



FIT FOR PURPOSE? THE U.S. NUCLEAR POSTURE IN 2030 AND BEYOND

Workshop Summary

Center for Global Security Research
LAWRENCE LIVERMORE NATIONAL LABORATORY

Workshop Summary

FIT FOR PURPOSE? THE U.S. NUCLEAR POSTURE IN 2030 AND BEYOND

Center for Global Security Research
Livermore, California, June 8-10, 2020

Prepared By: James Blumhoff, Taylor Lamoureaux,
Anna Péczeli (lead author), Brice Richmond, Murry Smith¹

On June 8-10, the Center for Global Security Research (CGSR) at Lawrence Livermore National Laboratory (LLNL) hosted a workshop titled “Fit for Purpose? The U.S. Nuclear Posture in 2030 and Beyond.” This session brought together participants drawn across the policy, military, and technical communities. The workshop aimed to examine the existing modernization plans, the challenges that might obstruct their implementation, and the new deterrence requirements that might emerge in the future, in light of the modernization efforts of Russia and China.

Discussion was guided by the following key questions:

- Will the US nuclear posture be “fit for purpose” a decade from now?
- How might it evolve, or need to evolve, thereafter?
- What factors are likely to affect the modernization pathway?

Key take-aways:

1. Today, the U.S. nuclear posture serves various purposes: deterrence in a multipolar context, strategic stability, extended deterrence, assurance, and hedging. It also serves as a form of insurance against threats to the vital interests of the United States and its allies. These are unlikely to change by 2030.
2. The triad will be fit for purpose in 2030—assuming the modernization program is sustained and meets the just-in-time schedule, although some slippage is possible. Arms control may have a significant impact on the modernization pathway. In the absence of an arms control framework, an arms race driven by a desire for quantitative supremacy by any of the three

¹ *The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or Lawrence Livermore National Security, LLC, and shall not be used for advertising or product endorsement purposes.*

major powers seems unlikely. However, an end to arms control might reduce Congressional support for modernization.

3. Russia and China are adapting their strategic postures to changing circumstances. The future missile defenses of one or both may call into question the viability of ballistic delivery of nuclear weapons. Their future abilities to find and fix dispersed U.S. systems and/or to disrupt their command and control may call into question the survivability of U.S. forces. The nuclear command and control (NC2) system could be substantial and robust in 2030. And it could not, if the effort to strengthen and adapt it to changing requirements falters. A key question is whether it will be well tailored for deterrence as opposed to war-fighting.
4. Over the last two decades, Russia has made significant headway in conventional/nuclear integration, with new guidance, operational concepts, doctrine, planning processes, and exercises. China too has made many significant adjustments in the name of integrated strategic deterrence. The United States has only recently made such integration a priority again. Integration is not simply orchestrating conventional and nuclear strike planning or preparing to fight on a contaminated battlefield. It now requires integration of all the non-nuclear means as well (not just general-purpose forces but also missile defenses, cyber space, outer space, and information warfare).
5. The United States aspires to strengthen its hedge posture between now and 2030. But past unmet aspirations raise questions about future success. For decades U.S. leaders have said they want an agile, responsive infrastructure but until recently they put their focus and money elsewhere.
6. By 2030, the balance of central strategic forces among the United States, Russia, and China may have altered in various ways, but it is unlikely to have changed in a way that fundamentally calls into question the ability of the United States to retaliate in a devastating manner. The US is likely to have a nuclear posture much like today's force.
7. The extended deterrence balances in the transatlantic and transpacific alliances look much more problematic. NATO has made important progress since 2014 in adapting its overall deterrence and defense posture to new Russian challenges, but its 2020 posture is not robust against the emerging Russian A2/AD-like threat. In East Asia, U.S. alliances have also made progress—but mostly vis-à-vis North Korea, not China. The conventional balance vis-à-vis China is worrisome and eroding.
8. Just as the United States and its allies must worry about Black Swans in the decades ahead, so too must Russia and China. Accordingly, they too hedge—with large production infrastructures, robust supporting S&T investments, and an approach to modernization that fully exercises all of the design and production skills.
9. Overall, the United States and its allies can be cautiously optimistic that the U.S. nuclear posture will be fit for purpose in 2030. But there is a decent chance that modernization will not occur just-in-time and that capability gaps will result and that adaptations to the deterrent will be necessary but cannot be accomplished in a timely way.

Panel 1: Modernizing the US Nuclear Arsenal: The Road to 2030

- What is the existing plan?
- What factors might emerge to obstruct successful completion of the plan?
- Might additional requirements emerge?
 - What impact might the possible end of US-RF nuclear arms control have?
- Might requirements be relaxed?
 - What impact might NST extension, a new arms control deal, or delivery system delays have on requirements?

