normative mechanisms altered the behaviour of states external to, as well as internal to, the agreements.

The nuclear ban clearly belongs among the body of subversive arms control. It stems from the frustration of non-nuclear-weapon states with the weaknesses of the Non-Proliferation Treaty (NPT) regime and failure to achieve new progress towards disarmament. It aims to regulate the behaviour of states that have not taken part in its negotiations and which will not join a resulting treaty. It is a broadly multilateral treaty and will doubtless involve a majority of states. The threshold for entry into force is low, flexible provisions accommodate controversial issues, such as transit and verification standards, and there are only nominal efforts to address implementation or enforcement of disarmament, which is not expected to occur within the treaty framework. Instead, the aim of the treaty is broad and normative influence on the behaviour of external actors.

These qualities of the treaty text have been criticised, and certainly they would threaten traditional arms control approaches, which work through formalised mechanisms targeting participants. However, the subversive arms control model demonstrates how characteristics that would typically be perceived as weaknesses are in fact fundamental to this developing, normative approach to arms control.

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10. Anti-Personnel Mine Ban Convention, 'Stockpile Destruction,' <[https://www.apminebanconvention.org/fileadmin/user\\_upload/StockpiledMinesDestroyedByStatePartyJun2017.pdf](https://www.apminebanconvention.org/fileadmin/user_upload/StockpiledMinesDestroyedByStatePartyJun2017.pdf)>, accessed 15 June 2017.
  11. David Alexander, 'US Says will Abide by Mine Ban Treaty Except on Korean Peninsula', *Reuters*, 23 September 2014.
  12. International Campaign to Ban Landmines and Cluster Munition Coalition (ICBL and CMC), *Landmine Monitor 2016* (Geneva: ICBL and CMC, November 2016), pp. 1-2, <<http://reliefweb.int/sites/reliefweb.int/files/resources/Landmine-Monitor-2016-web.pdf>>, accessed 15 June 2017.
  13. *Ibid.*
  14. ICBL and CMC, *Cluster Munitions Monitor 2016* (Geneva: ICBL and CMC, August 2016), p. 8, <<http://www.the-monitor.org/media/2394895/Cluster-Munition-Monitor-2016-Web.pdf>>, accessed 17 August 2017.

The nuclear ban has not failed because nuclear-weapon states have chosen to boycott it, but there are nevertheless significant obstacles facing the process. Subversive arms control has achieved its aims to an impressive degree in the cases of landmines and cluster munitions, at least so far. However, nuclear weapons have a very different, even exceptional, role in the security of the states that rely on them. Using norms to change the cost–benefit calculations for reliance on landmines and cluster munitions was effective because other weapons were less costly alternatives that could still fill a similar strategic function. By comparison, it is more difficult to make the argument that conventional weapons could replace the strategic roles of nuclear weapons, especially for nuclear-weapons powers such as Pakistan that have disproportionate conventional weaknesses.

Second, the participation of allies of nuclear powers may be critical to the normative processes that subversive arms control seeks to initiate. Allies of major users and producers are best positioned to increase the political and security costs of relying on prohibited weapons. So far, not only nuclear weapons possessors but also their security partners have demonstrated strong resistance to the nuclear ban process, which may insulate nuclear powers from shifts in the cost–benefit calculus for possession.

Finally, nuclear weapons have so far proved to be more resilient to normative influence than other types of weapons. Landmines and cluster munitions had received little scrutiny by the public for their humanitarian impacts prior to the Ottawa and Oslo processes, which represented a watershed moment in civil society participation on their respective weapons issues. The same cannot be said for nuclear weapons, the use and possession of which is already heavily stigmatised in the international community. The elimination of nuclear weapons is considered a foundational objective of the UN and features in the General Assembly's first resolution.<sup>15</sup> Civil society has advocated against nuclear weapons possession and use almost since their conception, and the issue of disarmament has witnessed massive public engagement around the world.

Most criticism and support regarding the nuclear ban relies on a traditional arms control framework, which does not capture the aims and mechanisms of subversive arms control. To argue for or against a successful outcome, first it is essential to establish *what* the intended outcome is as well as *how* it is pursued. For subversive arms control processes, such as the nuclear ban, the aim is normative influence on the behaviour of external actors via maximised participation in a broad reframing of values and expectations. It will be difficult to translate the success of earlier subversive arms control treaties to nuclear weapons, which play a unique role in security and society; nevertheless, subversive arms control can be an effective approach because of, and not despite, the ways in which it deviates from traditional models.

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15. UNODA, 'Nuclear Weapons', <<https://www.un.org/disarmament/wmd/nuclear/>>, accessed 15 June 2017.

# VII. US Nuclear Modernisation: Necessary and Feasible?

Christina Krawec

In 2016, US President Barack Obama approved a multibillion-dollar nuclear modernisation programme. The plan devotes a significant portion of the US defence budget to update nuclear weapon delivery systems, modernising the three branches of the nuclear ‘triad’: land-based intercontinental ballistic missiles (ICBMs); sea-based submarine-launched ballistic missiles (SSBNs); and air-based strategic bombers.<sup>1</sup> While US nuclear modernisation is necessary to maintain reliable international deterrent, the current plan is problematic: it is not financially realistic. Therefore, a framework for prioritisation is needed to cut the high predicted costs.

## A Necessary Cost

Former US Secretary of Defence Ash Carter, during his September 2016 visit to North Dakota’s Minot Air Force Base, said that modernisation is ‘not a choice between replacing these platforms or keeping them; it’s really a choice between replacing them or losing them’.<sup>2</sup> This is indeed the case: the nuclear triad is out of date. The current air-based B-52H bomber fleet is ageing rapidly. By the 2040s, when these aircraft retire, many will have served upwards of 70 years.<sup>3</sup> The US Navy also plans to replace the *Ohio*-class SSBNs with twelve new *Columbia*-class submarines.<sup>4</sup> Captain Scott Pappano of the US Naval Sea Systems Command has cited major concerns regarding the analogue data-processing systems and tactical electronics currently used in SSBNs: replacement parts are becoming obsolete and more difficult to find.<sup>5</sup> If the US does not replace these technologies, they will be lost.

The valued continuation of deterrence is another reason the US must maintain strong nuclear capabilities. A solid form of deterrence acts as a threat to adversaries: if an attack occurs, the US has the capacity and willingness to strike back with unacceptable damage. As long as nuclear weapons exist, the US will maintain an interest in ensuring its own arsenal can provide a reliable and effective deterrent.

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1. Kingston Reif, ‘US Nuclear Modernization Programs’, *Arms Control Today*, 5 June 2017.
  2. Yeganeh Torbati, ‘Cost of Modernizing US Weapons to Fall to Next President’, *Reuters*, 27 September 2016.
  3. *Defence Industry Daily*, ‘Up to \$11.9B for B-52H Maintenance’, 28 July 2017.
  4. Reif, ‘US Nuclear Modernization Programs’.
  5. Megan Eckstein, ‘Subs Approaching Several Firsts as Navy Prepares Them to Reach 42 Years of Service’, *USNI News*, 3 February 2016.

