

STABILITY AT LOW NUCLEAR NUMBERS
SUMMARY REPORT ON “A STABLE TRANSITION TO A NEW NUCLEAR ORDER”
PROJECT FUNDED BY THE MACARTHUR FOUNDATION

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Introduction

What conditions are needed for a stable transition to a new nuclear order, one in which the total number of nuclear weapons would be reduced to very low numbers, perhaps even zero? We have addressed the myriad issues raised by this question with funding from a grant on “Creating Conditions for a Stable Transition to a New Nuclear Order,” co-directed by Catherine Kelleher and Judith Reppy, from the John D. and Catherine T. MacArthur Foundation to the Judith Reppy Institute for Peace and Conflict Studies at Cornell University.

Our project had three goals: to take a fresh look at the theoretical underpinnings of the arguments about strategic security and nuclear doctrines; to encourage members of the younger generation (NextGen) scholars working on nuclear security issues to see themselves as part of a network that stretches from scholars in the field to active participants in the policy process; and to disseminate the products of the project to the policy community, in Washington and elsewhere. We convened five workshops—in Berlin (December 2014); Ithaca, NY (November 2015 and November 2016); Monterey, CA (February 2016); and Washington, DC (May 2016)—and held five discussion (“reach-in”) meetings with Washington insiders at the Cosmos Club in Washington, DC. Programs for the workshops are included in this Report as Appendix 3. The list of participants and the contributed papers and rapporteur reports for the workshops are posted on the project website at <https://pacs.einaudi.cornell.edu/project-%E2%80%9C-stable-transition-new-nuclear-order%E2%80%9D>. We also produced an Occasional Paper, *Selected Essays on the Transition to a New Nuclear Order*, Judith Reppy and Catherine Kelleher, eds. (July 2016), available at <https://pacs.einaudi.cornell.edu/occasional-papers>.

This essay concentrates on our project’s first goal: a re-assessment of the deterrence literature and the conditions for stability during a transition period to low nuclear numbers, perhaps nuclear zero. It is based on the work of the participants in the workshops and on our own reading of the literature, both from the early days of the nuclear age and more recent contributions following the end of the Cold War.

Background for the project

In a very real sense, the seeds of our project were sown by the “Gang of Four” op-ed in the *Wall Street Journal* in January 2007 calling for worldwide nuclear disarmament (Schultz et al. 2007). This call, coming from four highly respected individuals in the policy world, re-invigorated the

debate over the usefulness and dangers of nuclear weapons around the world, and spurred similar calls from diplomats and politicians in other countries. In April 2009, President Obama gave an important speech in Prague, in which he stated that the United States was committed “to seek the peace and security of a world without nuclear weapons.” (Obama 2009). This shift in the political climate encouraged scholars to return to the topics of strategic security and nuclear deterrence, topics that had fallen into neglect following the end of the Cold War. One such effort was a series of meetings organized by Catherine Kelleher under a grant from the Carnegie Corporation, which resulted in our co-edited book, *Getting to Zero* (Kelleher and Reppy 2011). In that volume the question of what a transition to nuclear zero would look like was broached, but not analyzed in detail. Our MacArthur project was intended as a step toward filling the gap by commissioning papers that examined specific aspects of nuclear weapons policy and paid attention to different regional security architectures.

In the years since President Obama’s speech in Prague, the movement for nuclear disarmament has faced many challenges. At the systemic level, the international situation has deteriorated: The Russian annexation of Crimea in 2014 and the subsequent fighting in Ukraine, along with the weak response to this challenge from the European institutions—institutions that were believed to be a safeguard against any armed conflict on the European continent—are only one example. We must add to the list the string of nuclear weapons tests carried out by North Korea in defiance of UN resolutions; China’s more assertive foreign policy and increased military spending; and the prolonged war in Syria, which has tested the ability of the international community to cooperate on a policy for ending hostilities. The 2016 election of Donald Trump as president of the United States has added additional uncertainty to the international scene. These events have conspired to create roadblocks to progress in nuclear disarmament and have pushed nuclear disarmament down the list of policy priorities. At the national level, all the P-5 Nuclear Weapons States (NWS) are engaged in modernizing their nuclear arsenals, and India, Pakistan, and North Korea are increasing the number of weapons in their stockpiles.¹ The US Congress has been mired in partisan battles that have precluded any progress on arms control measures, and the European Union (EU) has been preoccupied with migration issues and, more recently, the UK decision to leave the EU. There have been some more favorable developments—notably the 2015 Iran JCPOA agreement and the growth of an international social movement to make nuclear weapons illegal—but overall, the international environment is less favorable for nuclear disarmament initiatives than it was when we began this project in early spring of 2014.