The first panel provided an overview of the ongoing modernization efforts in the United States. The Trump administration's NPR had a lot of continuity with previous administrations: maintaining the triad and focusing on a credible deterrent were not new elements. There have been some changes in the modernization programs, but most of these changes were due to the deterioration of the threat environment. Besides the set of capabilities that are undergoing modernization, R&D and manufacturing are equally important parts of this endeavor. This is a complex program with simultaneous modernization efforts in all legs of the triad: the Columbia class SSBNs which are replacing the Ohio class, the GBSD which is replacing the current Minuteman ICBMs, the B-21 strategic bomber, the LRSO nuclear-armed air-launched cruise missile, the nuclear capable F-35 fighter jets, the nuclear-armed SLCM, and the next generation of C2 system to address modern challenges and threats.

This modernization plan comes with three types of major risk: program risk, political risk, and risks posed by an unpredictable threat environment.

The program risk follows from the complex and comprehensive nature of the modernization plans. These are highly interconnected programs, and there is no margin for error—problems or delays with one program will affect other programs as well. Success requires a robust R&D and manufacturing base that also includes the commercial sector. The United States needs to re-learn production skills that have not been used for a while. Acquisition oversight will need to look at these programs as an integrated whole, not as individual programs. Any failure could result in a stand-down of some part of the U.S. nuclear deterrent.

The second set of issues that could influence the success of the modernization efforts involve the prospects for continued bipartisan support for nuclear modernizations. President Obama built a fragile consensus in 2010, and bipartisan support for modernization also continued under President Trump. There have only been a few disputes around these issues. These included disagreements about slowing down the GBSD (which seems to be the most vulnerable element of the ongoing modernization efforts), cutting back funding for the W87-1 modification program, and discussions whether to proceed with the low-yield SLCM. So far, all associated funding was approved for these programs, however, there might be challenges in the next two decades. The COVID-19 pandemic is likely to create a new pressure on defense spending, but the panelists argued that these programs are not expensive relative to what they are providing to the United States. The second challenge is that many lawmakers see arms control linked to modernizations (President Obama's New START ratification deal with Senator Kyl was a clear example of this). Today, there is a perception that the Trump administration is hostile towards arms control, and

the fragile political consensus might be undermined if the New START agreement is not extended, or if the United States resumes underground testing.

The third major challenge for the modernization plans is the risk of evolving threats. The current plans are about replacing the existing arsenal, not doing anything more. But the question remains whether it will be sufficient in 2030? This will largely depend on how the Russia threat evolves over time, and whether there will be any major technological surprises. Today, the United States and its allies live in a more dynamic security environment with multiple potential sources of conflict from nuclear armed adversaries. In a modern conflict, nuclear command and control is likely to be more challenged than during the Cold War period. We see a dramatic increase of capabilities for kinetic attacks on NC2 systems, there is also a growing potential for cyber attacks, and an attack on satellites in a conventional conflict could also have devastating effects for NC2 systems. Therefore, in case of a conventional conflict that escalates to a nuclear war, the nuclear exchange could start with a degraded NC2 system. In order to respond to these types of threats, the United States needs to make sure that its NC2 system can survive conventional attacks.

The threat environment is further complicated by Russia's aggressive behavior and its new nuclear weapons that are outside of the New START Treaty framework. These systems, and the growing number of hypersonic weapons created a set of unprecedented challenges for the United States and its allies. China is also a growing threat in many different domains, including the nuclear domain. There are concerns about the direction of the Chinese nuclear threat. They are likely to at least double the size of their stockpile to become a first-tier force. China's advances in missile technologies are designed to push the United States out of the region. At the same time, the Chinese government has been unwilling to engage in conversations about transparency or arms control. All these challenges create growing concerns for extended deterrence and the ability of the U.S. to assure its allies in the future.

Regarding the issue of arms control, the end of the INF Treaty provided an opportunity for the United States to strengthen its assurances to its allies in Europe and the Asia-Pacific. Washington will need to examine whether the arms control arrangements of the past can continue to serve the original purpose of fostering greater stability in the future. There are legitimate concerns in this area. Russia has a growing arsenal that is not regulated by arms control agreements, and China showed, so far, no willingness to join this process. Regardless of the issue of New START extension, the United States will need a long-term solution for the above problems. But even if arms control efforts will be unsuccessful, it is unlikely that we will see a renewed arms race. The current U.S. modernization plans are about maintaining the existing stockpile, and the United States is in no position to enter a costly arms race. The nuclear warhead production infrastructure is simply not sufficient to support it, and the United States is not going to be in a position to respond to an emerging arms race in the next 10-15 years.

Panel 2: Modernizing the US Nuclear Arsenal: 2030 and Beyond

- What is the intended approach to warhead modernization beyond 2030?
- What challenges need to be addressed between now and 2030 to enable success post 2030?
- What risks are likely to need sustained attention after 2030?