A strong nuclear arsenal serves, furthermore, as a powerful message to allies. Modernisation signals that the US is committed to protecting its non-nuclear allies and cooperating with other nuclear-weapons states (NWSs) to work towards peace. Non-nuclear allies rely on the US for protection, and drastically lowering the number of such weapons will shake their trust. Modernisation serves as an international reminder that the US is equal to other NWSs, will not be intimidated by another state's nuclear option, and that diplomacy is the best and only option for resolving tensions.

## Modernisation Concerns

Although maintaining a robust nuclear deterrent is vital, it must also be cost effective. The highest concern regarding the nuclear modernisation scheme is its cost. The plan calls for \$400 billion over the next decade to be spent on advancing nuclear weapons delivery systems, or an estimated \$1 trillion in the next 30 years.<sup>6</sup> But placing \$1 trillion into modernisation may weaken other branches of the US military as their financial requests are rejected; for example, US Navy plans to build SSBNs will use funding meant for conventional ships.<sup>7</sup>

Opponents of modernisation, such as former Secretary of State Bill Perry, claim that the solution to these slowly deteriorating technologies is to retire current fleets without replacing them.<sup>8</sup> However, this would sorely undermine US security. The bomber and submarine fleets are arguably the most important aspects of the nuclear triad. The US must keep long-range bomber aircraft because they can be armed with both conventional and nuclear warheads, allowing flexibility in a variety of defensive and offensive situations.<sup>9</sup> The submarines are vital for survivability; because they are hidden in the ocean and more undetectable than the aircraft or land-based systems, they will likely survive an adversary's first strike.<sup>10</sup> These weapons give the US military the unique flexibility and protection vital for defence against a nuclear threat.

## Prioritisation Recommendation

Given the high costs associated with the current modernisation plan, other options should be considered. By prioritising certain aspects of the triad over others, an alternative modernisation framework can be established.

### **Delay ICBM Replacement**

The current plan calls to replace ICBMs with the new Ground-Based Strategic Deterrent (GBSD). However, the land-based leg of the triad has several weaknesses. These delivery systems cannot

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6. Congressional Budget Office, 'Projected Costs of US Nuclear Forces, 2017 to 2026'.
  7. James E Doyle, 'Better Ways to Modernise the US Nuclear Arsenal', *Survival* (Vol. 58, No. 4, 2016), pp. 27–50.
  8. 'Nuclear Modernization', William J Perry Project, <<http://www.wjperryproject.org/nuclear-modernization>>, accessed 3 August 2017.
  9. Kingston Reif, 'Budget Would Raise Nuclear Spending', *Arms Control Today*, March 2016.
  10. Torbati, 'Cost of Modernizing US Weapons to Fall to Next President'.

be forward deployed, reducing their ability to provide allies with the assurance of protection. In addition, neither the ICBM nor the GBSD can be used against any nation other than Russia. If the US were interested in targeting countries, such as Iran or North Korea, the targeted launch path would pass over Russia, possibly causing panic and pre-emptive retaliation. Therefore, plans to modernise the land-based leg of the triad should be put on hold while the air- and sea-based legs remain the main focus. The mobility of the other two delivery pathways gives the US flexibility to change tactics at the last minute and recall attacks, which cannot be done with ICBMs.

Furthermore, the other two delivery systems do not have a ‘use-it-or-lose-it’ mentality. In other words, in the event of an attack against the US, there would be limited time to decide whether or not to launch an attack with ICBMs – or risk having the entire fleet wiped out by adversaries. The scattered and mobile nature of the other two legs of the triad do not face this challenge.

### **Reduce Number of Active Submarines**

The US could also consider downgrading from twelve submarines to ten, which would save around \$13 billion over the next decade.<sup>11</sup> Under current plans, there will be a period of approximately ten years (2030–40) during which only ten submarines will be active due to the *Ohio*-class decommissioning and *Columbia*-class commissioning schedules.<sup>12</sup> Therefore, the US Navy can use this decade to evaluate the long-term benefits of running an effective deterrent with ten submarines. If it appears to be viable, the final two submarines do not need to be introduced to the planned fleet.

### **Prioritise Air-Based Long-Range Standoff Missile (LRSO)**

The current modernisation programme intends to replace the Air-Launched Cruise Missile with the Long-Range Standoff Missile (LRSO). This should remain a top priority because LRSOs provide a number of strategic benefits that will strengthen the overall US nuclear capability. First, the LRSO can avoid Anti-Access/Area Denial weapons, which have been in development in Russia. Adversaries’ improving air defence means that it could be too dangerous for bomber pilots to fly in and drop, for example, a gravity bomb in external territories. The LRSO eliminates the need for pilots to fly in themselves, allows for more loitering time outside dangerous territories and gives the US administration more time to make critical wartime decisions. The flexible nature of LRSOs can also make strategic planning for potential adversaries more difficult, since they cannot predict where or when the LRSO will be deployed. Because of these characteristics, LRSO development is indispensable for US modernisation.

## **Conclusion**

The nuclear modernisation scheme is imperative for the continuation of a viable US nuclear programme as an effective deterrent. However, in its current state, the plan poses serious

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11. Ronald O'Rourke, 'Navy Columbia Class (Ohio Replacement) Ballistic Missile Submarine (SSBN[X]) Program: Background and Issues for Congress', US Congressional Research Service, 12 May 2017.

12. *Ibid.*

fiscal challenges. By prioritising the LRSO, reducing the number of operational submarines and delaying land-based systems, the US nuclear deterrent can satisfy its missions and purpose in a cost-effective manner. The US deterrence force has a serious effect on the world and its continued nuclear development; therefore, as an integral part of international affairs, the plan should be implemented with caution and practicality.

# VIII. A Novel Approach to Submarine Dismantling

Michael Donnington

LUNCHED IN 1960, HMS *Dreadnought* was the first British nuclear-powered submarine. Since then, all subsequent vessels have been powered the same way, including those dedicated to maintaining the Continuous At Sea Deterrent. Despite the significant operational benefits nuclear propulsion provides,<sup>1</sup> by its very nature, once a submarine completes its life in service, it cannot be disposed of by existing means.

With the correct maintenance procedures, nuclear submarines can remain in afloat storage indefinitely. Yet, due to a combination of government policy to be a responsible nuclear operator, the increasing costs of submarine storage and the desire of the general public and external stakeholders to find a more sustainable solution, it was decided to launch the Submarine Dismantling Project (SDP) to consider the available options. Its aim is to deliver a safe, environmentally responsible, secure and cost-effective solution for dismantling 27 of the UK's defuelled nuclear-powered submarines after they leave service with the Royal Navy.

