NATIONAL INSTITUTE FOR PUBLIC POLICY

INFORMATION SERIES

CONVERSATIONS ON NATIONAL SECURITY

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Issue No. 480 February 24, 2021

Conversations on National Security is a series of interviews with key national security experts conducted by David Trachtenberg, Vice President of the National Institute for Public Policy.

An Interview with Dr. Richard L. Wagner, former Deputy Director of the Lawrence Livermore National Laboratory, Assistant to the Secretary of Defense for Atomic Energy, and member of the Defense Science Board

Q. Many observers believe the U.S. nuclear weapons enterprise is in need of across-the-board modernization, with all three legs of the U.S. strategic nuclear Triad rapidly ageing out. The current U.S. modernization program, initiated by the Obama Administration and continued by the Trump Administration, involves recapitalization of the land-, sea-, and air-based elements of the nation's strategic nuclear deterrent. Do you believe the current modernization program is sufficient to maintain a credible, effective deterrent for the foreseeable future?

A. The current modernization program is essential but far from sufficient. Along with two other things, discussed below, an urgent program to develop and field a new and fundamentally different nuclear command, control, and communications (NC3) architecture, including its integrated tactical warning and attack assessment (ITW/AA)

component, is also essential. This should be treated with the same, or greater, sense of importance as the modernization of the three types of strategic platforms.

Two more things would provide a more robust deterrent: increasing our ability to extend deterrence and adding qualitatively new/different capabilities to each leg of the traditional strategic triad.

First, I believe that it's wrong to separate so-called "strategic" deterrence from overall deterrence, which includes extended or regional deterrence. Crises that could involve "strategic"-level deterrence start in regions. We've let our capabilities for regional deterrence atrophy, including regional nuclear capabilities/deterrence, and should rebuild them.

Second, I've come to believe, over decades, that Russia, and possibly China, have concepts of operations with nuclear weapons — operations and concepts that underlie deterrence — that are different from ours, including what we in the United States think of as "strategic" deterrence. Russia and China have had decades to figure out how to deal with, or work around, the qualitatively static characteristics of our "strategic" triad. We need to develop some qualitatively new characteristics for our "strategic" forces.

The question posed is about the U.S. nuclear weapons "enterprise." That includes facilities and capabilities, in addition to weapon systems themselves. There are two categories: the defense industry and the National Nuclear Security Administration (NNSA) capabilities. I suspect that DoD contractors are still pretty competent, though there are special capabilities needed for nuclear weapons that may require some attention. Some years ago, there was some question about the ability to produce large solid-rocket motors. I've lost track of the status of this, but the strategic modernization program will create further incentive to attend to it. The NNSA production complex needs much more aggressive modernization, including for emergency responsiveness starting with weapon pit manufacturing.

Q. The United States last conducted an underground explosive nuclear test in 1992. Since then, nuclear test expertise and infrastructure have atrophied with increased reliance on modeling and computer simulations. How do you assess the ability of computer-based simulated nuclear tests to ensure the continued efficacy of the U.S. nuclear deterrent? Should the United States consider the resumption of explosive nuclear testing and, if so, when? At what point does the United States risk

undermining the effectiveness of its nuclear deterrent as a result of the continued moratorium on nuclear testing? What events should trigger a reassessment of U.S. nuclear testing policy?

A. Modeling and computer simulation, and non-nuclear experiments, have always been absolutely essential for our warhead design and maintenance programs, even when we were doing nuclear tests. Over the decades when we were doing nuclear tests, we increasingly relied on steadily improving simulation and non-nuclear experiments, and less on the demonstrations afforded by nuclear tests. This was in part because the physics involved in modern designs was hard to access with the kinds of diagnostics one can do on nuclear tests, and in part because we had accumulated physics measurement data from hundreds of relevant past nuclear tests. Over the past twenty-five years we've developed a wide range of further-improved non-nuclear experimental capabilities, and our computational capabilities are, almost literally, infinitely greater.