From the perspective of the national laboratories, ensuring U.S. nuclear deterrence effectiveness on a 2045 time horizon will face three main challenges. The first is maintaining the needed balance in force structure at a time when Russia and China are modernizing and diversifying their forces. Second, the United States will need to maintain offense-defense stability, part of which requires that U.S. strategic assets need to be heavily defended, or buried deep. And third, new technologies and disruptive cyber and space capabilities are likely to challenge the United States. The strategic community will need integrated thinking on how these capabilities change the nature of great power relations, and what kind of opportunities and problems they create.

By 2035, the United States will have elements of the new triad, but looking beyond the existing plans there is nothing formally programmed in. There are some “place holders” but the United States needs to examine whether the currently planned capabilities will sustain nuclear deterrence effectiveness or additional capabilities will be needed. The synchronization between warhead modernizations, delivery systems, and major infrastructure milestones is imperative. Besides, big scientific milestones need to be achieved, as well as advanced manufacturing and production capabilities to allow work beyond the 2030s. One of these major necessities is going to be pit production. This is a lot of work, dispersed within a large complex, and it will require sustained attention.

On top of the already mentioned risks associated with bipartisan support, funding and emerging threats, the human factor is also crucial. NNSA will need to maintain the ability to attract and retain the best and the brightest minds. The national laboratories will need to remain competitive with the private sector and high-tech companies that are taking over some government responsibilities. The laboratories will also need to balance the complexities of telework and on-site work, and they will need science and security to adapt to modern era IT productivity tools.

The labs also need to plan for uncertainties and increase their resilience. The COVID-19 pandemic was a clear example of such an unexpected challenge that could happen again. Besides, the United States will have three presidential elections until 2030 which could create unexpected challenges in the political arena. Acknowledging these uncertainties and preparing for the future with scenario planning would be useful. NNSA needs to be prepared for a lot of “worst case” scenarios. Regarding resilience, the United States has to make sure that its hardware, its institutions, and its people are all resilient. This will require diversification, interoperability, modularity, innovation, scalable processes, compensatory structures, and the involvement of other agencies. The key factor in the resilience of humans is cognitive diversity in the different teams, transparency to challenge each other, looking up and out, and the readiness to act decisively when things change rapidly.

Panelists emphasized that the current modernization plan is just a replacement and a recapitalization of the infrastructure that the United States had, and the work is not going to be complete in 2030. At the moment, everything is well coordinated but the schedule is tight and there are serious programmatic risks. The first priority is to complete the current plans and then focus on potential future warhead developments. So far, there has not been much thinking on what those new warheads might be. But because of the growing challenges, thinking needs to start now.

Beyond 2030, the United States will need to have a sustained focus on deterrence effectiveness. It already allowed its nuclear triad to age, and any delays would keep the current capabilities deployed for dangerously long. There is also a need for increased attention on the integration of these systems. Planning needs to take into account potential technological breakthroughs by the adversaries. All this requires a responsive infrastructure that would allow the United States to act in a timely manner. It has been decades since the United States designed a new nuclear warhead, and right now it takes 10+ years to execute a life extension program. This might not be good enough in the future. Besides, many of the current plans were put into place before the return to great power competition, which raises the question whether these plans are still adequate in the new environment.

In order to prepare for the future, the United States should aim to make the current programs as efficient as possible. This should include utilizing new manufacturing procedures, learning from these opportunities, and driving costs down to recapitalize and gain better flexibility against future financial challenges. The United States needs to have a holistic look at the production complex. Certification of nuclear weapons is still possible without having to go back to nuclear testing, and the United States even has the technical capability to do a clean-sheet design without testing. A clean-sheet architecture should utilize a modular approach to warhead design. The labs are already doing limited life component changes, this should be expanded. NNSA should revitalize thinking outside of the box that has been missing for so long, and it should emphasize new approaches to innovation to be able to produce new weapons in a future where the timelines and costs are fixed. The weapons that have recently undergone life extension will start to age out in the 2040s, and the United States will need a posture that allows to adapt to whatever circumstances it will have to face.

Panel 3: NC3 and AI: 2030 and Beyond

- How far will the US have gotten with NC2 modernization by 2030?
 - What major tasks will remain?
- What impact might artificial intelligence have on NC2? What impact should it have?
- Will the system be capable of delivering integrated strategic effects?