The SDP is sponsored by the Ministry of Defence (MoD), with seven decommissioned submarines stored afloat at Rosyth Royal Dockyard in Scotland, and thirteen at Devonport Royal Dockyard in Plymouth.<sup>2</sup> A further seven are still in service; the remaining are *Trafalgar* class and *Vanguard* class. It is planned that seven will be dismantled at Rosyth and 20 at Devonport.

Countries such as the US, Russia and France have implemented a full Reactor Compartment (RC) separation and storage technique.<sup>3</sup> This involves cutting the complete RC from the submarine, and preserving and storing it on land. Following a public consultation by the MoD, however, it was agreed that all radioactive waste would be removed from a complete submarine before being transported to a UK ship breaker for full dismantling:<sup>4</sup> a new approach.

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1. Magdi Ragheb, 'Nuclear Naval Propulsion', in Pavel Tsvetkov (ed.), *Nuclear Power – Deployment, Operation and Sustainability* (Rijeka, Croatia: InTech, 2011), p. 7.
  2. Ministry of Defence, 'Submarine Dismantling Project, Consultation Document on the Site for Interim Storage of Intermediate Level Radioactive Waste', November 2014.
  3. David Wells, 'Nuclear Powered Submarine Dismantling Past, Present and Future', Nuvia, April 2014.
  4. Ministry of Defence, 'Submarine Dismantling Project, MoD's Response to Consultation', March 2013.

## The SDP Strategic Decisions

The MoD has undertaken a thorough and robust consultation programme with the general public, which has been used to make key decisions that include the removal of radioactive waste at both Devonport and Rosyth. This will share the opportunities, including careers, supply chain and learning, across two communities, and prevent the need for costly transport of decommissioned submarines between sites as well as the political risk associated with transporting the submarines from Devonport to Rosyth and vice versa.

The Reactor Pressure Vessel (RPV) will be removed intact and packaged in a transport container. It will be consigned to an interim store until the Geological Disposal Facility (GDF) is available. The RPV will not be removed from the submarine until the transport container and interim store are ready, and the regulatory approvals are in place. The interim Intermediate Level Waste (ILW) store will be located at the site in Capenhurst, Chester; Atomic Weapons Establishment Aldermaston is retained as a fallback site.<sup>5</sup>

## The SDP Strategy

To deliver the safe dismantling of submarines, five distinct but integrated projects have been developed to take a boat from afloat storage through to being fully dismantled (Figure 1).

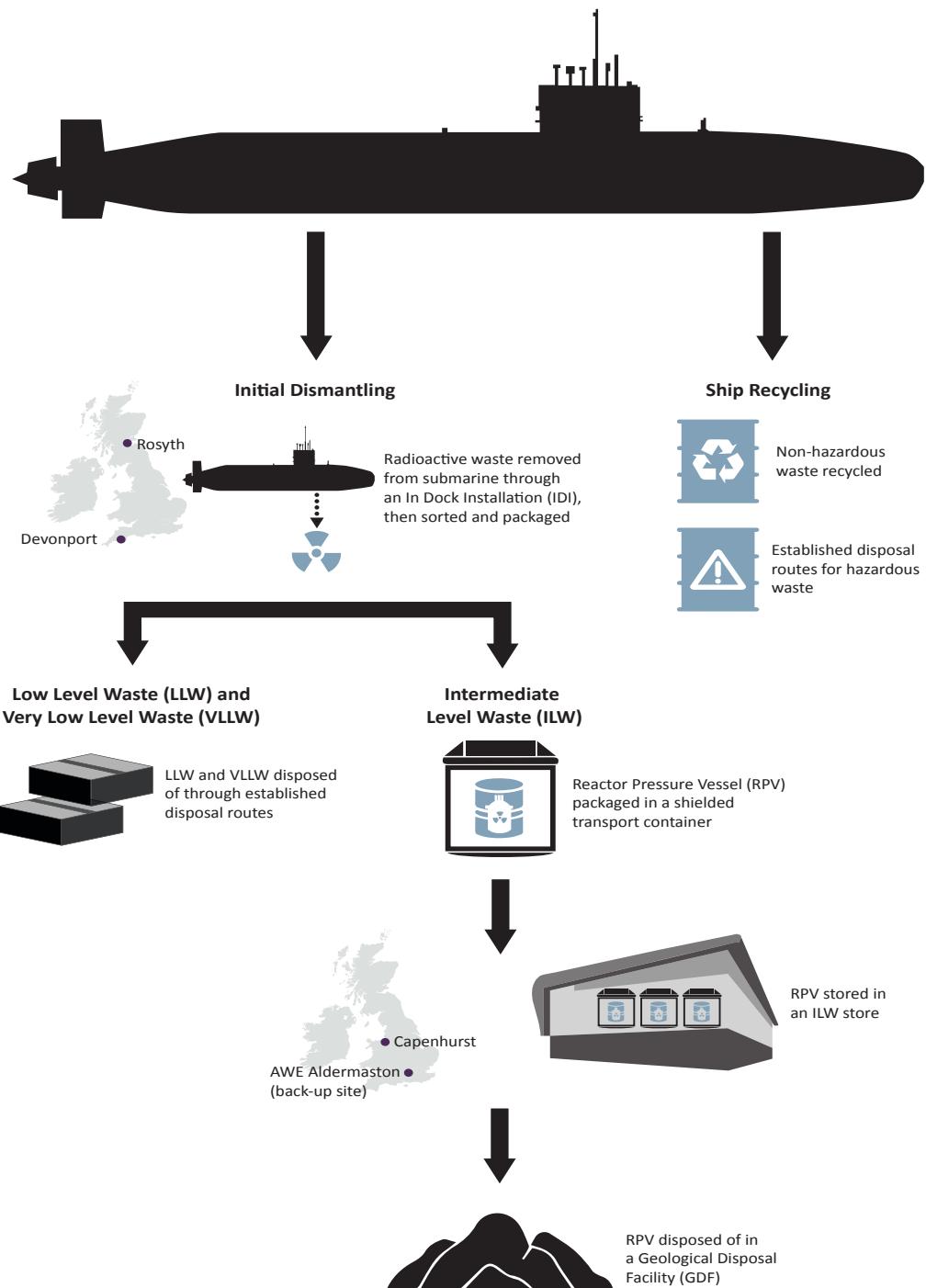
It will start with Initial Dismantling (ID), in which all radioactive materials will be removed safely from each submarine. A bespoke shielded transport container will be used to transport the RPV from the submarine to the ILW interim store. The ILW interim store will safely store the RPVs in their transport containers, pending disposal to the GDF. Once cleared of all radioactive material, the submarine will be dismantled completely at a commercial UK ship-recycling facility. Throughout the whole process, security management will safeguard all classified information and equipment from the submarines.

### Initial Dismantling

The aim of ID is to safely remove all radioactive material from defuelled submarines, which will be led by Babcock International Group at its Rosyth and Devonport sites.