So far, though we've had to make some changes in the details of our warheads, we've been careful not to change them beyond what we've been able to have confidence in using computation, non-nuclear experiment, and reference to the measurements made on past nuclear tests/experiments. There's even a case to be made that we can have greater confidence in the reliable performance of today's stockpile than we had in the stockpile that existed at the time we stopped doing nuclear tests.

In the future, we are likely to need warheads of types that aren't in today's stockpile. In the past, we conducted hundreds of nuclear tests covering a wide range of such designs. That data is available to help put such designs into the future stockpile without additional nuclear tests. One would need to provide greater design margins for some of these designs, but I believe it's understood how to do that in many cases. There are certainly some areas where the physics is uncertain, but we know how to stay away from those, with one possible exception that might require a physics test to resolve over the next ten years or so.

There are a few areas of the broad parameter space of getting explosive energy from fission and fusion for which we know we don't have a good database from past nuclear tests. If, in the farther future, we were to determine that we need such exotic items in the stockpile, we might have to do some nuclear tests to make the physics measurements needed. If we did have to resume testing, the improved non-nuclear experimental capabilities we've developed over the past twenty years could provide the basis for improved measurements on future nuclear tests.

This all depends on having very skilled physicists, chemists, and engineers to make the necessary judgments. Today's are as capable as those who originally designed and built the stockpile, and they have much better tools. The very difficulty of the job has continued to attract very good people. And the stockpile has changed slowly enough (so far) that it has been possible for the older generations of people to validate the maturation of the new people's judgment.

What I've written above is a fairly optimistic story. But some believe that, without an occasional test, we won't really "know." In the sense that those people mean "know," however, all we ever really "knew" after a test was that that identical object, if tested again, would (or wouldn't) work. But the types of weapons in the stockpile don't consist of absolutely identical objects; there are always manufacturing variations and differences between the operational environments and the downhole test environment. To account for those differences, we almost always relied on calculations and non-nuclear experiment, just as we do today.

Having said all that, however, there may be a certain sense in which the "really know" argument has some merit. In my own thinking, that could mean that confidence in the reliable performance of current warheads may be degraded by some small amount below the assumed canonical "one" of the past, moving it closer to the somewhat lower reliability regime of the delivery platforms. But we've always had a deterrence posture that had some margin, so that small degradations in reliability didn't (and don't) threaten deterrence. And the assertion of the canonical reliability of "one" in the past was probably not true.

Another reason we tested in the past was to understand the effects produced by nuclear explosions. During the last decades of testing, the focus was mainly on the effects on our own military systems produced by enemy explosions, rather than the effects of our own explosions on targets. At the time we stopped testing, there was some uncertainty in our understanding of these effects. Effects lie in regions of the physics and engineering that are different from those pertinent to producing the explosion. We haven't done anything like the large scientific program in those regions as we've done for the weapon functioning, and nuclear tests might be required to address those. This is an area requiring more attention.

Q. After the end of the Cold War, the U.S. nuclear weapons laboratories shifted much of their operational focus to non-nuclear scientific pursuits. Was this shift prudent, and is it time to reevaluate the mission of the national laboratories?

A. The fraction of the labs' programs doing weapon work hasn't changed that much. The Science-Based Stockpile Assessment Program has been a very large program. (It ranks with the largest scientific programs ever done.) Furthermore, the other major programs at the Labs have generally been chosen with an eye to complementing and sustaining the areas of science and engineering in the weapons programs.

But the labs' capabilities have diminished considerably for other reasons, two of which I'll mention. First, there's a lot more red tape and bureaucratization of even the weapons programs. Forty years ago, the weapons program was almost entirely managed internally to the labs, within very broad guidance from Washington, with latitude to rapidly move resources to solve problems or take advantage of opportunities; today it has been split into dozens of sub-programs, the management of which requires negotiation and approval from Washington. This permeates to even the lower levels of the enterprise; some estimates say that the actual productivity of people at the labs is half of what it could be without the encumbrances of unnecessary compliance.