The third panel began with an examination of the role of NC3 (nuclear command, control, and communications) in a changing world. While the purpose of the arsenal is preventive, it must be usable, even under direct attack. However, new domains and systems such as cyber and hypersonic platforms are changing the way the world looks at nuclear weapons, which are

becoming only one part of a much larger picture. As such, NC3 is fit for purpose if it enables the combination of nuclear weapons, hypersonic, and cyber-based capabilities to deter nation-states or others from using nuclear weapons in the future. Over the next ten years, NC3 is crucial to modernization and integration efforts. In the past, NC3 primarily operated as a stand-alone, air-gapped system. Moving forward, NC3 can no longer exist by itself. The most likely scenarios that involve escalating crises, are not scenarios where thousands of warheads are coming over the horizon. Moving forward, it will important to understanding NC3 as part of broader C2, and looking at how NC3 can be leveraged to escalate and deescalate crises, in conjunction with other capabilities. In the interest of deterrence, NC3 will need to be more widely integrated into multi-domain-joint C2 systems.

The panel also discussed the role of AI. The impact of the software revolution, artificial intelligence, and the acquisition challenges also received significant attention amongst panelists. The role of AI, in particular, has proven a point of confusion in recent debates. Instead of destabilizing deterrence, AI may enhance deterrence and reliability by improving communication resiliency, identifying off-ramps, and taking courses of action for the national command authority. Despite these potential benefits, the panel agreed on the need to maintain a human in the loop of nuclear decision making for the foreseeable future. However, it was noted that the US can easily insist on maintaining a human in the loop due to its confidence in its second-strike capability. Other states will likely move forward with increased automation because they lack similar confidence in their second-strike capability. Looking at the ability of AI to improve aspects of NC3 systems, a second caveat was the need to promote the exercise of cognitive judgment by decision-makers so that they do not merely execute options suggested to them by new systems.

Tangentially, two issues will determine the degree to which NC3 modernization will progress by 2030. The first is how NC3 will be handled starting in 2023 when specific budget allocations take effect. The second factor will be whether the US is able to more effectively mirror the private sector in acquisitions. Today's model of DoD acquisitions will not be sufficient for carrying out NC3 modernization. The success of some of the new acquisition models that DoD is currently piloting will play a significant role in determining the success of future efforts. Integration and the software-based revolution may also allow for quicker and more efficient updates or adjustments to NC3 systems. However, this may mean that supply chains and hardware vulnerabilities will become more prevalent despite not being entirely understood. To minimize the risk of these vulnerabilities, the US will need to learn much more effectively how to handle supply chain management, code writing, recruitment, update implementation to systems, and general development.

In the next ten years, AI is unlikely to handle human cognitive loads or social cues. As such, the need for a human in the loop is paramount. The events and crises that new systems will be called upon to deal with are often one-off crisis events with varying escalation pathways. By relying on a human in the loop, the US can leverage the benefits of AI while also benefiting from human flexibility and innovation. This will demand intensive focus on human capital. While the US possesses the most relevant warfighting data on which to train new systems, it will need to prepare the data correctly, train operators to understand when to trust data, and train senior

leadership to carry out and understand the technology behind NC3 to realize human-machine benefits.

The final point in discussion was the role of misinformation in an NC3 context. The US faces skillful adversaries. There are two confirmation biases to consider in the NC3 context. First, that of data poisoning, when the underlying algorithm is compromised due to the insertion of malicious data. Second, spoofing or camouflaging where data is fooled in real-time so that the system works as intended but is fooled into misinterpreting data.

Effective cybersecurity will be vital to ensure data reliability and prevent spoofing on the battlefield. However, the risk of such misinformation or other malicious actions compromising new systems demonstrates why focusing on human-machine NC3 systems rather than full automation is a good bet moving forward.

Panel 4: Conventional/Nuclear Integration and Future Nuclear Requirements

- What has been done to address the NPR commitment to strengthen integration?
- What has been done to address the concerns raised by the National Defense Strategy Commission about US deterrence strategy?
- If and as the US increases its planning focus on regional conventional wars against nuclear-armed adversaries, might new nuclear requirements emerge?

The first question is what we mean by conventional/nuclear integration. The panel pointed out that the community of military operators generally focuses on integration at the operational level of war. Thus they are focused on the tactical effects of battlefield use or how to offset adversary use of nuclear weapons in an otherwise conventional war. For this reason, much of the military discussion centers on the question of how to conduct military operations on a battlefield where they have been attacked with tactical nuclear weapons. Yet nuclear-conventional integration can and should be broader than just being prepared to fight in a nuclear environment. In order to use military power in a holistic manner, it is necessary to consider the many other possible avenues of integration that could produce a seamless continuum between conventional and nuclear weapons.

To put this issue in context, it is useful to take a longer historical view. One way of thinking about conventional/nuclear integration firmed up in the Cold War—and is reflected in NATO's doctrine of flexible response (1968). This approach comprehensively integrated conventional and nuclear strategy, doctrine, and operations. After the Cold War, thinking shifted to the opposite extreme and the nearly complete de-linking of conventional and nuclear operations in the context of Major Theater Wars in which nuclear conflict was conceived as possible only as the last gasp of a dying rogue regime. With the renewal of major power rivalry, the US now faces the challenge of integrating a broad spectrum of capabilities and operations with nuclear capabilities and operations. The conventional toolkit now includes not just general-purpose military forces but missile defense, non-nuclear strategic strike, cyber, space, special operations forces, etc. Think of this third phase as conventional/nuclear integration 3.0.

