

Navigating the Nuclear Future

Conference Report
September 27, 2019



SCHAR SCHOOL OF POLICY AND GOVERNMENT

Center for Security Policy Studies

at George Mason University

Navigating the Nuclear Future
The 2nd Annual International Security Symposium
September 27, 2019

Opening Remarks: Dean Mark Rozell and Director Ellen Laipson

Panel One: The Great Powers and the Nuclear Agenda

Modernization, deterrence, new thinking about the utility of nuclear weapons

Lieutenant General (Ret.) Frank Klotz, former NNSA

Brigadier General (Ret.) Peter Zwack, NDU/INSS

Dr. Ketian Zhang, GMU Faculty

Moderator: Trevor Thrall, GMU Faculty and CATO

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Panel Two: The NPT and its Limitations

Managing Nonproliferation, WMD Terrorism (1540), future of India, Pakistan, Iran, DPRK

Alexandra Bell, Center for Arms Control and Nonproliferation

Suzanne DiMaggio, Carnegie Endowment

Leonard S. Spector, MIIS

Moderator: Dr. Greg Koblenz, GMU Faculty, Director Biodefense Program

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Buffet Lunch & Networking

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Panel Three: Connecting the Dots—Nuclear Technology and the Transnational Threat Environment

Dr. Brian Mazanec – Nuclear Weapons in the Cyber Age

Andrew Paterson - Nuclear Energy and Climate Change?

Ambassador (Ret.) Laura Holgate NTI – nuclear security, terror, crime...

Moderator: Ellen Laipson

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Welcoming Remarks

Dean of the Schar School of Policy and Government, Mark J. Rozell, welcomed the audience to the Center for Security Policy Studies' (CSPS) second annual symposium on international security. He provided some background on CSPS as one of the Schar School's research centers, dedicated to fostering faculty and student research collaboration on international security, offering student-led experiential learning, and hosting a series of events exploring current and enduring topics in international security.

Ellen Laipson, Director of CSPS, introduced the themes of the symposium. *Navigating the Nuclear Future* is an exploration of a broad spectrum of issues related to nuclear weapons and nuclear technology. In the course of the three panels during the day, topics to be explored will include the status of nuclear doctrine and stewardship of weapons by the great powers, to the ongoing challenge of preventing the spread of nuclear weapons to new states, to the ways in which nuclear technology affects or is affected by other transnational challenges, from cyber capabilities to climate change to crime and terrorism.

Panel One: The Great Powers and the Nuclear Agenda

Rapporteur: James Suber

CSPS Fellow

International Security Masters Student, George Mason University

Schar School professor Trevor Thrall opened with a lighthearted remark that perhaps the title of the symposium should have been “Back to the Nuclear Future” because after a period of dormancy, nuclear issues are again a popular topic for security experts, partly due to the return of Great Power competition. There are a number of pressing issues to cover, including the U.S. nuclear posture and debates about modernization, the Russian perspective, and the Chinese perspective. Professor Thrall expressed concern that public debate was so far minimal on these issues, but he was hopeful that the panel’s discussion might help bring attention to them.

Lieutenant General (Ret.) Frank Klotz

Lieutenant General (Ret.) Frank Klotz provided an overview of the American approach to nuclear security and the current challenges being faced. He stressed that it is vitally important to have a robust and ongoing civil discourse about nuclear weapons and policy. As background, he explained that since the early 1960s, the U.S., under both Democrat and Republican-controlled administrations and Congresses, has pursued two broad approaches: the first, to maintain nuclear deterrent forces capable of surviving a first strike and mounting a counter strike; the second, to pursue arms control agreements that limit the number and capabilities of nuclear forces. The manner in which the U.S. has implemented these two approaches has varied over the decades. At the height of the Cold War in 1967, the U.S. possessed over 31,000 weapons in its nuclear arsenal; by 2017, that number had significantly decreased to 3,800. Gen. Klotz, based on his career in the Air Force and as administrator of the National Nuclear Security Administration at the Department of Energy, expressed his support for this longstanding dual-track approach.