In one respect, however, the deterioration in the security environment has been salutary. It has reminded us that our analyses and proposals would have to be robust enough to accommodate unexpected, yet inevitable, shocks to the system, whether they originated in political upheavals

¹ The United States modernization program includes new delivery vehicles and missiles, as well as replacement of aging infrastructure at the national labs. Current estimates are that the cost will total \$400 billion over the next ten years (Mehta 2017).

or in technological changes that might alter the security calculations of national states. The challenges of the past few years also point to the need to nurture existing institutions that facilitate international cooperation, even as we consider what new institutions and practices might be needed.

Reflections on Concepts of Stability

As originally conceived, the concept of stability in the international system and the conditions for a smooth evolution over the long transition to low nuclear numbers was the major focus of our project. Over the course of the project, however, we came to realize that stability, *as such*, should not be the goal. Indeed, the disruptive events listed above suggest that to entertain such a goal is an exercise in fantasy. Any systemic change will involve disruption and adjustment—the goal cannot be to avoid such challenges, but to address them with policies that provide for the evolution of institutions and practices to adapt to lower nuclear numbers.

The alternative of introducing sharp discontinuities in established understandings of security relationships creates the risk of reactions, up to and including nuclear war, which would undercut any progress toward nuclear disarmament. There may be an argument for revolution as an agent of change, but it is not one that can be responsibly embraced when nuclear weapons are present. Hence, the intense interest in maintaining strategic stability over time in the face of the inevitable changes in the political situation and technology.

Thus, while the phrase “stable transition” may seem an oxymoron, as used here the phrase is shorthand for a much more complex set of ideas. The stability we need will encompass a range of different elements, including the ability for institutions to evolve without breaking down. It will include strategic stability, understood in terms of nuclear force structure, deterrence relationships, and the incentives to use nuclear weapons (Acton 2013); the stability and robustness of the non-proliferation regime; the stability of international alliances in the face of shifting nuclear capabilities; and the stability of domestic political coalitions in favor of nuclear disarmament.

Strategic stability can be narrowly defined in terms of incentives and disincentives for pre-emptive or surprise attack—the scenario that pre-occupied the early nuclear theorists—or, more broadly, to include the political context at a given time. James Acton (2013) has argued for the narrow definition, writing that a situation is stable “*if* neither side has or perceives an incentive to use nuclear weapons first out of the fear that the other side is about to do so.” This definition has its origins in the idea of equilibrium in classical mechanics; that is, it equates stability with balance (Schelling 2013). In effect, it stipulates that mutual deterrence exists and is robust. However, although it has the advantage of being simple and well understood, the narrow definition does not capture the full range of stability conditions needed during a lengthy transition period to low numbers.

For that, we need a more dynamic definition, one that incorporates perturbations associated with changes in technology and political circumstances: in short, one that recognizes that changing conditions produce changing risks and opportunities. An analogy might be the treatment of stability in the economic growth models of the 1940s and '50s, for example, in the work of Evsey Domar and, independently, Roy Harrod. The Harrod-Domar model was famously unstable because it postulated rigid capital-labor ratios. If every element of the model did not grow in lockstep, the growth rate spiraled down, leading the world back to economic stagnation. Stability over time requires relationships to be self-correcting: disturbances should unleash reactions—e.g., investments in new technology or international flows in labor and capital—which will drive the economic system back into balance, not away from it. Fortunately, in real life such adjustments are common, and the Harrod-Domar model was soon supplanted by a more flexible representation of the economic growth process.

In the case of nuclear relationships, an emphasis on equivalence in nuclear force structures in analyzing stability has arguably bestowed predictability in a certain set of scenarios, but at the cost of locking in categories that, viewed differently, could be considered flexible. An example of this was the US debate over ICBM survivability in the 1980s, in which doomsday scenarios abounded, with barely a mention of the nuclear weapons on submarines, weapons that could, by themselves, guarantee assured retaliation. Other examples can be found in the politics of extended deterrence and in the fantasies spun around the idea of limited nuclear war: responses deemed to be highly predictable are almost certainly contingent on factors falling outside the analysis.

