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Achieving a Credible Nuclear Deterrent

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Imagine trying to keep a 1957 Chevy running in pristine condition—perhaps not difficult for a classic-car aficionado, but such a vehicle would not be practical for daily commuting. Gen Kevin Chilton, commander of US Strategic Command, points out that the B-61 warhead, designed in the 1950s but still in the US nuclear arsenal, contains vacuum tubes—something he equates to maintaining a '57 Chevy for everyday use.[1]

A credible deterrent requires adversaries to believe that (1) the instrument of deterrence will deliver the level of destruction claimed and (2) the entity wielding the instrument would actually employ it. The absence of either belief destroys the deterrent's credibility. Over the past two decades, both the reliability of US nuclear weapons and certainty about US political will to employ them have declined; therefore, the credibility of US deterrence, ultimately guaranteed by nuclear weapons, has also declined. Furthermore, the United States no longer maintains a sufficient industrial base for these devices—the nuclear weapons complex—to support its nuclear deterrence strategy. This article argues that America should restore the credibility of its nuclear deterrence by designing, testing, producing, and fielding a new nuclear weapon, which would effectively revive a viable nuclear weapons complex and demonstrate political resolve.

After offering a brief background on nuclear weapons and the weapons complex, this article examines the foundational nature of nuclear weapons with regard to deterrence strategy, our neglect of the nuclear weapons complex, the uncertain reliability of the weapons stockpile, and, consequently, the diminished credibility of our deterrence. It concludes by showing that designing and fielding a new weapon will correct these deficiencies and provide new military capabilities.

Nuclear Weapons and the Complex

A basic understanding of nuclear weapons—very complex mechanisms made up of thousands of parts—will help inform a discussion of their industrial base.[2] At the heart of a nuclear weapon resides the nuclear explosive package (NEP). All current US weapons consist of two stages. The first stage, or primary, works on the same principle as the atomic bombs employed during World War II. At the center of the primary lies a "pit," a hollow core of fissile material (usually plutonium) surrounded by a chemical explosive. When the explosives detonate, the resulting shockwave compresses the pit, which becomes so dense that it creates a runaway nuclear fission reaction. Before the pending nuclear explosion destroys the pit, a "boost gas" (a mixture of deuterium and tritium) is injected into the pit to increase the fraction of plutonium that undergoes fission, yielding greater energy

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for use in the second stage. The harnessed portion of the primary's energy then ignites the second stage's fusion fuel. Most of the energy yield from thermonuclear weapons comes from the secondary.[3] A *nuclear warhead* includes the NEP along with supporting components.[4]

A *nuclear weapon*, composed of a nuclear warhead and a set of supporting nonnuclear components, produces nuclear energy of a militarily significant yield.[5] The components consist of weapon-specific items such as fuses, batteries, and reentry vehicles and bodies.[6] All nine nuclear weapon types currently in the US stockpile were designed in the last century—some as far back as the 1950s but none more recently than the 1980s.[7]

Eight government-owned, contractor-operated sites make up the nuclear weapons complex:

> Los Alamos National Laboratory . . . and Lawrence Livermore National Laboratory . . . which design [NEPs]; Sandia National Laboratories . . . which designs nonnuclear components; Y-12 Plant . . . which produces uranium components and secondaries; Kansas City Plant . . . which produces many of the nonnuclear components; Savannah River Site . . . which processes tritium from stockpiled weapons to remove decay products; Pantex Plant . . . which assembles and disassembles nuclear weapons; and the Nevada Test Site, which used to conduct nuclear tests but now conducts other weapons-related experiments that do not produce a nuclear yield.[8]

Nuclear Weapons Strategy Remains Relevant

A credible deterrence, impossible without reliable nuclear weapons, advances US interests in three ways: (1) underpinning US national security by guaranteeing the US military's ability to bring overwhelming force to bear against an adversary, (2) helping prevent the proliferation of nuclear weapons by removing the imperative for allies to develop their own nuclear weapons, and (3) dissuading rivals from breaking treaties designed to control nuclear weapons and then engaging in an arms race. According to the Congressional Commission on the Strategic Posture of the United States, "In a basic sense, the principal function of nuclear weapons has not changed in decades: deterrence. The United States has the weapons in order to create the conditions in which they are never used."[9]