The panelists pointed out that the process is currently underway to rewrite guidance at all levels of the military to make good on the commitments of the 2018 Nuclear Posture Review. This effort has been undertaken in parallel, meaning that rather than follow a top down direction, every level from Secretary of Defense to the combatant commanders are thinking about the question of integration. With the new guidance being put into place, combatant commanders are implementing revisions based on the new guidance. The pace of the implementation varies across commands. Ultimately, training and exercises will demonstrate how effectively integration is being implemented. Exercises have begun to reflect integration but due to the restraints of the COVID-19 pandemic, many of these exercises are being delayed.

While such planning is necessary, it does not address all the problems that the US is trying to solve through conventional/nuclear integration. Part of the problem is that potential U.S. adversaries have already integrated their tools of deterrence across domains and theaters. Thus, the challenges they will present will be different than those the United States has faced in the past. Today, the conventional superiority that the US has relied on will not necessarily provide a decisive advantage early in a conflict. This creates an exploitable gap in the ability of the US and NATO to defend their interests.

Panelists also addressed the issue of stove piping in the nuclear review process, and the organizational structure of the military as well. The US does not have a general staff—nor should it. Rather, change has been driven by the chairman of the JCS who has the responsibility to be the global integrator. Stove piping is also baked into the strategic review structure. It was suggested that an integrated strategic capabilities review should be undertaken to complement the National Defense Strategy, and these two reviews should ultimately be integrated as well. While there are different ways to overcome stove piping, it was also recognized that the very organizational structure of the military contributes to this issue. Thus, it may be time to reconsider the organization established through the Goldwater-Nichols legislation. Such fundamental changes will require the sustained attention of Congress. This is equally true for the review process, which is mandated by Congress. Only when the relevant armed services subcommittees take up the issue can the problem really be solved.

On the question of whether new nuclear requirements will emerge over the next decade, panelists responded with a unanimous maybe. In the European and Asian theaters, there are new facts on the ground that may one day require new capabilities. Of equal importance to U.S. allies is the broader strategy in which capabilities will be deployed. The US has stated repeatedly its intent to deploy only conventional INF-range missiles to the Asian-Pacific but has not made a clear case for the fit of such systems in a comprehensive, integrated regional deterrence architecture. One possible pathway to increase conventional/nuclear integration is including Asian allies more closely in nuclear planning along the lines of NATO's Nuclear Planning Group and High Level Group. While discussing the details of targeting might not be feasible, more can be done to improve allied consultations.

Panel 5: The Extended Deterrence “Balance” in 2030

- How will the separate deterrence architectures (nuclear and more broadly) in Europe and East Asia have evolved between now and 2030, if at all?
- Will the deterrence position of US allies and alliances have grown stronger or weaker relative to neighboring major power rivals and regional challengers? Why?

NATO has made considerable progress in strengthening its deterrence architecture and growing stronger. Nuclear weapons have played a critical role in furthering both. Nevertheless, there is more to be done. The panelists had doubts whether Russia finds this architecture credible. Why? First, NATO’s nuclear deterrent is still quite modest relative to the Russian regional nuclear force. Moreover, Russian air defenses are strong, which raises a question about the credibility of NATO’s nuclear threat. Additionally, Russia believes there is an asymmetry of stakes between the two sides—that it would have more at stake in a conflict with NATO—and thus that it would find it easy to discount NATO’s threats. Furthermore, Russian leaders may doubt that NATO members would have the political resolve to engage or prevail in a conflict. Russia’s robust nuclear arsenal could one day be used to apply extreme coercive pressure on NATO.

With these problems in mind, the panel shifted to a discussion of how NATO’s deterrence posture ought to evolve by 2030. Some improvements will be made to the alliance’s deterrence architecture by 2030. Will they be sufficient? It remains to be seen what effect, if any, the COVID-19 pandemic will have on defense spending and investments. Improvements in capabilities will likely be insufficient if European states fail to increase military spending to 2% of their GDP. Progress could also slow if there are insufficient investments in research and development. NATO is also falling behind on nuclear matters vis-à-vis Russia. Moscow is adding to its nuclear capabilities at both the strategic and sub-strategic levels. It seems that the extended deterrence “balance” in Europe will likely favor Russia by 2030 if NATO does not seriously commit to this issue. Additions to nuclear sharing arrangement are not feasible. European anti-nuclear sentiment will, at the very least, make any additions to NATO’s nuclear deterrent difficult. At the same time, all members will have to make tough political decisions if NATO is to maintain a credible deterrent. The continued erosion of the trans-Atlantic relationship will play a big part in the evolution of the European security architecture. Friction between the US and NATO is not new, but some in Europe believe the US will remain a reluctant and troublesome ally for the foreseeable future. Repairing the relationship is a must.