Babcock is the support partner for the Royal Navy's submarines; it has a wealth of product knowledge and operational experience in submarine reactor plant maintenance and overhaul.<sup>6</sup> The ID project scope includes design of the radioactive waste-removal process, manufacture and installation of the required infrastructure, obtaining regulatory approvals, and undertaking physical deplanting work on the submarines.

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5. Ministry of Defence, 'Submarine Dismantling Project, MoD's Response to Consultation and Strategic Environmental Assessment Post-Adoption Statement about the Site for the Interim Storage of Intermediate Level Radioactive Waste', August 2016.
  6. Babcock International Group, 'Vengeance Case Study', <<https://www.babcockinternational.com/Case-Studies/Vengeance>>, accessed 8 August 2017.

**Figure 1:** SDP High-Level Process Strategy

Source: Ministry of Defence, 'Submarine Dismantling Project: Consultation Document', 28 October 2011 <[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/35909/sdp\\_consultation.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/35909/sdp_consultation.pdf)>, accessed 24 August 2017.

Waste will be removed from the submarine into a controlled environment in the dock next to the submarine through an In-Dock Installation (IDI). Using the latest instrumentation, waste will be assayed to establish if it is radiologically implicated. Active waste will be put in sealed containers before being sent to an onsite processing facility. Once in the facility, it will be security declassified and packaged in containers for consignment to an active waste-processing facility.

The active waste-processing facilities will use a host of best-practice techniques to decontaminate or size reduce the waste to minimise the volume sent to the Low-Level Waste Repository, and maximise the volume of recyclable metals. The deplanting waste-removal process has been developed to ensure that the waste hierarchy has been implemented where practicable.

Non-active waste will be put into separate sealed containers and sent to a different processing facility, where it will be security declassified and final reassurance monitored to ensure that no radioactive material is released into conventional waste streams. Following radiological clearance of the submarine, the hull will be prepared for transportation to a commercial shipbreaker in the UK.

A two-staged approach has been implemented to allow work to begin, driven by critical dependencies on the programme. Stage 1 is the removal of small item Low-Level Waste (LLW) and Very Low-Level Waste (VLLW). Stage 2 is the removal of large item LLW and all ILW. In between the two stages, the submarine will be returned to the basin for afloat storage. There are a number of operational advantages of the staged approach.

Commencing ID at this stage by removing LLW, as opposed to waiting for the RPV transport container and the interim store to be ready, allows the overall programme-critical path timescales to be reduced. This also accelerates the risk reduction of the submarine's radioactive legacy. The two-staged approach enables early regeneration of suitably qualified experienced personnel at Rosyth to support SDP delivery before the more complicated task of RPV removal is undertaken.

It also supports the public aspiration of undertaking submarine dismantling and allows earlier demonstration of LLW removal activities that highlight capability, reducing programme risk and uncertainty. Following successful demonstration of both stages, they will inform a single process based on an approach that considers deplanting of the entire reactor plant in a single docking.

## SDP Forward Programme

To date, Number 2 dock at Rosyth has been transformed and new infrastructure has been installed to support the dismantling requirements, including a new gantry crane, a new caisson, accommodation and health physics buildings, and an IDI (Figure 2). The regulatory approvals and facility safety cases are in place and Stage 1 has started on Swiftsure; the RC pressure hull cut is complete and waste deplanting is underway.

**Figure 2:** Swiftsure in Dock No. 2 at Rosyth with RC Access Facility in Place, 2017



*Source: Babcock, May 2017.*

Planning for ID Stage 2 has commenced with a design and safety study into the possible removal processes for the RPV. This will be the basis of the concept design stage that is planned to start in 2017. The ability to start ID Stage 2 depends on the RPV transport container being available to accept the RPV as soon as it is removed from the boat. The MoD has embarked on a competitive procurement process to design and build the first of these transport containers in readiness.

Stage 1 ID of Swiftsure is due to complete in August 2018.

## Summary

SDP is of strategic importance for the MoD and Babcock Group, and it is excellent news that the waste removal has started on Swiftsure. The first submarine is a proof of concept that will demonstrate the process, and the operational feedback and learning from experience will inform subsequent submarine dockings at both Rosyth and Devonport.

Using this novel approach of deplanting the RC, the UK's nuclear submarine legacy will be safely, securely and environmentally managed and disposed of.



# IX. Tactical Nuclear Weapons: Revisiting History's Key to Crisis De-Escalation

Andrea Howard

THE US HAS a long record of upholding global, extended nuclear deterrence guarantees. This trend has roots in the beginning of the Cold War during the 1950s, when the US relied on nuclear weapons to secure the borders of its allies. In the wake of the Crimean crisis in 2014, the US must revisit one of the most pressing questions from the 1950s: How can a major power make credible an intent to defend a smaller ally from attack by another major power?

Amid declines in defence spending at the beginning of the Cold War, President Dwight D Eisenhower answered this challenge with tactical nuclear weapons (TNWs). The US should consider spending the estimated \$1 trillion to modernise its nuclear arsenal, as TNWs could serve a similar deterrent role today.

In the 1950s, Eisenhower's 'New Look' strategy promoted 'firepower with less manpower', which translated into building up the TNW arsenal and making TNWs ready for deployment around the world.<sup>1</sup> While there is no universal definition for 'tactical' nuclear weapons, these miniaturised devices can be grouped by features such as range, delivery vehicle, yield and intended target.<sup>2</sup> Under the 'New Look', the US designated TNWs for battlefield purposes – weakening an aggressor's capability or counterforce targeting – which distinguished them from ballistic missiles and their larger, strategic targets. In the European theatre, the US deployed around 5,000 of its 20,000 TNWs during the Cold War, including short-range missiles, artillery shells and landmines.<sup>3</sup>

The nature of the US deterrence posture shifted when America deployed TNWs in various theatres. Deterrence is dissuading an aggressor from changing the status quo, through threats of either punishment or denial, or a combination of both,<sup>4</sup> and at a minimum, it involves two actors. Deterrence theory first developed with a focus on punishment strategies, where defenders issue credible threats of retaliatory damage against aggressors. The aggressor will

1. John T Cappello, Gwendolyn M Hall and Stephen P Lambert, 'Tactical Nuclear Weapons: Debunking the Mythology', USAF Institute for National Security Studies, Occasional Paper No. 46, August 2002, p. 8.
2. Brendan Thomas-Noone, 'Tactical Nuclear Weapons in the Modern Nuclear Era', Lowy Institute Analysis, September 2016, p. 2.
3. Mansoor Ahmed, 'Pakistan's Tactical Nuclear Weapons and Their Impact on Stability', Carnegie Endowment for International Peace, 30 June 2016.
4. Glenn Herald Snyder, *Deterrence by Denial and Punishment* (Princeton, NJ: Princeton University Press, 1959), p.7.

likely choose not to attack because unacceptable damages on valuable population or industrial centres will outweigh the benefits.