Nuclear weapons remain a critical underpinning of US national security and defense strategy, as noted Pres. Barack Obama, speaking in Prague in April 2009: "Make no mistake: As long as these [nuclear] weapons exist, the United States will maintain a safe, secure and effective arsenal to deter any adversary, and guarantee that defense to our allies."[10] The *Capstone Concept for Joint Operations* further amplifies this theme, observing that US forces once again need to make strategic nuclear deterrence a focus area and that US failure to maintain its nuclear capabilities could encourage potential adversaries.[11] With regard to the role of fielded forces, General Chilton said that the nuclear mission remains US Strategic Command's top priority, voicing his belief in the importance of maintaining a safe, reliable nuclear stockpile until nuclear weapons are no longer a part of the country's arsenal.[12]

In addition to the classic deterrence goal of preventing a massive nuclear attack against the United States, today's nuclear arsenal "should be designed to provide robust deterrence in the most difficult of plausible circumstances: during conventional war against a nuclear-armed adversary."[13] Without an ability to back up threats with force, deterrence is not credible. Ensuring the availability of nuclear capabilities that are militarily useful for all situations does not make the United States more likely to use nuclear weapons; instead, it gives credibility to US deterrence.[14] To remain an effective deterrent against lesser nuclear powers, especially during conventional conflict with a nuclear-armed enemy, the US nuclear arsenal should give the president options having the greatest probability of

destroying an adversary's nuclear forces without causing excessive casualties—a requirement that may call for new, low-yield weapons. Moreover, Keir Lieber and Daryl Press write that "any nuclear arsenal should also give U.S. leaders options they can stomach employing in these high-risk crises. Without credible and effective options for responding to attacks on allies or U.S. forces, the United States will have difficulty deterring such attacks. Unless the United States maintains potent counterforce capabilities, U.S. adversaries may conclude—perhaps correctly—that the United States strategic position abroad rests largely on a bluff."[15]

and the will to use it in defense of our allies. If our allies cannot depend on us, then they will be motivated to develop their own nuclear weapons and the means to deliver them. Most of them are capable of doing that in a few years."[18]

In addition to helping deter attacks against the United States and its allies and helping prevent nuclear proliferation, a credible nuclear deterrent also dissuades China and Russia from pursuing a nuclear arms race with the United States. As long as America can produce and field enough nuclear weapons to maintain strategic balance with Russia, that country has no incentive to break arms control agreements in an

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Deterrence strategy is essential not only for helping to protect the United States from attack but also for assuring allies and partners. This assurance, stemming from a concept known as extended deterrence, eliminates the need for allies and partners without nuclear arms to pursue weapons programs of their own.[16] Many of those parties could launch successful programs and begin building their own nuclear arsenals within a few years if the United States fails to meet their deterrence needs, thus triggering global waves of nuclear proliferation contrary to US interests.[17] Gen John Loh, formerly the Air Force's vice chief of staff, clearly articulates the importance of extended deterrence: "Extended deterrence provides our umbrella of deterrence for others. . . . But that means we have to maintain a credible, robust nuclear force attempt to attain strategic supremacy. However, failure to do so could have a destabilizing effect, ignite a new nuclear arms race, and even tempt China to gain nuclear strategic balance with the United States.[19]