Speaking to the first part of the American approach, Gen. Klotz highlighted the current challenges facing the U.S. nuclear force. First, each leg of the nuclear triad is in need of modernization. For example, the B-52 bomber is nearly 60 years old and needs new engines

and updated electronics in order to fly for 30 more years. Every aspect of the Minute Man III intercontinental ballistic missile system is showing signs of serious aging, and another life extension program will be nothing more than a band-aid solution. Infrastructure in the nuclear security enterprise also needs updating, with some buildings dating back to the Manhattan Project. Gen. Klotz recalled that as the administrator of NNSA, problems like a collapsing roof could shut down operations for weeks. The nuclear modernization program, which began in the Obama administration and continues in the current administration, is addressing these issues.

Addressing the second part of the American approach, Gen. Klotz advocated for resuming arms control dialog with Russia. This had been a central part of U.S. policy, even



during the darkest days of the Cold War. The Intermediate-Range Nuclear Forces Treaty (INF) expired in February 2019, formally relegated to the history books. Its demise leaves only one bilateral arms control agreement between the U.S. and Russia, the New Strategic Arms Reduction Treaty (New START), which is due to expire in February 2021. This is only eighteen months away, only ten years after the treaty entered into force, and only three years after the

U.S. and Russia both met their reduction targets.

New START could be extended up to 5 years without requiring ratification by the U.S. Senate. However, the current administration has been very noncommittal about extending the treaty. Past and present senior military leaders continue to support extending New START for several reasons: it caps the Russian arsenal at known levels; it offers important insights into the size and capabilities of Russian nuclear forces beyond that of traditional intelligence and assessment methods; and it affords greater confidence in the size and structure of our own nuclear forces.

To Gen. Klotz, broadening the scope of arms control to include China is a worthy goal that he supports, but he recognizes it takes careful thought and coordination with allies, as well as painstaking negotiation. He concluded by saying that the wisest action the U.S. could take right now would be to extend New START before it expires, thereby gaining time to figure out successor agreements.

Brigadier General (Ret.) Peter Zwack

Brigadier General (Ret.) Peter Zwack provided insight into the Russian approach to nuclear security. He began with a reminder about Vladimir Putin's state of the nation speech on Mar. 1, 2018, in which Putin announced the development of five advanced nuclear weapon systems. This is a troubling development to Gen. Zwack, who is concerned that both the United States and Russia may be backsliding into Cold War-era mindsets. Although he sees some bluster in these new weapon programs, the Russians are actively developing them, which means the U.S. needs to pay attention to them.

Gen. Zwack explained that Russia is motivated in part by a sense of insecurity, which he traces back to the 1990s after the fall of the Soviet Union. This siege mentality is caused by a perception that the U.S. and NATO are existential threats. The Russians believe that fundamentally the U.S. system conflicts with their own, and they fear that external actors will foment a color revolution to topple the Russian regime. Other causes of the insecurity are Russia's geographical expanse; the country spans eleven time zones and is 40% larger than the US. Also, its declining population is less than half the size of the U.S.' and one ninth the size of China's. Nuclear weapons offer Russia a deterrent that it can use to threaten retaliation in case it perceives that it is losing in a confrontation. Russia's strategy is preemptive and reactive, which Gen. Zwack believes is dangerous.

The world is tilting in strange ways, Gen. Zwack observed. The checks and balances that came about during the Cold War—a period of enormous insecurity—are eroding. The destabilization is partly due to modernization programs and the looming expiration of New START, but also it's important to note that China is very protective of its nuclear arsenal and wary of being brought into any arms control treaties. These treaties are not just about counting missiles, but they were also effective confidence-building measures. Although New START is the only nuclear arms control treaty left between the U.S. and Russia, Gen. Zwack saw silver linings in the continuing existence of verification regimes through New START and the Open Skies treaty.