Second, a defender can attempt to deter an adversary with a credible threat of denial by persuading the challenger that it will fail to succeed in its objectives. While protecting its own territory, the defender can also seek to protect a third-party's territory.<sup>5</sup> This is called 'extended deterrence', and it typically aims to shield an ally from an attacker's challenge to the status quo.<sup>6</sup> As the US reduced its conventional forces abroad, TNWs marked a shift from punishment strategies to extended deterrence via denial; TNWs threatened to degrade conventional attacks by Communist forces on European and other allies around the world.

Early Cold War crises, characterised by a recognised threat of escalation and need for urgent attention, were the testing grounds for the new deterrence posture. Although (and perhaps because) the US predominantly deployed TNWs to the European theatre, four crises with TNW presence transpired outside this theatre, in Asia and the Caribbean: the Korean War (1950–53); the First Taiwan Strait Crisis (1954–55); the Second Taiwan Strait Crisis (1958); and the Cuban Missile Crisis (1962). Using the comparative method to analyse the effects of TNW threats on an attacker's aggression, the first three crises represent positive cases (where a threat of TNW usage by the defender was understood by the attacker), and the Cuban Missile Crisis serves as a negative case (because a threat of TNW use was not received). These cases have shared, prominent characteristics that help to neutralise potential confounding factors, instead highlighting the impact of TNW threats.

The cases, summarised in Table 2, had three main, common characteristics: an extended deterrence relationship between a powerful defender and third-party 'pawn'; an attacker's awareness of the presence of tactical nuclear weapons, ready for firing; and US involvement between the timeframe of 1949 (the breaking of the US nuclear monopoly) and 1962 (the emergence of a détente on nuclear threats after the Cuban Missile Crisis).

For each of these cases, recent declassification by the US government has provided access to valuable primary resources, including memoranda of discussions from the highest-level policy meetings, as well as between the presidents and advisers. Primary sources for the North Korean, Chinese and Soviet perspectives, however, remain classified. This lack of transparency is a major limitation when studying nuclear policy, particularly outside the US context.<sup>7</sup> Nonetheless, the available sources provide insight into how TNWs played a role in de-escalating early Cold War crises.

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5. *Ibid.*, p. 37.

6. Paul Huth, 'Extended Deterrence and the Outbreak of War', *American Political Science Review* (Vol. 82, No. 2, June 1988), p.424.

7. Gerald Hughes, Peter Jackson and Len Scott (eds), *Exploring Intelligence Archives: Enquiries into the Secret State* (London: Routledge, 2008).

**Table 2:** Roles of Actors in the Four Selected Cases: 1950–62

Pawn	Year	Attacker(s)	Defender
Republic of Korea	1950–53	Democratic People's Republic of Korea and Communist China	US
Quemoy-Matsu	1954–55	Communist China	US
Quemoy-Matsu	1958	Communist China	US
Cuba	1962	US	Soviet Union

Source: Author; for a similar chart, see Paul Huth, 'Extended Deterrence and the Outbreak of War', p. 440.

First, the Korean War escalated into a nuclear crisis upon Eisenhower's election in 1953. With campaign promises to end the Korean War, Eisenhower believed that use of TNWs could end the depletion of US resources in the increasingly unpopular conflict. In the 131<sup>st</sup> meeting of the National Security Council (NSC) on 11 February 1953, Eisenhower first raised that the US 'should consider the use of tactical atomic weapons in the Kaesong area'.<sup>8</sup> NSC-147, approved in April 1953, laid out six alternative actions, and all but the first permitted atomic use. At the 145<sup>th</sup> meeting of the NSC on 20 May 1953, Eisenhower claimed that it 'would be necessary to expand the war outside Korea and it would be necessary to use the atomic bomb' if the North Koreans and Chinese rejected the armistice.<sup>9</sup> As the Chinese and North Koreans began to stall the April 1953 peace talks, then Secretary of State John Foster Dulles presented a final armistice offer to Pyongyang on 25 May, using the Indian prime minister to relay a threat of 'stronger', nuclear military exertion 'if armistice negotiations collapse[d]'.<sup>10</sup> Soon thereafter, the Chinese and North Koreans relaxed their aggressive stance, as demonstrated by the parties signing a prisoner of war repatriation and armistice agreement.<sup>11</sup>

In the following years, threats of TNW use would help de-escalate the First and Second Taiwan Strait Crises. As the Chinese Communists threatened to take the offshore islands of Quemoy and Matsu and potentially Taiwan, the US demonstrated resolve to use TNWs. Then Chief of Naval Operations, Admiral Arleigh Burke, determined 'the best hope of quickly and decisively stopping [a] Communist attack ... is an immediate counter-attack with atomic weapons'.<sup>12</sup> Then Army Chief of Staff General Maxwell Taylor found it 'necessary to use nuclears' during three separate scenarios of a Chinese amphibious assault, the targeting of Chinese gun emplacements, and a

8. US Department of State, Office of the Historian, *Foreign Relations of the United States, Korea, 1952–1954, Vol. XV* (Washington, DC: United States Government Printing Office, 1984), p. 1,299.

9. *Ibid.*, p. 1,768.

10. *Ibid.*, p. 1,773.

11. Bruce Cumings, *The Korean War: A History* (London: Modern Library Chronicles, 2011).

12. US Department of State, Office of the Historian, *Foreign Relations of the United States, Korea, 1952–1954, Vol. XV*, p. 1,768.

Chinese interdiction using air power.<sup>13</sup> Public statements by Eisenhower, Vice President Richard Nixon, Chief of Naval Operations Admiral Robert Carney and Dulles conveyed this TNW threat to the Chinese Communists at the end of the seven-month first crisis (four statements in March and April 1955)<sup>14</sup> and during the fifteen-day second crisis (two in September 1958).<sup>15</sup> While causation is impossible to prove in these nuclear crises, the delivery of these public statements correlated with Beijing reopening negotiations and curbing the shelling campaign at the end of the first crisis. The Chinese then established a more permanent ceasefire, alternate-day bombardment scheme at the end of the second crisis.<sup>16</sup>

The Cuban Missile Crisis of 1962 likely could have seen a significant reduction in US aggression had the Soviet Union issued an early TNW threat. The Americans remained unaware of the presence of TNWs, FROG missiles, until 25 October – ten days into the thirteen-day crisis.<sup>17</sup> Even without a Soviet statement about TNW use, the US then halted its military strategy of brinksmanship, discounting the option of invading Cuba, and instead engaged in secret negotiations. An earlier threat or reveal of the additional FKR cruise missile regiments probably could have deterred even more aggression, but the presence of those weapons instead remained a secret for nearly five decades.<sup>18</sup>