Atrophy of the Nuclear Weapons Complex

Any strategy that relies on nuclear weapons requires the existence of an industrial base—the nuclear weapons complex—capable of meeting the strategy's needs. Because the United States has underfunded and neglected its complex for two decades, the industrial base has atrophied to a point that, unless we take corrective action soon, we may lose the ability to maintain or produce nuclear weapons. If

that happens, we could regain it only through great expenditure of time and treasure. Melanie Kirkpatrick highlights the severity of the problem: "Since the end of the Cold War, the U.S. nuclear weapons program has suffered from neglect. Warheads are old. There's been no new warhead design since the 1980s, and the last time one was tested was 1992, when the U.S. unilaterally stopped testing."[20] Furthermore, the United States lacks the industrial capacity to manufacture nuclear weapons at production levels. True, it could produce a few by using laboratory assets, but that is not the same as serial production. Finally, only a handful of engineers and scientists still in the federal work force have designed and tested nuclear weapons—and all of them will retire in a few years.[21]

At the component level, the United States can no longer manufacture pits (the Rocky Flats plant, which produced pits, shut down in 1989) or produce tritium in weapons-complex facilities. In 2002 the congressionally mandated Panel to Assess the Reliability, Safety, and Security of the United States Nuclear Stockpile (the Foster Panel) said that the National Nuclear Security Administration (NNSA) had only mixed prospects of fulfilling its intended weapons refurbishments, including the B-61 and W-76 weapons, due in part to the inability to produce new pits.[22] Even though the NNSA declared in 2004 that "restoring our capability to manufacture plutonium pits is an essential element of America's nuclear defense policy," it delayed a decision to build a new pit-manufacturing facility, leaving the United States without production-level capability.[23] Critical to obtaining the designed yield, tritium has a decay rate of 5.5 percent per year, giving it the shortest shelf life of a nuclear weapon's components, but the US nuclear weapons complex has not produced it since 1988, when the K reactor at the Savannah River Site shut down. Tennessee Valley Authority reactors did resume production in 2005, however.[24]

Finally, the country is not producing top-level nuclear chemists to replenish the nuclear workforce. In the early 1960s, US universities granted up to 36 PhDs in nuclear chemistry each year, but that number has steadily declined.[25] The American Physical Society, the world's second-largest organization of physicists, commented that "only a handful of U.S. university chemistry departments currently have professors with active research programs in nuclear chemistry. . . . Thus, advanced education in nuclear chemistry education is all but extinct in the United States."[26]

The Obama administration's proposed budget for fiscal year (FY) 2011 includes $11.2 billion for the NNSA, a 13.4 percent increase from FY 2010's appropriation.[27] Thomas D'Agostino, NNSA administrator, said that more than $7 billion of the requested funds are for what NNSA terms weapons activities, which include increased investments to begin to recapitalize some physical infrastructure and build a resource base of human capital.[28] Although such a step is helpful, even the increase in funding for facilities will not allow the United States to reestablish the production level for pits. Further, it will not address the basic issue of uncertainty regarding the stockpile's reliability—an issue inherent in an approach that excludes full-scale testing of weapons. As the Foster Panel reports, even though no one can predict exactly when it will occur, "at some point, the nuclear test pedigree for a weapon will no longer be relevant."[29]

Weapons Reliability, Political Will, and Credible Deterrence

The Stockpile Stewardship Program (SSP) and Life Extension Program (LEP) may prove insufficient to ensure the reliability of stockpiled weapons—and any doubt is too much. The United States conducted 1,000 nuclear tests between 1945 and 1992.[30] Since self-imposing a moratorium on testing, the country has relied on the science-based SSP to certify the reliability of weap-

ons. That program, which "uses data from past nuclear tests, small-scale laboratory experiments, large-scale experimental facilities, examination of warheads, and the like to better understand nuclear weapon science," closely examines 11 stockpiled weapons of each type per year.[31]