In Northeast Asia, the situation appears equally troubling. Nuclear gains by both China and North Korea make U.S. extended deterrence in the region more critical than ever. China has been increasing the size of its nuclear arsenal and deployed forces. It has also improved its theatre strike capability that puts U.S. allies at increased risk. Japan and South Korea have limited non-nuclear strike capabilities. If Japan, South Korea, and the US fail to keep up with Chinese advances, the deterrence balance in the region will favor Beijing by 2030.

Because of the impressive gains in Asia, the US must prioritize China, while continuing to deal with Russia. This is an extreme burden. U.S. allies in Asia and Europe must assist in this endeavor by shouldering more burden. China has developed a theory of victory based on denial. China would rely heavily on maritime and air domains should hostilities break out. The allies must

work to develop a theory of victory that is also based on denial. Missile capabilities will play a key role in this strategy. China has developed an array of intermediate-range missile forces while the US was still bound by the INF Treaty. Basing enhanced strike weapons in Japan and South Korea will be essential in re-balancing this. Such weapons would allow the allies to neutralize China's first strike advantage, attack its airbases, destroy its ships, and block any amphibious operations. Essentially, these capabilities would be an asymmetrical approach to deny China a military advantage. Though the US was once reluctant to give Japan and South Korea strike capabilities, that reluctance has decreased. Panelists noted that Japan can contribute to Taiwan's security by being able to defend its own island chain. This would relieve pressure from the US, allowing it to focus on defending Taiwan should the need arise.

Though Japan and South Korea could play a greater role in the realm of conventional strike, it is highly unlikely that they will play a direct role in the nuclear mission. Asian allies are pleased to see the modernization of the U.S. strategic arsenal and the forward deployed nuclear weapons in Europe. They do not think such an arrangement would work well in their region. Chinese and North Korean air defense systems would likely prevent airspace penetration by dual-capable aircraft. A lack of perceived utility makes the allies relatively unwilling to base dual-capable aircraft on their territories.

Participants asked what first steps the allies could make towards a more integrated strategic deterrent across Europe and Asia. A possible starting point could be adding more to the European and Pacific Deterrence Initiatives. Panelists argued that it would be advantageous to have trilateral discussions between the US and its allies. This could inspire new thinking about deterrence across the board. But thinking too much about hardware and not competitive strategies would be unwise. Regarding the issue of US assurances, the collapse of extended deterrence in Europe and Asia could be triggered by many different factors. One is through significant U.S. troop withdrawals from allies' territory. The recent decision of the US to unilaterally remove troops from Germany harmed NATO because Washington did not consult with Germany and/or other allies. Ultimately, extended deterrence would most likely collapse if the US refused to retaliate against an attack on its allies.

Panel 6: The Tripolar Strategic Offense/Defense Balance in 2030

- Are the strategic postures of Russia and China likely to have changed substantially between now and 2030? If so, how? If not, why not?
- Will the United States have lost, gained, or preserved its position in the separate bilateral strategic relationships?
- Are differences in national approaches to nuclear modernization consequential for the nuclear balance?

The Russian Federation has nearly finished its nuclear weapons modernization program. By 2030, Russia will have a qualitatively enhanced strategic arsenal. Most notably, Russia is developing a new series of exotic nuclear systems. These include a hypersonic glide vehicle, a nuclear-powered cruise missile, a submersible nuclear drone, and a heavy intercontinental ballistic missile capable of carrying between 10-15 MIRVs. Additionally, Russia is transferring a

number of its systems to mobile platforms in an effort to enhance the arsenal's survivability. Sub-strategic nuclear systems are also being modernized. Approximately 2,000 theatre warheads have gone through upgrades. Questions remain whether Russia is looking to expand the size of its nuclear arsenal. If so, will expansion be confined exclusively to its strategic arsenal or will the sub-strategic arsenal also expand? Both seem highly unlikely as Russia continues to wrestle with economic pressures.

Nuclear augmentation is certainly underway in China as well. By 2030, China will have a functional triad with twice as many warheads by the end of this decade. What does this indicate? For some, the Chinese modernization program is geared simply towards enhancing the survivability of its arsenal. Others believe that China might be attempting to reach nuclear parity with the US. The future of Chinese nuclear posture is also in question. A Chinese move to a 'launch-on-warning' posture is very possible. A change in strategy for first use, limited nuclear war, and counterforce targeting seems unlikely for now. At the same time, it cannot be ignored that advancing Chinese cyber and space capabilities would greatly affect escalation dynamics that could lead to a nuclear conflict. For all these reasons, it is increasingly important for the US to seek appropriate arms control with China. Whatever happens with arms control, China will continue to be an increasingly strong regional power that is making military advancements on all fronts. Failure to respond in an appropriate fashion could have negative consequences on U.S. strategic standing.

