RELIABLE REPLACEMENT WARHEADS: PERSPECTIVES AND ISSUES

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Foreword By
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Foreword

The United States Nuclear Strategy Forum examines and reports on a spectrum of issues associated with the strategic forces of the United States, with particular emphasis on nuclear forces. This report addresses one of the most important of the nuclear weapon-related issues to be considered by the 110th Congress, the Reliable Replacement Warhead (RRW) program.

The RRW program is intended to produce a variety of benefits for the nation. Benefits include improvements in warhead safety, security, and manufacturing, sustainment of the nuclear arsenal with decreased likelihood that nuclear testing will be needed in the future, and lower costs over the long-term resulting from fewer nuclear warheads and a streamlined nuclear warhead production complex.

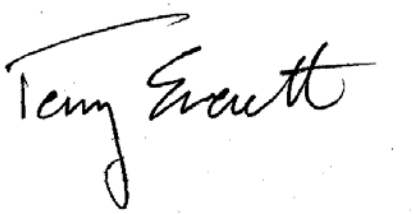
The Department of Defense endorsed the RRW concept in the 2006 Quadrennial Defense Review (QDR). The QDR report stated that RRW "could enable reductions in the number of older, non-deployed warheads maintained as a hedge against reliability problems in deployed systems, and assist in the evolution to a smaller and more responsive nuclear weapons infrastructure."

Many in Congress have supported general goals—from both this Administration and the preceding Administration—to reduce the nuclear arsenal, sustain an appropriately-sized nuclear force, and retain a skilled technology base. However, nuclear weapon modernization initiatives for the post-Cold War environment have been more problematic and have received particularly intense scrutiny in Congress. The absence of a national consensus on the role of U.S. nuclear weapons for the twenty-first century and the specific nuclear weapon capabilities needed has made it difficult for members of Congress to judge the merits of any specific modernization initiative within the broader strategic context.

Reflective of this environment, in 2004 Congress denied funding requested for studies of future nuclear weapon concepts and redirected the requested funding to initiate the RRW program. Concerns in Congress centered on whether the weapon concepts to be studied were necessary, and whether such programs might be viewed by others as provocative. In addition, last year the Congress directed a commission on the Future Strategic Posture of the United States. The commission, which has not yet begun its work, is intended to be an important next step toward developing a national consensus on nuclear weapon capabilities needed for the decades ahead.

Over the past two years Congressional support for the RRW program has been conditioned on a range of goals intended to keep this program within boundaries acceptable to a bipartisan audience. The degree to which all of the intended goals and benefits of RRW can be realized remains to be demonstrated. However, the prospect of substantial benefits for the nation, especially in those areas for which support already exists, provides a strong case for continuing work on the RRW.

This report provides a valuable complement to existing material on the RRW program developed by the Department of Energy, Department of Defense, and Congressional Research Service. Together with existing material, this report will help in framing the discussions of complex issues that will be needed over the next few years to achieve a clearer understanding of the potential benefits and costs of transitioning the nation's nuclear stockpile and infrastructure toward RRW-type designs.



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U.S. House of Representatives

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Executive Summary

Since the end of the Cold War, proposals for nuclear weapon development and production in the U.S. have historically led to political controversy and debate. The debate has usually been between those who favor strong military capabilities—including nuclear weapons—because the world is a dangerous place and those who see nuclear weapons as a primary reason why the world is a dangerous place. There is currently no national consensus on the specific programs for nuclear modernization which are appropriate for the U.S. in the emerging geopolitical environment. Since the beginning of the current administration, a variety of nuclear weapon–related studies and advanced concept initiatives have been debated and shelved due to insurmountable barriers in the legislative process. The lone exception is the Reliable Replacement Warhead (RRW).

The RRW program promises important benefits for the nation that include safety and security improvements in the nuclear arsenal, potential long-term confidence without nuclear testing, and cost savings once the RRW concept has been proven. In addition, the RRW program will help reenergize the U.S. technical and engineering communities and provides a basis for streamlining and modernizing the warhead production infrastructure. By design, the RRW program will not result in new or improved military capabilities; it is not being pursued to implement some new approach to deterrence.