A stable transition to low nuclear numbers will require a process in which there is no compelling incentive for pre-emption, no incentive to acquire additional nuclear weapons—i.e., no advantage to be gained in a renewed nuclear arms race—and no incentive for nuclear proliferation. An arms race is obviously a move in the opposite direction from nuclear disarmament. It also exacerbates tensions and increases the risks of misperception of intentions and of accidents. Proliferation, even if only at low numbers, has those risks and an additional one: the likelihood that the national effort required to produce nuclear weapons, especially if carried out in secret, will also produce a set of domestic institutions that will resist any effort to reduce the role of nuclear weapons in national policy. Entrenched nuclear establishments complicate the domestic politics of pursuing international controls on the weapons, whether the goal is further reductions or compliance with verification measures, because they are dedicated defenders of the status quo (Reppy 2011).

A further complicating factor will be unintended and unforeseen consequences of technological change, whether it takes the form of seemingly minor changes in nuclear weapons design (Postol 2014) or of the large-scale changes associated with advances in information technology and

cyber security. And the stability conditions in these different policy arenas will not be independent of each other, but rather will be connected by feedback loops, both helpful and otherwise.

How Low is Low?

“Low” is a relative term, so it behooves us to specify what we mean when we use it. Compared to peak numbers of nuclear weapons, one could argue that nuclear numbers are already low. In the peak year of 1986, there were more than 64,000 nuclear weapons held by the P-5 countries plus Israel; by 2016, even with two additional nuclear weapons states—India and Pakistan—the total number of warheads had dropped to an estimated 8890 (Kristensen and Norris, 2016).² But if one considers the destructive capability of a single warhead, a count of nearly 9,000 cannot be considered “low.”³

Under the New Start Treaty, the United States and Russia are each allowed 1550 deployed nuclear strategic weapons, a level to be achieved by 2018. Three years later the treaty expires, and at present it is not clear what, if anything, will replace it. Even analysts who oppose nuclear zero (e.g., Schelling 2009) consider the New Start numbers to be unnecessarily high, and argue for reductions. One possible benchmark for “low” numbers might be the numbers that were widely bruited for a follow-on arms control agreement after New Start: for example, 1000 nuclear weapons for each side. Another would be 500 each, the number that former Secretary of Defense Robert McNamara, speaking with Walter Pincus in the mid-1990s—many years after he left office—considered sufficient (Pincus 2014).

In the spirit of transition, we might begin our analysis with that lower number—say, 500 deployed nuclear weapons each for the two leading nuclear weapons states, a number that would leave them clearly the dominant holders of nuclear weapons and leave mutual assured destruction (MAD) intact. That fact alone suggests that, for numbers to drop considerably lower, changes in nuclear doctrine, force structure, and international security relationships will be needed. Indeed, it is the specter of those changes that appears to motivate much of the opposition in the United States and elsewhere to nuclear disarmament (e.g., Kirkpatrick 2009, Lowther and Hustus 2013, Payne and Schlesinger 2014).

² The figures cited here do not include warheads awaiting dismantlement, a considerable number in recent years. As of 2016, North Korea is not yet included in the tally because it is not considered to have weaponized and operationalized its nuclear weapons capability.

³ Frank von Hippel (2016) reports on a 2004 poll that asked the American public how many warheads the United States had. The median answer was 200, and that number was considered by the respondents to be more than enough for deterrence. The actual number of US warheads for that year was 8540 (Kristensen and Norris n.d.).

On the path to much lower or zero nuclear numbers there are several significant markers, depending on the issue being considered. For example, if we are interested in prospects for further arms control agreements, it seems clear that, although the immediate next step might be the resumption of bilateral negotiations between the United States and Russia (Krepon 2016), to go to a significantly lower number (possibly the 500 mark for each country), arms control negotiations would need to expand to involve the other nuclear weapons states, including the NWS outside the non-proliferation treaty (NPT) regime. Except for North Korea, these other states currently have nuclear arsenals in the 100–300 range, some of which are growing (Woolf 2017). As long as the United States and Russia have thousands of nuclear weapons, the other NWS can absolve themselves of any responsibility to reduce their much smaller arsenals, but as total numbers drop their weapons will necessarily become part of the equation. Negotiating multi-lateral reductions is almost certain to prove more difficult than bilateral negotiations, if only because of the need to satisfy more competing interests, not to mention the vast asymmetries in military and economic power which, along with specific histories of hostility, inhibit the development of trust. To cite a single example, questions of relative status are likely to bedevil any negotiation that involves both India and Pakistan.