The United States must take several measures if it hopes to preserve its strategic position vis-à-vis its peer competitors. First, it is imperative for the US to successfully complete its nuclear modernization process. Any delays in nuclear modernization will make the United States more dependent on other systems including ballistic missile defense, and regional prompt strike capabilities. Panelists noted that arms control will also become more necessary if budget cuts and/or other delays manifest.

The U.S. position will also be affected by non-nuclear factors. First, the United States has seriously lagged in developing an appropriate strategic approach to conflict management in the age of great power competition. The war on terror distracted many from thinking seriously about the problem set faced today. The US must do its homework and develop a strategy for modern challenges. The outcome of the upcoming presidential election will also have consequences for the U.S. strategic position. There could be leadership changes in China and Russia too, albeit at a much later date. Nevertheless, Vladimir Putin and Xi Jinping are ageing. Both are likely to handpick successors who will advance their agendas. The military doctrines of competitors could also change by 2030. The United States must anticipate all such changes. There is an increased need to think more seriously about how to deal with low level nuclear use, particularly in relation to Russia.

Participants were also concerned that an arms race action/reaction cycle could start between the three countries. In this regard, increased transparency between the countries could help. The major powers' militaries ought to engage in frequent substantive dialogues to better understand each other. Without understanding each other's motives, any restraint will have to be predicated on the actions of others. China's lack of transparency thus far does not bode well for such prospects. It is unlikely that New START will be replaced by a more comprehensive

treaty. There are several reasons for this. First, the Trump administration's desire to include China in the New START framework is unlikely to succeed. Second, reductions in nuclear arsenals are currently unpopular in both the US and Russia. Third, but closely related, the Russians would likely be resistant to any reductions and/or limitations of their theatre nuclear forces. Lastly, the polarized nature of contemporary American politics would make any treaty ratification very difficult.

Panel 7: Black Swans and Sputnik Moments: Hedging Against Strategic Surprise

- Why have foreign threat developments in the last few years not motivated a different approach to modernization? Might future developments?
- What geopolitical and technical "surprises" can we reasonably anticipate?
- What form of hedge should we want to have in 2030? What are we likely to have?

Black Swans are completely unexpected events and would be hard to anticipate. On the other hand, Sputnik moments are foreseen by experts as part of a linear technological development. Technological Black Swans usually appear from new or unexpected uses that had not been considered before. The panelist agreed that technological development is constantly advancing but it takes time to succeed which allows future uses to be anticipated.

In addressing the first question posed to the panelists, there was some disagreement about why emerging threats had not changed U.S. plans for nuclear modernization. One panelist suggested that the United States was still behaving as it did during the post-Cold War era when the US embraced the peace dividend and reduced military spending and stopped thinking about competition. The aftermath of the Cold War was a period without great power competition, and this led to a decline of strategic thinking which remains today. At the same time, foreign threat developments had some effect on U.S. plans for modernization. The 2018 Nuclear Posture Review added the W76-2 low-yield SLBM and the low-yield SLCM capability. The panelist described these modifications were a direct response to new threat developments and were meant to fill gaps in the force.

The second major question was about the U.S. ability to anticipate geopolitical and technical developments. Several major technological developments were discussed as possible sources of surprise. One panelist specifically mentioned ballistic trajectories and how new technologies could enable access to weapons technology quickly and secretly. Technological development such as additive manufacturing could enable states to take a quick path to advanced weapons that disrupt the strategic balance. The development of additive manufacturing creates a quick path to ballistic missiles and nuclear technology. New threats have emerged to NC2 from developing cyber and computing capabilities, especially advanced AI systems. Each of these developments have the capability to add geopolitical and technical surprise in the future.

The panelists discussed what the implications of surprise would be on the U.S. force structure. Geopolitical and technical surprises could require adjustments to the U.S. force structure in a number of unexpected ways. Technical surprises such as warhead malfunction or new sensor technology that would allow the detection of SSBNs would require major modifications in the

current force structure. Geopolitical surprise could also require force modifications. Examples for geopolitical surprise could include a simultaneous crisis with Russia and China, or the need to reassure allies with the rapid deployment of a non-existent weapon system.

China and Russia will engage in hedge strategies to avoid potential surprises. China and Russia are concerned about geopolitical and technical surprises including the possibility of changing international or internal conditions. By investing in science and technology, and modernization they seek to gain flexibility to respond to unexpected problems.