Given the role of TNWs in the de-escalation of early Cold War crises, the US should consider modernising its TNW arsenal. Russia currently maintains a large numerical advantage in TNWs over the US; one estimate claims that Moscow may have 2,000 TNWs capable for delivery, and a WikiLeaks report claimed that 3,000 to 5,000 is a more accurate estimate.<sup>19</sup> Of note, the international legal regime is not equipped to curb TNW proliferation. TNWs fall below the payload for the START treaties, and the INF Treaty and Presidential Nuclear Initiative (PNIs) serve as the only agreements that regulate some TNW characteristics. Moscow has delegitimised PNIs as a mere ‘goodwill gesture,’ and the INF Treaty recently strained when the US State Department accused Russia of violating the 500–5,500-kilometre range threshold with a cruise missile test.<sup>20</sup>

The US needs to match adversaries rung-for-rung on the escalation ladder, perhaps with B61-12 bombs and the LRSO air-launched cruise missile. Critics cite past US and NATO resistance to former President George W Bush’s Reliable Replacement Warhead and Robust Nuclear Earth

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- 13. David Walker, ‘Eisenhower’s New Look, Tactical Nuclear Weapons, and Limited War with a Case Study of the Taiwan Strait Crisis of 1958’, D.Phil. thesis, George Washington University, 2004, p. 307.
  - 14. Appu Kuttan Soman, *Double-Edged Sword: Nuclear Diplomacy in Unequal Conflicts – The United States and China, 1950–1958* (Westport, CT: Greenwood Publishing Group, 2000), p. 137–38.
  - 15. Walker, ‘Eisenhower’s New Look, Tactical Nuclear Weapons, and Limited War with a Case Study of the Taiwan Strait Crisis of 1958’, p. 313.
  - 16. JH Kalicki, *The Pattern of Sino-American Crises: Political–Military Interactions in the 1950s* (Cambridge: Cambridge University Press, 1975), p. 199.
  - 17. Michael Dobbs, *One Minute to Midnight: Kennedy, Khrushchev and Castro on the Brink of Nuclear War* (London: Alfred A Knopf, 2008), p. 145.
  - 18. Dobbs, *One Minute to Midnight*, p.125.
  - 19. Igor Sutyagin, ‘Atomic Accounting: A New Estimate of Russia’s Non-strategic Nuclear Forces’, RUSI Occasional Paper, November 2012, p. 2.
  - 20. Nikolai Sokov, ‘Nuclear Weapons in Russian National Security Strategy’, in Stephen J Blank (ed.), *Russian Nuclear Weapons: Past, Present, Future* (Carlisle, PA: Strategic Studies Institute, 2011), p. 215.

Penetrator.<sup>21</sup> Russia and China, however, have plans for integrating new technologies into existing TNW cruise- and ballistic-missile platforms and into new delivery vehicles, such as underwater drones.<sup>22</sup> The US needs a capable and credible in-kind response, and TNWs are a potential solution.

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21. Michael Krepon and Joe Kendall, 'Beef Up Conventional Forces; Don't Worry About a Tactical Nuke Gap', *Breaking Defense*, 28 March 2016.
  22. Bill Gertz, 'Russia Building Nuclear-Armed Drone Submarine', *Washington Free Beacon*, 8 September 2015.



# X. Deterrence Communications: Theory and Practice

Oliver Barton

**A**LONGSIDE ‘CREDIBILITY’ AND ‘capability’, ‘communications’ forms the third key pillar of UK deterrence policy. Deterrence communications (DetComms) are a crucial instrument of policy and strategy, not just an adjunct.

DetComms include all national means of communication that could have a bearing on how an audience perceives our credibility and intent, including our thresholds, red-lines, resolve and preparedness to respond. These means of communication include: declaratory policy; public diplomacy; defence engagement; and military ‘presence, posture and purpose’.<sup>1</sup> Deeds are as important as words. ‘[A]ctions will speak louder than words over time, since they form audiences’ empirical evidence of our reputation and resolve’.<sup>2</sup>

Strong resolve and sufficient punitive capability could prove inconsequential, or possibly even counterproductive, if the adversary fails to understand: the specific action from which we wish them to refrain; our willingness and ability to exact costs and/or deny benefits should they fail to comply; and how they would be better off acquiescing to our wishes than persisting.

This paper sets out the characteristics of an ‘ideal’ DetComms strategy, the challenges involved in achieving this ideal and the practical steps that need to be taken to address them.

DetComms involve not just messages sent, but messages received. Messages received, and what they say about the efficacy of both our messaging and our underlying strategy, should inform adjustments to both our deterrence strategy and communications.

The success of any deterrence strategy can never be guaranteed. However, achieving our objectives can be made more likely, and the implications of failure made potentially less damaging, by ensuring that our DetComms fulfil a range of criteria.

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1. See Dimitry Dima Admasky, ‘The 1983 Nuclear Crisis – Lessons for Deterrence Theory and Practice’, *Journal of Strategic Studies* (Vol. 36, No. 1, 2013), pp. 4–41.
  2. General Sir David Richards quoted in Ministry of Defence Development, Concept and Doctrine Centre, ‘Strategic Communications: The Defence Contribution’, Joint Doctrine Note 1/12, January 2012, p. 3-3.

DetComms should be treated as an integral part of our overarching deterrence strategy. DetComms should inform, support and be developed in parallel to the other strands of our wider deterrence strategy, including changes in our posture and the conduct of contingency planning.<sup>3</sup>

DetComms should be tailored, wherever possible, to the specific actor, action and circumstances which we are trying to deter. While all actors (that are able to make decisions on the basis of calculations of perceived costs and benefits) are determable, not all actors will be deterred by the same thing.<sup>4</sup> Variations in their perceptions, goals, values and norms will affect how an actor will perceive our efforts to deter and their own decision-making process.

Tailoring our communications requires systematic analysis of not only the adversary, but the other audiences to our messaging.<sup>5</sup> Systematic analysis should ensure that a wide range of perspectives is sought, that biases are identified (as far as possible) and that the level of confidence in recommendations is identified.<sup>6</sup>

It is essential that the content of our messaging is comprehensible to the target audience. Actions can be more important than words, but we should not assume that our actions will always speak for themselves. In order to avoid misunderstanding, and the potential for unintended escalation, clarity of purpose is essential. In order for the meaning not to be lost in transmission or translation, explanatory messages should be sent via a medium that will not be ignored or corrupt its contents, and expressed in terms that are familiar, intelligible and have an impact on the intended audience.