Overall, the challenges are grave, and are made increasingly complex by emerging technologies and the cyber domain. Decision makers will have very little time to make consequential decisions. To illustrate how easily a nuclear crisis could erupt, Gen. Zwack recalled that just a few months ago Russian and Chinese bombers flew in tandem testing Japanese and Korean airspace. For all of these reasons and concerns, Gen. Zwack said, he is a firm advocate for arms control.



Professor Ketian Zhang

Professor Ketian Zhang then took the podium to speak about Chinese nuclear capabilities, modernization efforts, and postures. Strategically, the Chinese approach to nuclear security strives to achieve a second-strike retaliatory capability. China also has a theory of strategic substitution, for example seeking to use cyber capabilities to deter and gain advantage. Despite some speculation, Chinese doctrine still maintains a “No First Use” (NFU) policy for nuclear weapons. Yet, China is increasing its number of warheads and missiles that could reach the United States. This stance allows for limited ambiguity regarding its application of the NFU policy. The NFU policy would become especially tenuous if the U.S. were to strike China with conventional forces.

A U.S. offensive is China's primary concern, yet it does not believe that the stakes are high enough to justify a U.S. strike. Regardless, China is concerned about its missile defenses and U.S. long-range conventional abilities to strike Chinese nuclear forces. China has also been trying to modernize its forces since the mid-1990s, generally emphasizing quality over quantity. These efforts include: replacing its liquid fuel missiles with solid fuel; increasing reliability and survivability; and improving existing land-based ICBMs, as well as making them road mobile.



There are mixed feelings towards a sea-based nuclear deterrent, as Chinese submarines likely will not achieve adequate survivability against U.S. and Japanese capabilities for several decades.

Professor Zhang was doubtful about a trilateral arms control arrangement between the U.S., Russia, and China. She cited a recent statement from the Chinese Ministry of Foreign Affairs, then she laid out the Chinese rationale. First, China has a small nuclear force compared to the U.S. and Russia. It sees any limits to its smaller force as comparatively unfair. China also argues that its intermediate range missiles are only deployed within its own territory, not overseas like the U.S.'s. China's strategic situation is also different than

the U.S.'s because its neighbors are strategic threats. Thus, Dr. Zhang concluded, China is unlikely to participate in any nuclear arms treaties.

Discussion

What are the most likely cases for using nuclear weapons would be for the U.S., Russia, and China?

Gen. Zwack posed three scenarios in which Russia might become involved in a nuclear exchange. The first would be a Russian strike in response to a perceived Western-fomented color revolution. The second, a Russian fear, would be that the U.S., empowered by the precision of its global strike capability, targets Russian nuclear forces. The third, a conventional conflict between Russia and the West that is bending towards the latter would lead to the Russian strategy to "escalate to deescalate." Gen. Klotz felt the most likely scenario would involve a regional crisis in Europe or East Asia that escalates out of control, leading to one or more sides authorizing limited use of tactical weapons, which would spiral out of control. (MAYBE DROP THIS SENTENCE?? He noted that this conceivable scenario has encouraged the major nuclear powers to carefully avoid engagements between their military forces.)

Professor Zhang explained that China would be most likely to escalate to the nuclear level over a conflict involving Taiwan and Tibet. Beyond these, there are no other issues, including issues with Japan or the South China Sea, that would likely push China to justify a

nuclear first strike. However, she caveated, there is a danger of misperception that could lead to escalation.



Prof. Thrall observed that to avoid these hypothetical crisis scenarios, it is necessary to not only have sound nuclear policies, but there also must be well-thought out non-nuclear policies. Gen. Klotz remarked that even in the midst of the Cold War, the U.S and Russia negotiated agreements such as the Incidents at Sea, designed to reduce the likelihood of an accidental engagement or misperception about the other side's intent. He added that, unfortunately, a lot of the U.S. expertise in negotiating these types of agreements has been lost due to the focus on

counterterrorism and the loss of communications exercises related to more strategic contingencies. During the Taiwan Strait Crisis in 1996, for example, the U.S. and China were in constant communications at the civilian and military levels. The signaling was intentional and clear in that case, in order to avoid any misperceptions and escalation.