The increasing capability of missile defenses are another constraint on the relative meaning of low. George Lewis (2015, 2017) argues that once nuclear numbers drop below the perceived capabilities of ballistic missile defenses (BMD)—which are improving over time—further reductions in the number of weapons would threaten the condition of mutual assured retaliation, which is widely perceived as the linchpin of nuclear deterrence, and hence strategic stability. In the face of an effective BMD system, states would be tempted to increase, not reduce, the number of warheads in order to maintain a guaranteed retaliatory force. Lewis concludes that unless the spread of BMD capabilities can be capped, we will be in this unstable region when nuclear numbers fall below 500 for the largest nuclear powers.

A third consideration is that as nuclear numbers are reduced, other kinds of weapons, particularly advanced conventional weapons such as those envisioned for the US Prompt Global Strike program, become more salient markers of relative power. At some point, some NWS may see their nuclear weapons as necessary to balance against attacks from countries with overwhelming conventional superiority, rather than solely as a deterrent to nuclear attack. Moreover, even if nuclear weapons are successfully removed from the security calculations, the rivalries and security dilemmas that exist between states today will not disappear. Without much hard work to improve relationships through cooperative arrangements, the advanced conventional weapons will become the major locus of power and strategic instability.⁴

These considerations, and others, will come into play over time, as nuclear arsenals are reduced. At present, they lie in the future, but it is important to keep them in mind, following the dictum

⁴ For more detailed discussion of this issue, see Kubiak and Leah (2016).

proposed by Peter Dombrowski in our earlier *Getting to Zero* project: Evaluate all policy initiatives according to the criterion that, at the least, they do not directly or indirectly militate against further reductions in nuclear weapons. In other words, “First, do no harm.”

The Deterrence Puzzle

Nuclear weapons have not been used in the course of war since 1945. Although in the early days of the nuclear age much effort was put into considering scenarios of nuclear use, it gradually became clear that the weapons were essentially unusable. Many would attribute that happy fact to the weapons’ powerful deterrent effect, particularly during the Cold War when the United States and Soviet Union built arsenals containing tens of thousands of weapons and maintained them on trigger alert. Other analysts attribute the record of no use to sheer luck, and point to numerous accidents and misunderstandings that could well have led to nuclear exchanges, many of which we are only now learning about (Schlosser 2013).

There is a major puzzle, however, in understanding how nuclear deterrence came to occupy such a privileged place in discussions of strategic stability. In a paper originally delivered at the November 2015 workshop at Cornell, Benoît Pelopidas (2016) has traced in detail how Thomas Schelling conflated the element of *fortuna*, or chance, with the concept of risk in his pioneering analysis of nuclear deterrence and US-Soviet relations. Risk involves probabilities that can be estimated and managed, while chance is, by definition, uncertain and hence unpredictable. Pelopidas argues that the elision of the two categories served to minimize the perceived possibility of accidents or unauthorized use, and to create an unwarranted illusion of controllability.

There is a related and even more fundamental critique of deterrence as a safeguard against the use of nuclear weapons: the assumption that all parties will behave rationally in a crisis. This assumption has been discredited by developments in psychology and cognitive theory (Erickson et al. 2013, Müller 2013), but not abandoned. The relatively simple models of deterrence relationships that populate the strategic studies literature typically ignore the biases that infect all decision making—e.g., attribution bias, loss aversion, the tendency to discount evidence that challenges existing beliefs—and the effects of emotions on decisions (Stein 2009). The models favor a mode of analysis that offers seeming precision—for example, in scenarios of gradual escalation—at the expense of any claim to reflect reality. But context counts: an abstract model of deterrence relationships is unlikely to be a useful guide to policy, especially in the post-Cold War era with multiple actors, including non-state actors.