RRW is unlikely to be controversial with the American public because the objectives of the RRW program coincide with the nuclear weapon-related goals most broadly supported by the public. However, if the RRW program is misunderstood or mischaracterized, it may become the next casualty of the lack of a national consensus regarding U.S. nuclear weapons.

The potential connection between RRW development and nuclear proliferation is a possible point of contention. There is little evidence, however, to suggest that developing and producing RRW warheads will undermine nonproliferation objectives or spark a new “arms race.” Those countries currently possessing or seeking nuclear weapons will likely continue to do so regardless of U.S. action on RRWs.

Key allies are currently protected by U.S. extended deterrence commitments. If these allies lost confidence in America’s willingness to sustain the reliability and effectiveness of the weapons that underpin that commitment, U.S. nonproliferation goals would be seriously damaged. RRW will help support U.S. nonproliferation goals and extended deterrence commitments by sustaining confidence in U.S. nuclear deterrence. The RRW program will enable this to be accomplished while also reducing the likelihood that nuclear testing will be required to validate warhead performance.

Of the five nuclear weapons states recognized by the Nuclear Nonproliferation Treaty, the United States is the only country that has not initiated nuclear weapon modernization programs for the post-Cold War era. In particular, Russia, China, and to a lesser extent France are actively developing and producing new nuclear warheads. In the next few years the U.K. will consider whether it needs to develop and produce a new warhead for its deterrent replacement program. In contrast, the United States seems hobbled by inconsistency and indecision on most nuclear weapon issues.

Currently, RRW is a program at a narrow nexus of nuclear weapon activities on which consensus can be achieved. For the near-term, RRW will serve as a catalyst to retain the U.S. technology base and infrastructure for nuclear warheads. If sometime in the future a broader national consensus on nuclear weapon modernization emerges, the U.S. will be better prepared to support that consensus as a result of the RRW program.

Introduction

In 2005 the United States initiated the Reliable Replacement Warhead (RRW) program. A significant volume of material describing the RRW program is available to the public. However, the preponderance of material is oriented toward technical issues associated with this program. This paper was developed primarily for an audience interested in understanding the policy and international issues associated with the RRW program.

This paper briefly describes the RRW program and identifies aspects of the program that make this effort different from previous U.S. nuclear warhead development programs. It then focuses on policy issues associated with the RRW program, including:

- Why is the United States pursuing this program at this time?
- What are the expected benefits and costs?
- How does the RRW program compare with previous nuclear weapon development activities?
- Is the RRW program related to controversial nuclear weapon programs such as very low-yield “mini-nukes” and earth-penetrating weapons (“bunker busters”)?
- Will development of the RRW require nuclear testing?
- Is the RRW program consistent with U.S. commitments under the Nuclear Nonproliferation Treaty (NPT)?
- What is the status of nuclear warhead development and production in the other nuclear weapon states? How would U.S. actions to develop and produce RRWs compare with the activities of the other nuclear weapon states?

Background

While several reports describing aspects of the RRW program are available to the general public,[1] most focus heavily on technical aspects, warhead development and production issues, and legislative procedures related to the RRW program. This paper outlines the background and history that led U.S. decision makers to initiate a RRW program, the expected benefits of an RRW program, and the uniqueness of this nuclear warhead program as compared to past warhead development programs.

The recent initiative to develop a reliable replacement warhead has its roots in the 2004-2005 timeframe when support for the RRW concept emerged nearly simultaneously in the Congress and within the Department of Defense (DoD).

Origin of Congressional Support for RRW

Congressional support for RRW emerged from the ashes of an administration-supported initiative to reinvigorate warhead design and engineering activities at the national laboratories. The programs to accomplish this goal—the Robust Nuclear Earth Penetration Study and the Advanced Concepts Initiative—were carryovers from the last years of the Clinton Administration and endorsed by the Bush Administration in the December 2001 Nuclear Posture Review. However, these programs were opposed by a few influential members of Congress who expressed concern that the programs to study options to improve nuclear weapon effectiveness were provocative and overly aggressive.