In order to compete with all the other messages present in an information-rich environment, DetComms need to be lucid, compelling and believable.<sup>7</sup> Above all they should be clear, credible and concise. Narratives and messages that are short, sharp and to the point are likely to have greater traction than messages that are exquisitely crafted, but whose subtleties can easily be lost.<sup>8</sup>

There is a need for the coordinated orchestration of all activity that contributes to our deterrence messaging to ensure that it is consistent and collectively works towards the overall

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3. Ministry of Defence Development, Concept and Doctrine Centre, 'Strategic Communications: The Defence Contribution', p. 1-4.
  4. Sean P Larkin, 'Cracks in the New Jar: The Limits of Tailored Deterrence', US Army Warfare College Research Project, 17 March 2011, p. 14; Colin S Gray, 'Gaining Compliance: The Theory of Deterrence and its Modern Application', *Comparative Strategy* (Vol. 29, No. 3, 2010), p. 281; Keith B Payne, 'Understanding Deterrence', *Comparative Strategy* (Vol. 30, No. 5, 2011), p. 398.
  5. M Elaine Bunn, 'Can Deterrence Be Tailored?', *Strategic Forum* (No. 225, January 2007), p. 6.
  6. Keith B Payne, *The Fallacies of Cold War Deterrence and a New Direction* (Lexington, KY: University Press of Kentucky, 2009) p. 111–14.
  7. Ministry of Defence Development, Concept and Doctrine Centre, 'Strategic Communications: The Defence Contribution', p. 2-11.
  8. Payne, 'Understanding Deterrence', p. 403.

objective. This includes the analysis, formulation, execution, evaluation and readjustment of DetComms, both across government and with allies.<sup>9</sup>

The effectiveness of DetComms needs to be measured and evaluated to ensure it is working. Likewise, the behaviour of the adversary needs to be checked that messages are being interpreted in the way they intend.<sup>10</sup>

A successful DetComms strategy must be able to ‘respond and adapt to facts on the ground, and to the reaction of target audiences’.<sup>11</sup> Against a likely background of high levels of uncertainty and ambiguity, the West needs to be prepared to accept that aspects of its underlying deterrence strategy may be flawed, and be able to adjust both our strategy and our DetComms.<sup>12</sup>

In practice, finely balancing all the competing factors outlined above is likely to be extremely challenging. Like any other area of strategy, ‘fog and friction’<sup>13</sup> will likely frustrate the conduct of DetComms.<sup>14</sup> Some of the risks and challenges that practitioners may confront and that they need to be prepared to manage include:

- Imperfect knowledge.
- Time pressure.
- Biases and stress.
- Competing needs of third parties and domestic audiences.
- Controllability of the strategic narrative.
- Assessing effectiveness.
- A need to respond to others’ messages.
- Asymmetry of stakes, capability and risk appetite.

Past practice and academic literature suggest a number of ways of mitigating these risks and challenges.

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9. Ministry of Defence Development, Concept and Doctrine Centre, ‘Strategic Communications: The Defence Contribution’, p. 3-3.
  10. *Ibid.*, p. 3-5.
  11. Paul Cornish, Julian Lindley-French and Claire Yorke, *Strategic Communications and National Strategy*, Chatham House Report (London: Royal Institute of International Affairs, 2011), p. x; Ministry of Defence Development, Concept and Doctrine Centre, ‘Strategic Communications’, p. 3-6.
  12. *Ibid.*, p. 2-9.
  13. Larkin, ‘Cracks in the New Jar’, p. 12.
  14. See Lawrence Freedman, ‘Deterrence: A Reply’, *Journal of Strategic Studies* (Vol. 28, No. 5, 2005), p. 1, where he writes, ‘Deterrence becomes a matter of strategy when A makes a direct attempt to influence B’s behaviour through warning about the consequences of certain acts that B might be contemplating. Such communication can go badly awry. The messages may be misunderstood or missed altogether. Even when A’s message has been perfectly well understood, B’s reaction may be to ignore the implications because it is deemed offensive or because of concern about how an over capitulation to A’s demands would create a reputation for weakness and lead to further demands from A and others’.

While it is impossible to predict with confidence adversaries' future actions and decisions, systematic analysis can help to: define the parameters of likely and unlikely behaviour; and narrow the odds of being wrong.<sup>15</sup> All analysis should be tested, and assumptions challenged, using well-established techniques, such as 'red-teaming' (the use of an independent group to critically assess the evidence and logic underpinning one's analysis), the testing of competing hypotheses, and the identification and consideration of negative evidence (instances not predicted by, or that directly contradict, the conclusions of the author's earlier analysis).<sup>16</sup>

The long-term goal of steady-state, or 'general', DetComms, is that crises are avoided not because the adversary has been actively deterred, but because they have internalised, and abide by, norms that set the bounds of acceptable behaviour.<sup>17</sup> To develop and engender such norms requires embedding the goal of general deterrence within wider Western foreign policy, and acting in accordance with the norms we espouse.

In order to minimise the risk of motivated biases, it is important to avoid placing an adversary in the situation, whereby, for lack of other options, they feel compelled to escalate in order to avoid imminent unacceptable losses. Reassurance is important because it 'encourages self-defined defenders to search for effective ways of communicating their benign and defensive intentions to would-be challengers ... The combination of carrots and sticks is often more successful than either alone'.<sup>18</sup>

Deterrence has the greatest chance of succeeding if *both* sides have a shared sense of risk, and a mutual understanding of each other's motivations and perceptions.<sup>19</sup> This requires communicating to the adversary: the general risks involved in brinkmanship; the specific risks they face in challenging you; and the way in which you both think about and manage these risks. Where possible, this communication should occur during steady-state so that it helps set the bounds within which both parties will later act should a crisis emerge.

Given the challenges highlighted above, it is important to recognise that deterrence is a 'blunt instrument, not a scalpel'.<sup>20</sup> Deterrence may be the only tool available to manage a situation plagued by high levels of uncertainty. However, deterrence has inherent limitations, and our ability to tailor our deterrence strategy will always be limited too.

Like any area of strategy, deterrence will always be frustrated by 'inescapable fog and friction'.<sup>21</sup> There will always be aspects about the target audience which we will not know, and obstacles to effective implementation we cannot entirely overcome. Systematic analysis and careful planning

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- 15. Payne, 'Understanding Deterrence', p. 410.
  - 16. Patrick M Morgan, 'Evaluating Deterrence', in Karl-Heinz Kamp and David Yost (eds), 'NATO and 21st Century Deterrence', NATO Defence College Forum Paper 8, May 2009, p. 49.
  - 17. Lawrence Freedman, *Deterrence* (London: Polity Press, 2004), pp. 30, 118.
  - 18. Richard Ned Lebow, 'Deterrence and Reassurance: Lessons from the Cold War', *Global Dialogue* (Vol. 3, No. 4, Autumn 2001), p. 128.
  - 19. Freedman, *Deterrence*, p. 5.
  - 20. Larkin, 'Cracks in the New Jar', p. 1.
  - 21. *Ibid.*, p. 12.

can minimise this uncertainty, but will never eradicate it entirely. Rather than demanding we resign ourselves to inevitable failure, such situations require a healthy pragmatism when tailoring our communications, and a humble appreciation of what is achievable via deterrence in general.<sup>22</sup>

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22. *Ibid.*, p. 25.