The last question is what hedges the United States has and what hedges should be developed in the coming years. The US seeks to maintain its ability to rapidly increase the number of deployed warheads to counter the potential geopolitical and technical surprises discussed above. However, the U.S. may face challenges in its upload capacity.

The failure to anticipate change has something to do with the loss of focus on strategic issues in the long period of strategic atrophy after the Cold War. The United States needs to reinvest in a new generation of strategic thinkers. Without cultivating a new generation, the US will continue to rely on concepts from the Cold War that may not fit the current needs. Building the institutions to train new strategic thinkers is a key to maintain the human capital needed to respond to unexpected geopolitical or technical events that may occur. However, adjustments to U.S. planning are not likely to occur until a major surprise occurs.

Panel 8: Conclusions and Implications

- What lessons follow?
- What can and should be done in the 2020s to ensure that nuclear deterrence remains “fit for purpose” in 2030 and beyond?

On the question whether the US nuclear posture will be fit for purpose in 2030, there is good news, and there are also many uncertainties that could undermine US success. Several systems will be significantly improved (like for example C2 systems), but the US nuclear deterrent will not be well tailored for a multipolar world barring significant changes. At the moment, the modernization plans are on track, they are funded, and there is a bi-partisan support behind them. However, there is a chance that we might see a change regarding one, or maybe all of these factors.

The post-pandemic deficits could undermine funding for the modernization plans, and bi-partisan support also seems to be fraying, partly due to the lack of progress on arms control measures. Sustained leadership focus and continued investments will be crucial for success. In the meanwhile, the laboratories are facing internal challenges due to the aging of the workforce, the heavy workload, and the difficulties of recruiting new talent. Currently, it is unclear whether the planned modernization activities in the 2030s will come to fruition. Besides, the arsenal in 2030 will “only” be a life-extended version of the 2020 arsenal which is itself a smaller and less diverse version of the 1990 arsenal. Although this arsenal will be capable of putting at risk just

about everything that an enemy leader may value, this mix of capabilities was tailored for an adversary and military problems long past.

The biggest uncertainties in 2030 and beyond relate to the future of extended deterrence, assurance, and strategic stability. European and Asian allies are seriously concerned about the credibility of US political commitments towards their defense. The strategic community on both sides needs to do its homework and prepare for the worst-case scenarios. What if we come to a breaking point? What are those breaking points? What would it mean if the United States was unwilling to retaliate against an attack on an ally? What would happen if the US government decided to roll back its assurances and withdrew from NATO? Such decisions would show allies that they are not valued, and their defense is not a US interest. However, the erosion of the US alliance system is exactly what Russia and China want to achieve.

Russia and China have made significant advancements in integrated strategic deterrence, which is evident in their modernization efforts and exercises. These developments make it imperative for the United States and its allies to get their intellectual houses in order and start planning for the real challenge, which is how to fight regional conventional wars against nuclear-armed adversaries. After three decades of not having to think much about this problem, there is a natural tendency to fall back on old ideas. There is still a dangerous absence of new strategic thought on managing escalation in an all-domain context. The barriers to accelerated progress are numerous.

Beyond 2030, it is highly unlikely that the US would have a larger or more diverse arsenal; it may be somewhat smaller and less diverse. Russia will have a fully modernized force that is unlikely to be substantially different from today's force. China's force may be double its current size and fully modernized and its precise role and purpose are likely to remain ambiguous. There will be significant uncertainties about where all three will be headed with force size and function by 2040. The imbalance that may be consequential in 2030 is the imbalance we are beginning to recognize in 2020: the imbalance in strategic thought about the requirements of effective deterrence in the kinds of conflicts we might face in an era of major power rivalry. The United States also needs to think more about crisis management because a failure to do so could result in unforeseen nuclear escalation.

Despite all these challenges, it is important to remember that the "sky is not falling." The United States will be fine as long it has a survivable deterrent. There are no alternatives for the US in terms of nuclear capabilities for the next 10-15 years. The US simply does not have the ability to deviate from the modernization course set. However, thinking should start about what comes after. Political problems with expanding capabilities are likely to continue at home, and also with the reluctant allies. The United States and its allies will need to do more to compete to keep up, while making some hard choices about where specifically to compete and where not. Both Russia and China could face significant domestic upheaval. One or both could stumble into conflict they did not seek. One or both could be compelled to abandon confrontational agendas in order to cooperate on mounting international challenges such as climate change. In light of all these uncertainties, hedging will be more crucial than ever. The United States might not have the capabilities or the posture that is optimal for 2030, but not ideal could still be sufficient.



Center for Global Security Research
Lawrence Livermore National Laboratory
P.O. Box 808, L-189 Livermore, California 94551
<https://CGSR.llnl.gov>

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. LLNL-TR-812255