Despite these problems, deterrence logic remains the dominant discourse when nuclear weapons are discussed. In Prague, even as he called for a world without nuclear weapons, President Obama stated, “As long as these weapons exist, the United States will maintain a safe, secure and effective arsenal to deter any adversary, and guarantee that defense to our allies . . .” (Obama

2009). In a more recent example, then-Secretary of Defense Ashton Carter stated, in arguing for modernizing the US nuclear forces, “. . . it’s really a choice between replacing them [nuclear weapons delivery systems] or losing them. That would mean losing confidence in our ability to deter, which we can’t afford in today’s volatile security environment” (Mehta 2016).

Perhaps the best we can say about nuclear deterrence is that it is performative, in the sense that asserting deterrence is enough to make it real, *so long as it is not contested*. The standard theory of deterrence presents a simplified version of the world, one that can be easily comprehended and manipulated. In that way, it becomes a technology that facilitates analysis and the communication of analytical results, which in turn shore up the performative act. Core deterrence is assumed to hold, even though it is impossible to prove that it is deterrence, and not some other factor, that explains the fact that—so far—there has been no use of nuclear weapons in war-fighting since 1945.⁵

Extended Deterrence

The United States stands alone in the extent to which it has entered into mutual security agreements with its allies. US nuclear guarantees are in place for 30 countries (28 NATO members, plus Japan and South Korea); by contrast, the number of such guarantees by the Soviet Union during the Cold War was considerably smaller, although one Soviet guarantee did come close to being invoked, in Cuba in 1962.⁶ The US guarantees are generally understood to commit the United States to use nuclear weapons, as necessary, to defend an ally that is attacked with nuclear, chemical, or biological weapons, or even just conventional weapons.⁷ Beyond deterring enemy attacks, the guarantees are also considered important to discourage nuclear ambitions that could lead to further nuclear proliferation in allied countries.

Extended deterrence commitments are inherently less credible than core deterrence statements because, by definition, they do not involve direct threats to the country providing the commitment. Thus, it is not surprising that there is considerable asymmetry between the demands of core deterrence and those of extended deterrence and reassurance, with allies requiring a greater show of strength to be reassured than is needed for core deterrence (Mount 2016). But measures intended to bolster reassurance for an ally may be seen by other countries as

⁵ It seems that there is no formal mechanism in the US government for regular assessment of the outcomes of actions taken to deter other states from hostile actions. See Karlin (2017).

⁶ Mark Kramer points out that the Soviet Union made implicit nuclear guarantees to North Korea during the Korean War, to China during the in 1957 crises with the United States over the offshore islands, and to North Vietnam during the Vietnam War. Personal communication, 8 August 2016.

⁷ Not all defense agreements include the nuclear guarantee—by one count, based on a broad definition of defense pacts, the United States is party to mutual defense pacts with 69 countries, covering a quarter of the world’s population (Taylor 2015).

provocative. For example, the 2016 decision to place US THAAD systems in South Korea in reaction to the North Korean nuclear tests has been strongly denounced by China (Mullany and Buckley 2017).

Extended nuclear deterrence agreements complicate US foreign policy in other ways. Where they offer a nuclear response to any attack on our allies, they are at odds with the negative security assurances to not use nuclear weapons against non-nuclear weapons states, which the United States, along with the other P-5 countries, has repeatedly pledged in connection with the NPT review conferences (Arms Control Association 2016). They also are a barrier to the possibility of the United States adopting a No First Use declaration, a policy shift that could help to remove incentives for pre-emptive attacks in times of high international tensions, but might also be seen as weakening extended deterrence agreements. More generally, reliance on nuclear weapons to provide reassurance reinforces their privileged position in security calculations and may send the wrong signal to allies and enemies alike (Mount 2016). As long as nuclear weapons are seen as the main currency of military power, it will be difficult to move to lower numbers (cf. Harrington 2016).

The broad use of extended deterrence by the United States is, perhaps, one reason that nuclear weapons are often described as a cheap way of providing security, because a nuclear guarantee allows the United States to economize on the expanded force levels and conventional weapons that would otherwise be needed for a credible deterrent to attacks on its allies. Credibility, however, is exactly what is in doubt when it comes to a scenario of using nuclear weapons in a situation in which the United States itself has not been directly attacked. In an effort to shore up credibility, US military units are based in numerous countries—notably, at present, in South Korea—where their presence serves to insure a response against any attack, not just one in which nuclear weapons would be used. During the Cold War, the US troops stationed in Berlin served a similar purpose: defense against a Soviet attack on the city could not hope to succeed, but the risk that such an attack would trigger a full-scale response had to affect Soviet calculations. In these situations, the US troops serve as hostages, and it is that role that provides credibility, not a security arrangement that includes a nuclear guarantee.