The other reason, related to the first, is that the labs' upper management must spend a larger fraction of their time managing a much larger number of individual projects, as well as non-programmatic compliance matters. During the 1970s, there were perhaps a half a dozen major programs at each lab, and the director himself was able to play a personal role in leading the most important few of them because there was latitude within each to do what was needed. Today, the labs have hundreds of projects, including in the weapons program, and each is more difficult to manage because of the compliance-related burden. So, the director has become mainly a business manager rather than mainly a leader of technical programs. This has resulted in a proliferation of positions with titles like "deputy assistant principal associate director," and good people are doing administrative work rather than program leadership.

Q. Last year, Russian President Vladimir Putin signed an Executive Order titled, "Basic Principles of State Policy of the Russian Federation on Nuclear Deterrence." The policy allows for the use of nuclear weapons by Russia under a range of circumstances, to include a conventional attack on Russia that threatens "the very

existence" of the state; an attack against "critical governmental or military sites"; or "reliable" warning of a missile attack. Do you consider Russia's current nuclear posture stabilizing or destabilizing? How should the United States respond?

A. Declaratory policy is worth less than the paper it's written on, unless it results in self-denial of actual capability, which seems not the case with the Russian nuclear posture. That said, the examples given seem like appropriate uses — deterrence uses —of nuclear weapons, although I have some concern about how extensive an attack would have to be on "critical governmental or military sites."

The problem is Russia's more offensively oriented capabilities and threats of nuclear use for purposes of coercion, including when a possibly legitimate defensive response to an attack becomes offensive. Russia's paranoia has been a problem for hundreds of years, and gave rise to the creation of an immense empire. Their paranoia (and pride) has led them to the belief that a good offense is the best defense.

At the level of exchanges of intercontinental-range weapons, their posture fits reasonably within the stability framework typified by avoidance of a disabling "first strike" capability, although I have some marginal reservations. (There are some questions about the overall framework of this stability paradigm, especially in a tri-polar world, but I won't go into them here.)

The great Russian preponderance in nuclear weapons for regional or battlefield use seems quite destabilizing, however. It allows Russia to carry out attacks at a level for which the West has limited ability to respond—somewhat analogous, at a regional level, to a strategic-level first strike. The West can't manage crises or escalation with such a large gap in the escalation ladder (to use a too-simplistic term).

Q. How would you define an "effectively verifiable" arms control agreement? What does "effective verification" mean and what should the United States insist upon in arms control negotiations to ensure any agreement reached is effectively verifiable?

A. I'd define "effective verification" as the ability to observe cheating 1) at a level that would give the cheater an advantage according to some metric of stability, or deterrence, or escalation management, etc., and 2) with such observation made by means that politically allow action to be taken in response to the cheating. (The parties need not have the same metric in order for this to work, but it does require each party to agree internally, and perhaps with allies, on the metric and the nature of the means of observation.)

I'm a strong proponent of serious red-teaming of monitoring and verification means. An example may illustrate. Decades ago, during one of the sporadic debates about a comprehensive test ban (CTB), CTB proponents asserted that cheating could be detected with national technical means (NTM), because a nuclear test is a large engineering operation with observable signatures. The nuclear weapons labs asserted that they could carry out a relatively low-yield test at the Nevada Test Site (NTS) that could not be detected by U.S. NTM. An experiment was conducted in which U.S. NTM carefully observed the Nevada Test Site over the course of a year. (Doing this experiment in the relatively confined area of the NTS made it much easier for U.S. NTM to monitor.)

During that year, the labs developed a way to do a test in which the preparations, hole-drilling, device emplacement, and methods for sophisticated diagnostic measurements would not be identified by NTM. The labs actually carried out all the necessary preparations for a test using these approaches, and they were, in fact, not detected by U.S. NTM. (At the time, the yield threshold at which seismic signals could distinguish a nuclear explosion from a chemical explosion was quite high, so seismic detection was excluded from the experiment on the grounds that it would have been inconclusive.) This experiment demonstrates what I mean by red-teaming of monitoring and verification. It cost a lot, but demonstrated a lot too.

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