In the FY2005 Consolidated Appropriations Act, Congress eliminated funding for the administration-supported nuclear weapon studies that would have focused on improvements in weapon effectiveness and redirected the funding to the newly created Reliable Replacement Warhead program. To date, Congress has spelled out over twenty goals for the RRW program in order to make this program acceptable to a broad, bipartisan audience.[2]

Origin of DoD Support for RRW

In early 2005, two DoD study teams, each looking at options for the future nuclear stockpile, reached similar conclusions—the U.S. approach to sustain its existing nuclear warhead stockpile needed to be redirected. One study was led by Gen. Larry Welch (USAF, ret.) and conducted by members of the U.S. Strategic Command

(USSTRATCOM) Strategic Advisory Group. The other, a study to develop a vision for stockpile transformation, was led by the Office of the Secretary of Defense.

Both studies expressed concern over the prospect of long-term success of the plan to sustain the Cold War-era nuclear stockpile indefinitely through periodic refurbishments (e.g., life extension programs). The indefinite refurbishment plan will be extremely difficult to execute (because many warhead components can not be replicated as originally built), and would result in modifications on top of other modifications that will be increasingly difficult to certify without nuclear testing.[3] Both studies concluded that the Reliable Replacement Warhead (RRW) concept, if feasible, would be a preferred alternative to the indefinite refurbishment strategy.

One important consideration at the time was the viability of the U.S. nuclear weapon technology base. The U.S. has not developed a new-design nuclear warhead in approximately twenty years and all test-experienced warhead designers and engineers will be retired by about 2012. Without a design and production effort to inject creative vitality into the warhead design and production enterprise, many feared that this professional community—reduced to a caretaker role—will quickly wither, leaving the United States without a viable technology base for this important element of national security. In the future, this could result in decreasing confidence in the nuclear stockpile and perhaps even a breakdown in confidence in the U.S. nuclear arsenal to deter WMD-armed adversaries. Such a future situation would present a "Hobson's choice," either to embark on a very expensive national initiative to recreate the technical expertise the nation had once possessed but lost over time, or abandon nuclear weapons as an element of the U.S. national security strategy.

An attractive alternative to the indefinite refurbishment strategy is to replace highly optimized, Cold War-era warheads with simpler, safer designs. The RRW concept promises benefits in several areas:[4]

- Assures long-term confidence in the reliability of the nuclear weapons stockpile.
- Enhances the security of nuclear weapons, through the use of state-of-the-art technology to prevent unauthorized use by terrorists, rogue nations or criminals.
- Improves the safety of the stockpile, through upgrades such as replacing conventional high explosives with insensitive high explosives.
- Helps to develop a more responsive nuclear weapons infrastructure by using replacement components that are easier to manufacture and maintain, and by exercising critical nuclear weapons design and production skills.
- Enables further reduction in the size of the stockpile, by increasing confidence in the infrastructure to produce weapons if and when they are needed.
- Decreases the likelihood that a nuclear test will be needed to confirm weapon performance.

The RRW concept, however, also brings with it some costs and penalties:

- RRW designs require relaxing the stringent performance characteristics that are the hallmark of the existing stockpile. As a result, RRW warhead performance (e.g., warhead explosive yield) may be lower than that of the warhead it will replace—a legacy[5] warhead of similar size and weight.[6]
- Funding will be required to develop the designs for replacement warheads and to establish modern manufacturing practices.
- Sustainment of the existing, legacy stockpile will still be required for a significant timeframe—at least until the RRW concept is proven and significant warhead production demonstrated.

RRW Issues

How does the RRW program differ from previous nuclear warhead development programs? The RRW program differs significantly in three ways.

- First, this development effort is not driven by new military requirements or new concepts for deterrence.
- Second, increased emphasis is placed on safety, security, and reliability. In the past, operational effectiveness as defined by military requirements was the primary driver for warhead development.
- And third, the goal is to develop and certify replacement warheads without underground nuclear testing. In the past, warhead development and nuclear testing went hand-in-hand.