Moreover, while there is no doubt that the United States has the capacity to deliver an overwhelming nuclear attack in response to an attack on an ally, all evidence points to a deep reluctance by political leaders to use nuclear weapons, even when their own forces are under attack and in danger of defeat (Tannenwald 2007). It defies reason that the US government would use nuclear weapons on behalf of a distant ally, knowing that such action would almost certainly trigger a retaliatory nuclear attack on the United States itself. That US allies cling to the language of reassurance cached in terms of nuclear guarantees is yet another example of the performative aspect of nuclear deterrence policies. The statement of a Japanese official says it all: “When it comes to the nuclear umbrella, it is like a talisman from the United States. Japan is

not sure how it works, but they put their faith in it and believe it will protect them” (quoted in Kubiak and Leah 2016, 4).

Obstacles to Nuclear Disarmament

What factors might threaten strategic stability in a world moving to low nuclear numbers? The development of effective ballistic missile defense systems has already been discussed; another would surely be the latent capability possessed by many advanced industrial countries to acquire nuclear weapons. Knowledge of how to build a nuclear weapon is now widely available, and many states possess the industrial capacity to produce nuclear weapons if they are prepared to make the necessary investment. That latent capability, by itself, provides those states with some leverage in their relationships with other countries; the Iranian case is a good example. Anne Harrington (2016) argues that Iran was able to use its nuclear program to deter military intervention without actually producing a bomb, or in her words, “[I]n so far as what makes Iran impossible to ignore is its nascent nuclear capabilities, it can be said that Iran was already trading on the future threat of nuclear attack in order to deter US invasion.” It remains to be seen if Iran’s example will affect the choices of other possible nuclear states.

Since 1970, the Nuclear Non-proliferation Treaty and its strictures against the spread of nuclear materials and know-how have been the main safeguards against proliferation. Reducing the arsenals of the major NWS to lower numbers would presumably strengthen the non-proliferation regime by addressing the persistent criticism from the nuclear have-nots that the NWS have not upheld their end of the bargain at the core of the NPT. But the inequities built into the NPT, which gives special treatment to those states already in possession of nuclear weapons by 1967, will not disappear with lower numbers if the low numbers are taken to be a permanent endowment. The possibility of joining the nuclear club may well seem more attractive when the imbalance between the major NWS and the smaller weapons states is less extreme than it has been to date.

These concerns play out in different ways across regions. The interstate rivalries within regions contain the possibility of a breakout cascade by a number of states, particularly in Asia, where South Korea, Japan, and Indonesia could be tempted to go nuclear in response to the threat posed by North Korea. There is, unfortunately, an institutional deficit in the region when it comes to cooperation on security issues; instead of established regional security institutions with patterns of cooperative behavior, there is a structure of individual hub-and-spoke agreements. One of the irritants in relationships among these presumed allies of the United States is the competition for US favors. South Korea resents the favoritism implicit in the more developed security arrangements between Japan and the United States. In the South Asian region, Pakistan has similar complaints about the special treatment afforded to India, following the end of the Cold War and the collapse of the Soviet Union. Recurrent crises involving Kashmir are fueling a local arms race between India and Pakistan to include both numbers of weapons and new types of

missiles. The risk of accidental war is high, and the deep mistrust between the two countries makes escalation difficult to control.⁸

Alternative Approaches to a Stable Transition to Low Nuclear Numbers

A world with low nuclear weapons will not be the current world, minus nuclear weapons. Many changes will be needed to facilitate a sustainable path to nuclear disarmament. Nancy Gallagher (2015) has argued for a holistic approach to analyzing stability conditions. Invoking Hedley Bull's views on the possibility of an international society, she proposes an alternative framework for reaching agreement on arms control measures, one that would go beyond the narrow technical features of nuclear weapons and verification to address issues of an equitable distribution of power and modes for enhancing mutual security. Similarly, Harald Müller (2013) has pointed out the logical flaw in assuming that a world with very few or zero nuclear weapons would look like the current world order. Instead, the process of nuclear disarmament will necessarily be slow and incremental and involve changes in political relationships, institutions, practices, and norms (p. 560). To cite a single example, Peter Dembrowski (2011, 272) has pointed out that the military will need to change their planning and training procedures, taking nuclear weapons off the table in their scenarios and war games.