If the SSP discovers problems with a warhead, then the LEP attempts to fix them by remanufacturing needed parts. Most experts agree that this practice has been sufficient to date and can probably continue for the short term, but they debate its viability in the long term. According to a report by the Lawrence Livermore National Laboratory in 1987, "Exact replication, especially of older systems, is impossible. . . . Documentation has never been sufficiently exact to ensure replication. . . . The most important aspect of any product certification is testing: it provides the data for valid certification."[32] In general, as the US nuclear arsenal matured through years of development, weapons became smaller and lighter so smaller delivery vehicles could carry them; thus, a single missile could carry more warheads, or a booster could carry warheads farther. This reduction in size required very exotic engineering, described by Ambassador Linton Brooks, former NNSA administrator, as "very close to performance cliffs."[33] Because of the need to make warheads as small and light as possible, yet assure that they would not accidentally detonate, even in very harsh environments, the designs included very little performance margin. In the absence of testing, Brooks feared that as the weapons aged beyond the time when engineers originally thought the warheads would be retired, the cumulative effect of changes from both the aging of the weapons and the utilization of remanufactured parts would induce increasing uncertainty about their reliability.[34]

In the case of the B-61 warhead, the LEP has gone beyond just attempting to replace original parts with similar new parts. It will try to change the B-61—essentially the only air-delivered weapon in the US arsenal—from utilizing analog circuitry to digital circuitry.[35] Under existing policies, this change—slated to take place by 2017—will occur without testing the complete nuclear weapon. Planning on untested weapons to deter existential threats to the country or expecting leaders of second-tier regional powers to believe that such weapons will always work as designed may be wishful thinking.

In addition to technical reliability, credible deterrence requires the political will to supply resources for nuclear weapons programs and to convince potential enemies that we have no compunctions about employing nuclear weapons if we must. The current administration and Congress are continuing the decades-long trend of allowing the credibility of US nuclear deterrence to erode. In his Prague speech, President Obama said,

> So today, I state clearly and with conviction America's commitment to seek the peace and security of a world without nuclear weapons.
>
> . . . First, the United States will take concrete steps towards a world without nuclear weapons. . . . We will reduce the role of nuclear weapons in our national security. . . .
>
> . . . My administration will immediately and aggressively pursue U.S. ratification of the Comprehensive Test Ban Treaty.
>
> And to cut off the building blocks needed for a bomb, the United States will seek a new treaty that verifiably ends the production of fissile materials intended for use in state nuclear weapons.[36]

Although administrations from across the political spectrum have endorsed the dream of a world without nuclear weapons, none in recent history have so overtly stated their intention to de-emphasize the role of these weapons in US national security.[37] Even though President Obama pledged to maintain a reliable nuclear-deterrent force, an adversary could interpret or misinterpret his position in a way that would raise doubt about US willingness to employ nuclear weapons under any circumstances, thus diminishing the credibility of US deterrence.

Through the power of the budget, Congress has also aided the demise of the nuclear weapons complex and diminished the credibility of the stockpile. In 2008 it cut off all funding for the Reliable Replacement Warhead (RRW) (formally terminated by the president in March 2009) and ensured that the NNSA did not proceed with its Complex 2030 program, which would have revitalized the nuclear weapons complex and positioned it to manufacture a new warhead.[38] Even if Congress approves the president's 2011 budget request to increase NNSA funding, improve some infrastructure, and refurbish Trident missile warheads and B-61 bombs, it has shown no willingness to commit strongly to nuclear deterrence by mandating design of a new warhead, ensuring production-level infrastructure, or directing new nuclear-yield testing of weapons.

The strongest political opposition to designing a new nuclear weapon or testing existing weapons comes from those who believe that engaging in design and test activities would increase the proliferation of weapons and weaken US credibility on nonproliferation. However, this position is inconsistent with historical events. Since the United States unilaterally stopped nuclear testing in 1992, France, China, India, Pakistan, and North Korea have tested nuclear weapons, three of those countries having conducted their first tests. Currently Iran is likely pursuing a nuclear weapons program. Libya, Syria, and Iraq had active programs, curtailed only after intensive military and political efforts. No evidence suggests that US restraint slowed other countries' determination to field nuclear weapons. Moreover, as previously discussed, if US allies no longer believe that America's doctrine of extended deterrence rests on reliable capabilities, they too may pursue nuclear weapons programs. The United States can best enhance its position on nonproliferation by not engaging in proliferation activities and holding accountable all who expand nuclear weapons technology. Designing and testing to maintain the US arsenal in no way extends nuclear weapons, but those activities do deter countries that might try to gain strategic equivalency with the United States or threaten the use of nuclear weapons to coerce it. Therefore, although well intended, the political opposition to maintaining strong, credible nuclear deterrence actually makes proliferation more likely.