The dramatic departure from past warhead development programs is worth exploring further.

Not Driven by New Deterrence Concepts or Need for New Military Capabilities. Why would the DoD support developing a nuclear warhead if there is no new military capability to be met or new concept for deterrence that calls for such a nuclear warhead? Military requirements tended to be the primary driver for nuclear warhead development from the late 1940's through the end of the Cold War. Since most military weapons were typically replaced or modernized within ten to fifteen years, new military requirements were generated for each new weapon system. Operational effectiveness improvements largely drove warhead design. Early nuclear warheads were large, heavy, and limited in explosive yield. From the early years, the military wanted lighter, smaller, and more powerful nuclear weapons. In the first two decades of the nuclear era, missiles and aircraft were relatively limited in range. The lighter the warhead, the farther a missile could fly. The military also demanded that warheads be packaged into

sizes and shapes that could be carried by many different types of weapons. As the nuclear arms competition progressed and the concept of multiple warheads on ballistic missiles became a requirement, warhead designers were confronted with the challenge of tailoring nuclear explosives to fit into small, cone-shaped delivery vehicles on ballistic missiles.

In the past the Department of Energy (DOE) routinely conducted exploratory research and development of nuclear warheads in order to understand the potential benefits and limits of nuclear explosives. Yet, concepts for improved warheads not tied directly to military requirements generally did not go beyond the research phase. For example, during the 1960's and early 1970's the nuclear weapon laboratories invested significant effort and conducted numerous nuclear tests to develop concepts for so-called "clean" nuclear warheads. These warhead concepts used complex techniques to reduce the residual radioactivity from a nuclear blast. The warhead concepts were part of the national "Plowshare Program" to explore uses for nuclear explosives for peaceful, domestic purposes such as mining and large-scale excavation.[7] Some designers at the national laboratories speculated that such warheads could be useful as battlefield nuclear weapons. Since, the DoD never developed formal requirements for such warheads, the concepts were eventually abandoned.

Now with significant reductions underway in the operationally deployed nuclear force[8] in response to the changed geopolitical environment, DoD is exhibiting less concern over optimizing warhead effectiveness and more concern over sustaining confidence in the stockpile over the long-term. Due to the reductions in payloads on existing ballistic missiles and aircraft, warhead weight and volume considerations are less constraining. Easing these constraints has opened the door for serious consideration of concepts such as the RRW. RRW designs are expected to be less prone to failure from aging and manufacturing irregularities and therefore should be sustainable with higher confidence over the long-term. For these reasons, as well as the enhanced safety and security that RRW can provide (see next section), the DoD has supported the RRW program.

Emphasizes Safety, Security, and Reliability. Each nuclear warhead currently in the stockpile was developed at a time when a very high priority was placed on weapon effectiveness characteristics. Safety and security were also high priority issues, but options to improve safety and security often had to be balanced against a variety of competing design features.

The development of the W88 warhead for Trident II submarine-launched ballistic missiles (SLBMs) demonstrates this tension among competing design features. This warhead was developed in the early 1980's, during the initial phase of President Reagan's strategic modernization program, and at a time when the ability to defeat hardened targets in the Soviet Union was emerging as a national priority. For this

reason, high explosive yield and packaging to enable multiple warheads to fit on each Trident II missile were key considerations in the final W88 warhead design.

During the feasibility study for the W88 warhead, a variety of warhead designs and yields were considered, including some with advanced safety features such as insensitive high explosives (IHE). Warhead designs with insensitive high explosive typically required a larger amount of explosive to implode the plutonium primary than similar warheads with conventional explosives. Thus, incorporating added safety from IHE meant the yield of each warhead would have to be reduced (to fit the IHE design in the same volume and weight as the conventional explosive design) and/or fewer warheads could be loaded on each missile (because each warhead would have a larger diameter than its conventional explosive counterpart).