These authors, and others, present a powerful critique of the conventional wisdom on nuclear deterrence and strategic stability, and an enticing view of the possibility for an alternative future. The time needed for the transformation to a more cooperative international society, however, is likely to be very long—if indeed, it is possible. The process cannot be risk free, but the risks of proceeding are arguably less than attempting to maintain the status quo.⁹

Missing Pieces

No single project can hope to cover all the complex issues at stake in a transition to low nuclear numbers. There are, however, some ideas that the project's papers and discussions touched on, but which clearly need more attention. One such issue is the tension between a strategy of norm revision to stigmatize the possession of nuclear weapons and the exigencies of the day-to-day maintenance of existing nuclear weapons, which requires a dedicated work force and infrastructure. The same problem will arise for the important task of verification of disarmament

⁸ See the papers and summaries of the project workshops on East Asia (February 2016) and South Asia (May 2016) for more discussion of the regional aspects of strategic stability.

⁹ Most analysts believe that nuclear disarmament will necessarily be a lengthy process because of the need to transform or dismantle the entrenched institutions of the NWS and their relationships with their allies. There is, however, an intriguing possibility that the transformation could occur quite quickly, through the delegitimization of nuclear weapons. Giovanni Mantilla (2016) describes such a process in the extension of the Laws of War to cover internal conflicts after WWII. The political mobilization of the new states created through decolonization acted as a group to counter the Western powers who found themselves in a morally indefensible position and felt forced to support the expanded Geneva Conventions, despite their strong misgivings.

agreements during the drawdown to very low numbers or zero. In effect, the question is how to maintain a high level of morale and competency in an enterprise whose primary mission has been marginalized and whose organizational assets are being dismantled.

In the case of the United States, there is ample evidence that the morale of the soldiers in charge of the nuclear weapons and the workers at the national labs entrusted with maintaining the nuclear stockpile has declined. Nuclear weapons are widely perceived to be no longer central to US security following the end of the Cold War and what has been freely labeled as “years of neglect” (Sheridan 2013, Hagel and Work 2014). The Air Force, which is responsible for two legs of the nuclear triad, has been embarrassed by reports of cheating on proficiency tests, lapses in security at missile sites, and mistakes in handling nuclear weapons. The most spectacular incident occurred in 2007, when a B-52 flew from Minot Air Force base in North Dakota to Louisiana with nuclear cruise missiles mounted on its wings; the crew was unaware that the missiles were there, and Minot did not realize that the missiles were missing for 36 hours (Barnes and Spiegel 2008).

The problems extend to security at the national labs. They include major security lapses at the facilities—perhaps best illustrated by the success in 2012 of a group of three activists, including an 82-year-old nun, in entering the Y-12 complex at Oak Ridge and remaining undetected for two hours—as well as lax performance of routine duties. For example, a leaking drum of hazardous waste from Los Alamos which caused a fire at the Waste Isolation Pilot Plant (WIPP) in Carlsbad, NM, was the result of careless use of kitty litter as a drying agent. WIPP will be closed for years, with decontamination and related costs of restoring operations estimated at over \$2 billion (Vartabedian 2016).

Buildings and equipment have decayed along with worker morale. Publicity around the security lapses have revealed the decrepitude of many of the Air Force and Navy military facilities, which, like the aging nuclear laboratories in the Department of Energy complex, have not been adequately maintained. For some time only one wrench of a type needed to service the ICBMs was available in the whole system, so that it was sent by Fed-Ex from missile base to missile base as needed. Underlying the lurid details was a culture fixated on those metrics that affected promotions, but ignored other problems (Sanger and Broad 2014).