Why hasn't China taken a more aggressive stance against North Korea's nuclear program, given the rationale that a nuclear crisis there could spill over into China?

Professor Zhang responded that for China it was a "Goldilocks" choice. On one hand, North Korea causes trouble for China, but on the other hand China views North Korea as a useful buffer zone. China also believes that the U.S. will restrain Japanese and South Korean aggression, and so it does not feel the need to change the status quo.

Why would a trilateral nuclear arms agreement between the U.S., Russia, and China be unlikely, given the precedent of successful backchannel negotiations during the 1960s?

Gen. Klotz reiterated Professor Zhang's earlier comments that China has good reasons for not wanting to participate in any arms control agreements. New START, for example, has very intrusive verification and transparency measures, which would be anathema to the Chinese, who want to preserve the secrecy of their forces, in order to ensure their survivability and deterrent effect.

Gen. Zwack voiced concerns that, at the military level, there has been much less communication between the U.S. and Russia in the last few years than before. He noted that the current commanders of INDOPACOM and CENTCOM have never met their Russian counterparts. This prevents regional commanders as first responders from being able to immediately deconflict with their foreign counterparts, a worrisome reality especially given the increasing ambiguity of conflict in the cyber domain. You don't want to have senior leaders meeting each other for the first time in the middle of a fast-breaking crisis.

Gen. Klotz added that around 2004 when he was commander of the U.S. ICBMs, he was able to host his Russian counterpart for several days, during which both sides were able to dispel a number of myths and misperceptions.

What are U.S. efforts to reduce warhead material, and how are China and Russia using commercial nuclear power to expand their influence abroad?

Gen. Klotz said he was a big proponent of nuclear energy, especially having been an under secretary at the Department of Energy for four years. The U.S. has had difficulty completing its commercial nuclear reactors, but it would be good for the U.S. to get involved international trade. At the same time, it's important to continue an emphasis on controlling U.S.-origin technology to ensure that exports do not contribute to proliferation.

Does China's NFU policy make it less likely to begin a conventional war with the U.S.?

Professor Zhang felt that the NFU policy does not necessarily mean China would not go to war with the U.S. She referred to the stability-instability paradox. She warned that the NFU policy might promote more lower level conflict, even at the gray zone level. It is most likely that China would use force to defend its interest in Taiwan. As a closing comment, Gen. Zwack encouraged the audience to listen to the 1960s-era music of Tom Lehrer; his songs, full of black humor about mutually assured destruction, capture the tense environment of the Cold War. Troubled by the current state of nuclear security, Gen. Zwack warned that even in satire like a Tom Lehrer song, there is a bit of truth.

Panel Two: The Challenges and Opportunities of the Nonproliferation Regime

Rapporteur: Gerry Moss

CSPS Fellow

Middle East & Islamic Studies Masters Student, George Mason University

The panel focused on nonproliferation tactics and strategies, with particular emphasis on current U.S. strategies. While the panel acknowledged the full range of proliferation issues, such as the India-Pakistan arms race, most of the panel's discussion centered on Iran and North Korea.

Is the historical record on nonproliferation still a useful guide?

Leonard Spector from the Middlebury Monterrey Institute considered how nonproliferation has worked over the decades, and he concluded that he remains hopeful that the future will resemble the past. There are five original nuclear powers from the dawn of the nuclear age, and only four additional states have become nuclear weapons states since then. This small increase in nuclear powers in over seventy years is what makes Spector optimistic for the nonproliferation regime's success. After all, it is not as if countries haven't tried or debated becoming a nuclear power. Back in the 1970s Taiwan, Brazil, and South Africa were attempting to build uranium enrichment facilities and that list of countries grew in the 1980s with Iraq, Libya, and Syria all looking into it. Even in the past decade Egypt, Saudi Arabia, Turkey, South Korea, and Japan have all considered developing a nuclear arsenal.



In each case, however, the plans did not materialize for numerous reasons, primarily a recognition that their own national security and economy, and regional stability, would be better off if each remained under the United States' nuclear umbrella. Spector argues that this is because each of them would come under immense diplomatic pressure if they were to pursue an independent nuclear capability.