Navy studies of design options and potential accident scenarios showed significant penalties in weapon effectiveness and only marginal improvement in safety. The Navy ultimately decided on a warhead design for the W88 that maximized effectiveness and did not include IHE. As a result of that decision, made almost two decades ago, warheads currently carried on Navy SLBMs do not contain insensitive high explosives. Easing the constraints on warhead volume and weight, as discussed above, makes a variety of technical improvements in safety, security, and reliability viable as part of the RRW program.

Avoids Nuclear Testing. The United States observes a moratorium on nuclear testing and has not conducted an underground nuclear test since 1992. The current nuclear stockpile was not designed for such an environment. Each nuclear warhead in the stockpile was developed when nuclear tests played an integral role in fine tuning the warhead design. In addition, periodic nuclear testing of these designs was part of the long-term plan to demonstrate proper performance over the lifetime of each warhead. Each warhead was typically expected to remain in service for twenty to twenty-five years.

Warheads in the existing stockpile were designed with narrow margins for performance and with the expectation that routine testing would help assess changes in performance over time. In the absence of nuclear testing, the DOE has developed improved computer simulation and experimental facilities to help sustain confidence in each warhead type. Annually the national laboratories review technical data from surveillance programs and experiments associated with each type of warhead. The directors of the national laboratories and the Commander, U.S. Strategic Command submit the findings of their reviews to the Secretaries of Defense and Energy. Annually the Secretary of Defense and Secretary of Energy jointly report to the President whether nuclear testing is needed.

Unlike the legacy warheads, RRWs will be designed for certification and service life without the requirement for nuclear testing. For several fundamental reasons, it

appears feasible that the NNSA will be able to develop RRW options without nuclear testing:

- RRWs will incorporate design features for which past nuclear test data is available, well understood, and has a history of success.
- RRWs, because they are being designed with large performance margins, will be inherently less sensitive to the cumulative effects of aging or manufacturing variances. As stated in a recent Los Alamos publication: "The RRW design is planted right on the middle ground of design parameters, far away from all failure-mode cliffs ..."[9]
- The RRW development process will take advantage of improved scientific tools—unavailable to the previous generation of warhead designers and engineers—such as warhead simulations on advanced supercomputers and sophisticated experimental capabilities.
- RRW concepts, if developed *now*, will be evaluated by test-experienced designers and engineers with comprehensive warhead design and certification experience.

What is the Current Status of the RRW Program and Proposed Path Forward? The Departments of Energy and Defense completed an eighteen month RRW feasibility study in November 2006. During the study, warhead design teams from Los Alamos National Laboratory and Lawrence Livermore National Laboratory, each in partnership with Sandia National Laboratories, developed an RRW candidate. The two competing RRW candidates were evaluated based on criteria that included safety features, security features, and manufacturing.

The Nuclear Weapons Council[10], a decision-making body composed of senior officials from DoD and DOE, reviewed the RRW candidates and the findings of the RRW evaluation team. They agreed on the following course of action:

- Select an RRW design for further development.
- Initiate a study to calculate cost estimates for the development and production of the selected RRW design.
- Refine the RRW concept so it can be deployed as a replacement for W76 warheads on Trident II (D5) submarine-launched ballistic missiles (SLBMs).
- Plan to initiate engineering development for the W76-replacement version of RRW in fiscal year 2008.
- Plan for initial production of RRW components to begin as early as fiscal year 2012. Annual production capacity will be limited by the rate at which the Los Alamos interim plutonium pit production facility can produce plutonium components for RRWs—estimated at 30 to 50 pits per year by the end of fiscal year 2012.[11]
- Once the RRW concept has been developed, produced, and certified, reduce the number of W76 warheads scheduled to be refurbished.

On December 1, 2006, the NNSA issued the following press release announcing the decision to continue the RRW program:

> Senior officials at the Department of Defense and the Department of Energy's National Nuclear Security Administration (NNSA) today said they have determined that the Reliable Replacement Warhead (RRW) is feasible as a strategy for sustaining the nation's nuclear weapons stockpile for the long-term without underground nuclear testing.
>
> "The Reliable Replacement Warhead will provide means to ensure the long-term reliability of the stockpile and enable us to establish a safer and more secure nuclear deterrent," said NNSA Administrator Linton Brooks. "It will give us the tools we need to build on the President's vision of maintaining the smallest nuclear stockpile that is consistent with national security requirements."