# XI. The UK Potential for Offshore Nuclear Power Plant Implementation

Nathan Edge

THE UK GOVERNMENT has embarked upon both a large Nuclear Power Plant (NPP) and a Small Modular Reactor (SMR) programme, which are expected to provide an additional 95 GWe of power to the UK electricity grid by 2035.<sup>1</sup> There is also the potential to implement Offshore Nuclear Power Plants (OFNPPs) within the UK as part of the large NPP and SMR programmes. There are some distinct advantages with operating these types of NPP compared to existing designs. This paper focuses on the high-level requirements of OFNPPs in terms of vessel choice, supply chain, safety and economics.

Large NPPs, such as the European Pressurised Reactor (EPR) construction at Hinkley Point in Somerset, are characterised by significant power capacity (over 1 GWe per reactor) along with large capital and infrastructure investments. SMRs, such as the NuScale reactor, are of smaller capacity, but have flexible designs that allow for variable power-plant capacity (10–100 MWe per reactor) as well as a greater move towards part standardisation and modular construction. It is claimed that this allows a greater number of parts to be manufactured in dedicated factories along with a greater use of ‘off-the-shelf’ components, reducing manufacturing time and capital cost. It is predicted that the SMR market in the UK alone will be worth around £400 billion by 2035.<sup>2</sup>

OFNPPs are a variation of SMRs in which a nuclear power-generating reactor is mounted on a floating or submersible vessel, rather than on the dedicated land-based sites that NPPs have been built upon up to now. For many years, naval vessels have used nuclear reactors as part of their design, most notably in the submarines of the US, the UK, France, Russia and China. However, OFNPPs differ in that their purpose is to produce electrical power to a national energy grid, rather than provide electrical or propulsive power to a floating or submersible vessel.

To date there has only ever been one true OFNPP, the USS *Sturgis*, which produced power for the US military between 1950 and 1976.<sup>3</sup> Both Russia and China have embarked on OFNPP programmes, which are aimed at producing power in remote regions of both territories where

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1. HM Government National Audit Office, ‘Nuclear Power in the UK’, HC 511, Session 2016–17, 13 July 2016.
  2. NuScale Powe, ‘NuScale’s UK Offering’, March 2017.
  3. Lucas W Hixson, ‘First Floating Nuclear Power Station to be Scrapped’, *Enformable*, 8 September 2014.

it is not possible to deliver power by conventional means, such as the Yakutia region of Russia.<sup>4</sup> It is also possible that OFNPP could play a part in the future of UK power generation.

The UK's principal operational and manufacturing experience is with submersible-type vessels. The UK has an active design, build, maintenance and decommissioning programme to support the Royal Navy's fleet of nuclear-powered submarines, beginning with HMS *Dreadnought* in 1960. Several studies have highlighted the strong experience the UK has in terms of the manufacture of reactor vessel internals, support systems and power trains.<sup>5</sup> This could be built upon for the implementation of a submersible-type OFNPP.

The other type of vessels with which the UK has experience are platform-type vessels, which see sustained use in the UK coastlines as part of the oil and gas industry and which could also form part of an OFNPP design. Although ship-type vessels are also a feasible option, from a manufacturing perspective it is likely that there would be a greater competitive advantage to outsourcing the design of the vessel of a ship-type OFNPP to outside partners where there is greater design and manufacturing experience for these vessels.

It must be noted that regardless of the choice of vessel, it is likely that any OFNPP programme within the UK would require permanent land-based facilities in some form. This is not only due to the fact that an OFNPP would require power connections to the mainland, but also because it is likely that onshore facilities would be a necessary part of licensing requirements, emergency response systems, refuelling and maintenance.

Furthermore, there is significant experience within the UK that could be built upon for onshore facilities as a result of the UK offshore wind industry. The onset of this industry has resulted in solid commercial experience in terms of offshore cabling requirements, and there is the potential for OFNPPs to share existing cabling infrastructure with offshore wind farms, particularly in the Irish Sea.<sup>6</sup> Refuelling and maintenance facility construction, as well as civil nuclear site licensing, has also been experienced in the UK at Devonport Dockyard in Plymouth, which could be built upon for a UK OFNPP programme.

The most challenging areas of study for OFNPPs are safety and economics: clearly, any OFNPP operating within UK waters needs to possess the equivalent of a site safety licence, which proves that the OFNPP can be operated safely under challenging conditions, including extreme weather, earthquakes, tsunamis and acts of military aggression or terrorism. Balancing this is the requirement that OFNPPs produce power economically for UK consumers. In terms of safety, all three vessel choices (submarine, platform and ship) would by their nature be more susceptible

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4. World Nuclear Association, 'Nuclear Power in Russia', updated 27 July 2017, <<http://www.world-nuclear.org/information-library/country-profiles/countries-o-s/russia-nuclear-power.aspx>>, accessed 4 August 2017.
  5. Nuclear Industry Association, 'Capability of the UK Nuclear New Build Supply Chain', Capability Report, December 2012, Appendix III.
  6. HM Government, 'UK Offshore Wind: Opportunities for Trade and Investment', June 2015, <[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/437077/Offshore\\_Wind.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/437077/Offshore_Wind.pdf)>, accessed 17 August 2017.

to extreme weather conditions compared with an equivalent land-based reactor. However, submersible-type vessels possess an advantage in that they can be operated underwater, where the threat of damage from terrorism, theft and extreme weather is significantly reduced.

There is also a greater level of experience in the UK in terms of modularisation for OFNPPs: raft type, modular construction has been implemented in the UK as part of the Astute build programme, in a similar fashion as the manufacture of US *Ohio*-class submarines.<sup>7</sup> It could also be said that current OFNPPs have economic potential equivalent to large NPPs: for example, the power capacity which has been ‘bought’ by a 75 MWe Russia OFNPP design, at an estimated cost of RUB 30 billion (approximately £385 million), is 5.15 £/W.<sup>8</sup> This is equivalent to the bought capacity of the Hinkley C EPR, which at a capacity of 1,300 MWe for approximately £20 billion is 15.6 £/W.<sup>9</sup> However, this does not take into account additional costs of OFNPP onshore facilities, nor does it consider variances in plant capacity resulting in demand from the UK grid. Clearly, although this has demonstrated the potential of these systems, there is still significant study required to make the case for OFNPP safety and economics.

In conclusion, the UK has significant design and manufacturing capability that would allow OFNPPs to act as part of the UK grid alongside SMRs and large NPPs. There are advantages of these systems in terms of manufacture and safety, particularly for OFNPPs, which are mounted on submersible vessels. There is also UK experience with onshore requirements, such as underwater power cables. Although more work on the safety and economic performance of these systems is required, OFNPP could form part of the UK’s nuclear energy future.

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7. Barry Bruner, ‘Next Generation Ohio-Class’, *Navy Live*, The official blog of the US Navy, 24 September 2012.

8. RT, ‘Russia Starts Work on Arctic Dock for 1st-Ever Floating Nuclear Power Plant’, 7 October 2016.

9. *Construction Index*, ‘Hinkley Point C Costs Rise 8%’, 3 July 2017.



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