The Backdrop for North Korea and Iran

Alexandra Bell opened with some of the positive changes that have taken place in the nonproliferation landscape. South Korea was able to restart a dialogue with North Korea after the 2017 election of President Moon Jae-in. The Winter Olympics, hosted by South Korea in 2018, provided the perfect opportunity to create a more productive environment between the two Koreas for eventual talks on challenges such as nuclear weapons or north-south normalization. Bell also brought up that there was a proposed economic agreement between the two countries, but it needed US support, which was not forthcoming. This was the beginning of Bell's concerns that the Trump Administration viewed diplomacy is something easy or something that should end in clear winners and losers.

Bell wants to see the Trump Administration empower its diplomats and even possibly come to terms with North Korea on issues other than nonproliferation. Her suggestions included formalizing an end to the Korean War or establishing a line of open communication between Pyongyang and Washington, modelled on earlier US-Soviet agreements to prevent nuclear events based on miscommunication or misunderstanding. Bell, however, was not hopeful that the current administration will have the patience or perseverance to accomplish such tasks, given the president' highly personalized approach to dealings with North Korea.



Suzanne DiMaggio discussed the failures of diplomatic talks between North Korea and the US. DiMaggio was unimpressed by the Hanoi Conference and the Singapore Summit because, despite the victory of getting North Korea to stop temporarily testing their nuclear weapons, they've continued the production and acquisition of fuel for new rockets. DiMaggio pointed out that North Korea is wary of anything the US offers because of Trump's decision to back out of the Iran Deal (JCPOA) after Iran had been holding up its end of the agreement. To add to that, DiMaggio pointed out how Iran is aware of North Korea's better treatment in nonproliferation negotiations and sees it as a result of North Korea having a nuclear arsenal. DiMaggio is worried that Trump's decisions with North Korea and Iran, especially when juxtaposed together, have made the world a less safe place and that coming back from these rash decisions will not be easy.

Discussion

What are the Trump administration's policies towards North Korea and Iran?

The panel agreed that Trump's policy has been both a step forward, but one that appears to be going nowhere. Trump is the first American president to meet with North Korea's president, which in theory created an opening for a revitalized process on denuclearization. Bell was initially optimistic about the Singapore Summit but was left disappointed by its conclusion. DiMaggio added to this by stating that North Korea has produced enough fuel for 12 additional missiles since the Singapore Summit.

DiMaggio did mention that some strides have been made diplomatically, with the Hanoi Conference's commitment by North Korea to stop testing its missiles. However, she added additional progress will be hard, given the US track record on rolling back other nuclear aspirants. North Korea has seen what has happened Muammar Gaddafi and Saddam Hussein and sees retaining its nuclear weapons as the only path to prevent similar US aggression. Furthermore, North Korea has seen how the Trump administration has treated Iran by backing out of the Iran Deal after Iran agreed to several steps in dismantling its nuclear program that will be costly if not impossible to reverse.

The panelists agreed that backing out of the Iran Deal was a mistake. Bell was quick to point out that Iran agreed to not proliferate in 1970 by signing the Treaty of Non-Proliferation of Nuclear Weapons (NPT) and they had kept that promise. Iran also continued to abide by the provisions of the Iran Deal for a full year after the US withdrawal. DiMaggio worries progress with Iran will be incredibly difficult going forward after what she calls "an all-out war on their economy."

Similarly to how North Korea is aware of how the US is treating Iran, Iran is aware and is watching how the US is treating North Korea. Tehran sees Trump's more favorable treatment of North Korea as a direct result of having nuclear weapons, and having withdrawn from the NPT. This has led Tehran to consider backing out of the NPT. This puts the US and its allies in a precarious predicament, as Europe is trying to get Iran to adhere to the Iran Deal. France has tried to negotiate among the JCPOA signatories a \$15 billion line of credit to subsidize the economic disturbances caused by US sanctions. However, Bell states that this is not a problem that can be tweeted, sanctioned, or missiled away.