If US allies no longer believe that America's doctrine of extended deterrence rests on reliable capabilities, they too may pursue nuclear weapons programs.

Recommendations

The United States should design, test, produce, and field a new nuclear weapon in order to maintain a viable nuclear weapons complex and ensure the credibility of the deterrent force. New technologies and materials allow for constructing a weapon with safer materials and antitampering technologies. Further, lower-yield weapons would add military utility and avoid unacceptable

levels of collateral damage. Additionally, a penetrating version could hold deeply buried targets at risk, obviating the need for high-yield weapons.

Before termination of the RRW program, Congress directed the NNSA to have the JASON advisory group, a prestigious organization of scientists who advise the government on defense matters, conduct an independent peer review of the need for the RRW.[39] According to that group, "To ensure the viability of its nuclear deterrent, the United States must initiate and invest in the RRW program now—so there will be no disconnect between today's credible deterrent and the one required for the future."[40]

The process of designing, testing, and producing a new weapon would revitalize the US industrial base for nuclear weapons, ensure that technical and intellectual capacity exists to validate the stockpile's reliability, and restore the credibility of US nuclear deterrence. Additionally, it would signal to friends and allies the United States' resolve to uphold its commitments to extended deterrence, thus assuring them they do not need to pursue their own nuclear weapons programs. Finally, the process will send a strong message to Russia and China that it is in their best interest to remain in the nuclear-weapons-control regimes and that they have nothing to gain by trying to attain nuclear supremacy over the United States. No technical reasons stand in the way of launching this program immediately—political desire and the will to do so are all we need.

Conclusion

Because of technological and fiscal realities, US deterrence depends upon nuclear weapons. Until we find a highly reliable way of defeating a nuclear attack on the United States and until advances in long-range strike enable a completely successful, disarming counterforce attack against any enemy's nuclear forces, America must rely on deterrence provided by robust nuclear capabilities. No other weapon systems offer the same level of assurance of US survival.

In a misguided attempt to create a safer world, the United States allowed its ability to support its nuclear deterrent strategy to atrophy, diminishing confidence in the reliability of the weapons stockpile and in the political will to use those weapons if necessary. Thus, the ensuing damage to the credibility of US nuclear deterrence increases, not decreases, the probability of using nuclear weapons. Designing, testing, and fielding a new nuclear weapon will both revitalize the US nuclear weapons complex and restore the credibility of America's deterrence. ✪

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Notes

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30. Medalia, *Reliable Replacement Warhead Program*, 12.

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34. Ibid. The details lie beyond the scope of this article, but some observers support placing a high level of confidence in the SSP. In general, those who support the assessments believe that because of the quantity of past test data, advances in modeling and simulation techniques, and huge strides in high-powered computing, we now have sufficient understanding to accurately model all the effects of aging on weapons.

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36. "Remarks by President Barack Obama."

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38. Medalia, *Reliable Replacement Warhead Program*, 1.

39. Ibid., 2.

40. Ibid., 3. In an exchange between Senator Dianne Feinstein and Administrator D'Agostino during a hearing before the Senate Appropriations Subcommittee on Energy and Water Development on the president's NNSA 2011 budget request on 10 March 2010, Mr. D'Agostino acknowledged that in 2009 the JASON group said it believed that the life of existing nuclear weapons could be extended well into the future. However, he also pointed out that "in many cases we can't make things the way we used to make them 30, 40 years ago. We just don't have the people. We don't have the processing techniques." See Senate Appropriations Subcommittee on Energy and Water Development, *Hearing on President Obama's Fiscal 2011 Budget Request*.