The US government’s response to these problems has been a commitment to modernize the nuclear complex and nuclear forces, even as the number of deployed weapons continues to fall (Reppy 2011, Woolf 2017). The modernization program, which was initiated under President George W. Bush and developed further during the Obama administration, has served the purpose of appeasing hawks in Congress while dealing with the failing infrastructure dating back to World War II. The modernization program encompasses the facilities at the national laboratories; the production of new missiles and new delivery vehicles, such as a nuclear cruise missile and a

new strategic bomber; and an increased investment in the concomitant command and control systems. The estimated cost is high—perhaps as high as \$400 billion over the next ten years (Mehta 2017). Opponents of the modernization argue that a more modest plan could meet the need for infrastructure repairs without further entrenching nuclear weapons in the nation’s security policy by literally setting their role in concrete (Collina 2014). It is not clear if the Trump administration will undertake to modify the modernization program or let it proceed as planned.

The issue of maintaining employee morale in a declining enterprise is part of a more general problem: how to handle a push back against nuclear disarmament at the domestic level. In general, active opposition can be expected from organizations, both military and civilian, which would lose their *raison d’être* if nuclear weapons were repudiated. It is likely that similar problems will arise in the nuclear complexes of the other NWS, even when political leaders have adopted pro-disarmament platforms.

Another area that needs more attention is the role played by public opinion and the peace movement in effecting change. Every major initiative toward nuclear arms control and disarmament in the past has been the product, in part, of social movements—from the early partial test ban treaty, to the nuclear freeze movement of the early 1980s, to the political upheavals that led to the end of the Cold War and subsequent reductions in nuclear weapons by the United States and Russia. Today there is a new effort from a peace movement, the International Campaign to Abolish Nuclear Weapons (ICAN), to achieve an international treaty outlawing nuclear weapons. Taking inspiration from the successful international campaigns for bans on land mines and on cluster munitions, ICAN has taken its cause to the United Nations. In December 2016 the General Assembly voted to begin negotiations for such a treaty by a vote of 113 in favor, 35 not in favor, and 13 abstentions. The campaign has stressed the overriding humanitarian objection to any use of nuclear weapons, while the opponents, who included the P-5 nuclear weapons states—except for China, which abstained¹⁰—Israel, members of the NATO alliance, plus a few other states, argued that such a treaty has no chance of succeeding without the support of the major NWS and diverts attention from the preparations for the 2020 NPT Review Conference.

Social movements like ICAN are far removed from the elite circles in charge of nuclear weapons policy, but they can have an effect. ICAN has shown itself to be adept at winning the support of national governments outside the inner circle of the P-5, which contributed to its success in the UN General Assembly vote. By relying on humanitarian arguments, it is helping to delegitimize the possession of nuclear weapons. Anti-nuclear movements have, however, been a cyclical phenomenon, and there are many questions concerning their effectiveness during the strong and

¹⁰ India and Pakistan also abstained; N. Korea did not cast a vote. The full vote is available at <http://www.icanw.org/campaign-news/results/>.

slow boring of hard wood which Max Weber proposed as a metaphor for politics (Holloway 2011).

Conclusion

The transition to a new nuclear order, when it occurs, will involve new thinking and the development of new security architectures. Based on what we have learned over the course of our project on stability at low nuclear numbers, we would argue that the new thinking should draw on understandings originating in early theorizing about nuclear strategy—in particular by reclaiming the concept of uncertainty, as distinct from risk—and should reframe the analysis to recognize the greater complexity of a world with multiple actors and sources of power. A greater respect for the dangers inherent in relying on nuclear deterrence to maintain the peace should accompany a willingness to think seriously about alternative security structures adapted to the specific circumstances holding in different regions of the world.

Stability in such a world does not rest on a static balance, but rather on the ability of institutions to adapt to changing circumstances without spinning out of control. New arrangements should favor cooperative solutions over exercises in raw military power. As the number of nuclear weapons drops, new challenges will emerge, both along traditional lines, such as the balance between offensive and defensive systems, and novel ones, such as the need to maintain the safety and security of the remaining weapons, while simultaneously dismantling the nuclear weapons complex in a verifiable and sustainable process. “Process” is the key word here—the transition to much lower nuclear numbers will be stable only if the changes in security relationships are accompanied by innovation in institutions and policies which confine the inevitable disruptions to manageable proportions. In short, resilience is needed, and we should be thinking about the ways in which it can be built into existing institutions as well as new ones.

The challenge is daunting, but not impossible. We have witnessed many great changes in international relations in the more than seventy years since the first nuclear explosion, and can expect many more. A final conclusion from our project is that hard work is needed on many fronts to achieve a transition to low nuclear numbers. This is not a novel idea but an assertion that agency rests in the hands of those who exercise it.

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