What nonproliferation opportunities have been missed?

DiMaggio focused on Iran specifically, she pondered if the war in Yemen, which has become the world's biggest humanitarian crisis, would still be ongoing. Perhaps if the US still had that chain of diplomacy imbedded in the JCPOA with Iran, it would have been possible for Iran and Saudi Arabia to come to terms on ending that costly proxy war. DiMaggio also does not

believe the latest attacks on Saudi Arabia's oil fields, presumably by Iran or its proxies, would have been made if the US had not withdrawn from the Iran Deal.

What one, single policy suggestion would you make?

Spector wants to see the NPT strengthened in the upcoming review of the Non-Proliferation Treaty in May 2020. His hope is that this would prevent future dilemmas such as Iran and North Korea. Bell would like to see world leaders come together and stop arms races and other Cold War tactics like what is being seen between India and Pakistan. DiMaggio would like to see leaders be made more accountable to stick to their country's deals.

Looking towards the future all the panelists seemed somewhat optimistic that the non-proliferation regime would prevail. Spector believes that other nations are aware that Trump is not the new normal for the US and that future US presidents will take a more disciplined and careful approach to dealing with proliferation challenges. DiMaggio is happy to see that the major Democratic Party frontrunners for the 2020 presidential election have all made getting back into the JCPOA a priority. She believes that other countries will take notice that Trump's policies are not the final word on this issue. Bell remained slightly less optimistic and worries that our future diplomats will always be hindered by the reality that the US backed out of the Iran Deal. Earlier in the panel Bell brought up that reopening diplomatic talks do not have to be centered around proliferation. Regarding North Korea, Bell suggests perhaps getting them to formalize an end to the Korean War. This sentiment was shared by DiMaggio regarding Iran, stating that the reopening of diplomatic talks can start by discussing the release of prisoners. The panel made it clear that despite the setbacks, there is a path forward.

Panel 3: Connecting the Dots: Nuclear Technology and the Transnational Threat Environment

Rapporteur: James Vizzard

CSPS Fellow

Political Science PhD Student, George Mason University

While the previous panels addressed nuclear issues as state weapons and preventing the proliferation of nuclear weapons to additional states, the final panel focused on other kinds of threats, actors, and uses of nuclear material. This includes the interplay between cyber security and nuclear vulnerabilities, proliferation to nonstate actors, and nuclear energy as an answer for climate insecurity.

Dr. Brian Mazanec

Dr. Mazanec opened the panel with a central question: *do cyber capabilities reinforce or undermine nuclear stability?* He identified the key characteristics of stability as reliability of weapons and adversary risk or second-strike capability. Dr. Mazanec then argued that cyber capabilities undermine nuclear stability in four ways:

1. Threats to the weapons themselves and nuclear command and control architecture. These issues were addressed in the 2018 Nuclear Posture Review. The Department of Defense has not consistently planned for cyber security as it has fielded new weapons, and there continue to be vulnerabilities in both weapons and architecture. Threats include spoofing, interfering with communications, attacking supply



- chains, and making weapons more vulnerable to theft.
2. Cyber-enabled information operations. In particular, information operations pose a risk to regional nuclear dynamics from non-state actors instigating a conflict. Disinformation can also undermine the non-proliferation regime.
 3. Cyber-enabled escalation risks. There is discussion of using both conventional and nuclear capabilities to respond to or deter cyber attacks. There are no defined norms for cyber employment and no defined redlines. Commitments of non-cyber means to deter cyber attacks may pose an escalation threat.
 4. Cyber-enabled technology convergence. Dr. Mazanec referred not to artificial intelligence in decision chains, but rather using AI to improve intelligence capability in ways that would permit adversaries to identify legs of the triad and undermine its deterrent value. Applied AI "could make the ocean visible and transparent."

In today's world cyber and nuclear security are intimately tied together.

Ambassador Laura Holgate

Ambassador Holgate spoke about nuclear security, particularly weapons that may be created by non-state actors. Highly enriched uranium (HEU) and plutonium are required for the production of nuclear weapons, and for the moment the required infrastructure is so big, expensive, and technically complicated that it is restricted to states. However, once non-state actors have the raw ingredients, converting them to a weapon is not that hard. Security efforts have therefore focused on containing HEU and plutonium. There is a limit to the political willpower to do what is necessary.

Candidate Obama believed we could generate the political will for steps that are actually not that hard. The Obama administration conducted four summits between 2010 and 2016 that included 50 countries, as well as the UN, IAEA, EU, and INTERPOL.



- These Nuclear Security Summits produced four communiqués and a series of detailed action plans. Participants were expected to bring to the summits steps they had accomplished or commitments to future actions that would contribute to nuclear security.
- The program produced over 100 commitments from the first summit, of which more than 80% were completed within two years. Recognizing thematic commonalities among the deliverables, the organizers established coalitions of countries that were pursuing similar initiatives, enabling more ambitious announcements that would not have survived in a consensus-based leader communiqué.

Since the Obama administration, there has been "a significant collapse of political will around nuclear security." Some countries believe nuclear security hampers their ability to have nuclear

materials. Moreover, there is an over-classification of things that should be public. Some actors believe that efforts to restrict the spread of nuclear materials are sovereign issues that should remain secret.

Ambassador Holgate's final point was that leadership matters. The summits enabled leaders to take actions they had believed to be too hard and greatly expanded the number of countries involved in nuclear security. The number of countries with HEU in their territory went from 35 to 22. There are large geographic regions with no HEU. However, those countries have been unwilling to collectively announce that they have no HEU. There is still an unfulfilled agenda to improve the methodology of security for military material.

The "holy grail" for nuclear security going forward is to figure out how to bake in incentives to do a good job on nuclear security. There are many entities involved, and many of those are private companies. Insurance breaks? Preferential loan access? Global seal of approval? Future efforts should aim to incentivize good behavior rather than just punishing bad-design high-quality nuclear security into new energy initiatives rather than retrofitting.

Andrew Paterson

Mr. Paterson addressed how nuclear energy can be seen as an effective response to climate change. He noted that commercial nuclear is the face of nuclear technology that civilian communities see. Even after severe cost overruns, cheap gas, and accidents there are still 50 plants under construction. Nuclear plants are clustered in rich countries, but new construction is primarily in Asia, and particularly in China and India. By 2050 there will be between 370-700 Gigawatts of nuclear production. With retirements, there will need to be at least 250 GW of new capacity to hit the low end of that projection.

The U.S. has made a lot of progress on reducing its carbon footprint since 2005. Statistics for the country as a whole are often misleading because individual states affect nuclear power, and there is consequently wide variation. The U.S. produces 20% of its electricity with nuclear, but Chicago is 50% and LA is only 10%. Virginia has reduced power emissions so far that 50% of the remaining reductions need to come from transportation. Europe, and particularly Germany, is making less progress on emissions because they have shut down nuclear power. There is no way to avoid increasing average temperatures by 2°C without nuclear power.

Why are 50 new plants being built? Japan has already restarted nine of its 40 reactors since the Fukushima disaster. Ukraine relies on 15 nuclear reactors for 50% of its electricity despite Chernobyl. The second Three Mile Island reactor has been operating for 40 years.

An even bigger challenge than climate change is the coming wave of massive urbanization. In the next 40 years, there will be more than three billion more people in the



world's cities. We have to incorporate fuel choices into urban growth. We can improve energy use footprint in cities as they grow, but cities do not provide opportunities for solar and wind because of the restricted geography. Nuclear power is going to enable clean urban living. China and India each lose one million people prematurely each year to air pollution.

The U.S. has already lost leadership in the nuclear energy field to China and Russia. China has pledged to build 30 nuclear reactors across the Belt and Roads route and is bidding on three new plants in Britain. Russia is selling reactors around the world. In exchange China and Russia are extracting concessions from customers, including military basing rights. They have incorporated the building of nuclear reactors into their foreign policy in order to seize space at U.S. expense.

Discussion

What are the governance and international norms regarding the cyber dimension of the nuclear threat?

Dr. Mazanec argued that the term "cyber" is used in a way that is not conducive to establishing norms because we call too many things cyber warfare. The U.S. does want to be a leader in establishing norms. The Obama administration was very active. This administration still supports it but is hedging in terms of U.S. advantages. We are taking more of an offense-oriented approach. There is some desire to walk away from the nuclear framework and achieve deterrence through cyber.

Is there an overlap between safety issues and security vulnerabilities?

Amb. Holgate explained that the difference between safety and security is advertency v. inadvertency. After Three Mile Island, nuclear was considered so sensitive that even safety discussions were difficult. Summit documents reference nuclear and radiological to deal with the various elements, such as the medical usage. Public health aspects of safety v. security incidents are radically different, but the public does not make fine distinctions, so radiological incidents would cause nuclear backlash.

How can we be sure that nuclear reactors are proliferation-resistant?

There is a principle of "acceptable risk." Other hazards, like failure of other sources during the Polar Vortex, are also dangerous. The track record of nuclear safety has actually been remarkable. Zero people died from Three Mile Island, and the containment vessel worked. Gen 4 nuclear fuel designs are more secure than current designs and more proliferation-resistant. They will be better in terms of storage and disposal. There have been 12,000 shipments of waste to Carlsbad with no accidents.

Amb. Holgate said that there is no rigor to the term "proliferation-resistant," and there is no reasonable expectation that the technology will save us. Security will have to be embedded in the administrative framework. What is more important is safeguards by design, security by design, and fuel cycles. Newer fuels are harder to use for nuclear weapons, but they are not proliferation-proof.

Is the U.S. position falling behind Russia and China attributable to humanitarian concerns or restrictions?

Amb. Holgate explained that there are no humanitarian requirements on our exports, but there are extensive non-proliferation strings. The big difference is the geopolitical issue. U.S. nuclear is primarily private, but other countries are nationalized and nuclear sales are integrated with foreign policy.

Mr. Paterson added that the Export-Import Bank can exercise some influence through financing, but you need to look case-by-case--each case is different depending on interstate relations. Poland will be an interesting test case. Britain is up for grabs.

Nuclear energy has a public relations problem with proponents playing defense. Can we frame the issue in a more positive way?

It is not the single solution to power problems. We live in a hybrid world. How do we develop the kinds of grids that will be necessary to transmit electricity to Detroit in February? Every solution begins with some sort of subsidy, and I don't see who's going to pay for it.

Mr. Paterson agreed that we need to develop a more positive message with respect to nuclear energy. In Congress, Senators are doing that for us. Sen. Murkowski has Democratic co-sponsors on the Nuclear Energy Leadership Act. I share your skepticism about the scale of money that's going to be required.

Amb. Holgate said that the questioner was right about public messaging. Are there communities that see the benefit of nuclear energy as part of an energy mix? Mr. Paterson added that he sees the debate about nuclear energy and climate responses as a kind of asymmetric warfare. The Sierra Club is pushing for 100% renewable, while he is not pushing for 100% nuclear. He wants to go back to acceptable risk. The idea that any radiation is dangerous is not good public policy. We live in a sea of background radiation. Acceptable risk includes benefits.

Biographies

Lieutenant General (Ret.) Frank Klotz was the Department of Energy's Under Secretary for Nuclear Security and the Administrator of the National Nuclear Security Administration. He was the Director of NNSA from 2014-2018. He has also served as the Commander of Air Force Global Strike Command, as the Director for Nuclear Policy and Arms Control on the National Security Council, and as a Senior Fellow for Strategic Studies and Arms Control at the Council on Foreign Relations.

Brigadier General (Ret.) Peter Zwack has formerly served as US Senior Defense Official and Attaché to the Russian Federation. He is the recipient of the Distinguished Service Medal, Legion of Merit, Defense Superior Service Medal, and many other awards and citations. He currently serves as a Senior Research Fellow at the Center for Strategic Research at the National Defense University.

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