On March 2, 2007, the NNSA announced that the RRW design team from Lawrence Livermore and Sandia National Laboratories was selected to lead the RRW development.

Why is RRW Development Needed Now? Recently completed studies of warhead aging have concluded that a key warhead component, the plutonium pit, is likely to last about twice as long as previously estimated. [12] It is, therefore, natural to ask whether the U.S. can delay RRW development.

There are several reasons why proceeding now with RRW makes sense.

- Components other than plutonium pits have demonstrated aging trends that dictate the timelines on which warhead will need to be replaced or refurbished. Surveillance of the existing stockpile reveals a growing number of age-related problems, such as corrosion and other material-related issues that individually or cumulatively affect weapon performance.[13] For example, a refurbishment program for W76 warheads, a type of warhead carried on submarine-launched ballistic missiles, will begin in fiscal year 2007. During refurbishment, over half of the components of each W76 warhead will be replaced with newly produced components. Refurbishment of these warheads is needed now, even though the plutonium pits do not need to be replaced.
- No back-up warhead exists that could be deployed on Trident missiles if a reliability problem with the W76 occurs. Since there are more W76 warheads in the current and planned deployed nuclear force than warheads of any other type, a failure of the W76 would more adversely impact the overall deployed force than a failure of any other type of warhead. Replacing a significant number of W76

warheads with RRWs as soon as possible would alleviate this concern and better distribute risk among the spectrum of warhead types.

- If the country is to benefit in the long term from a streamlined, less costly infrastructure for nuclear warheads—one of the by-products of RRW—planning for that infrastructure needs to begin now in order to limit the duplication of infrastructure capabilities needed for legacy warheads as well as RRWs. If RRW development proceeds without delay, about six years of development will be needed before the first RRW prototype can be produced. Once the path to an all-RRW stockpile is defined and determined to be viable, wise judgments on proper allocation of resources will be possible.
- If an all-RRW stockpile is to be achieved—and certified without nuclear testing—the expert judgment of remaining test-experienced warhead designers and engineers will be needed. These individuals possess the nation's corporate knowledge in their field and all will be retired within a few years. It will be important for them to work closely with the new generation of personnel and the new, increasingly powerful computational and experimentation tools developed under the stockpile stewardship program.

Will RRWs Be "New" Nuclear Warheads? One question that is often asked is whether RRW concepts will lead to a "new" nuclear warhead. This seemingly straightforward question cannot be answered accurately with a simple yes or no.

Take, for example, a situation that occurred during the second term of the Clinton presidency. Administration officials initiated the modification of an existing nuclear gravity bomb (the B61-7) to serve as an interim earth penetration weapon. (The resultant modified nuclear weapon is the current B61 Mod 11 earth penetrator that can be carried on B-2 aircraft.) A national debate ensued as journalists and technical experts heatedly debated whether the modification to the B61-7 represented a "new" warhead. Critics of the development of the B61 Mod 11 earth penetrating weapon argued that it represented a new warhead and should be prohibited. These critics held the view that any new nuclear weapon development was to be avoided and they attempted to frame the debate within the semantics of the term "new."[14]

In the case of the B61 modification, the U.S. took an existing (*not new)* warhead, put it in a different (*new*) configuration as an earth penetrating weapon*,* deployed it on the same (*not new*) delivery systems (B-2 aircraft), to achieve weapon effects on deep underground targets comparable (but *not new*) to effects from an older, higher yield gravity bomb that was to be retired. The comparable *(not new)* effects on the same (*not new*) targets were achieved in a somewhat different (*new?)* manner. Is there any wonder why there was disagreement over whether the term *new* was appropriate for this program?

For RRW concepts, the discussion over a term as imprecise as *new* can be similarly unsatisfying.[15] Perhaps a more straightforward approach is to clarify which aspects of RRW should be considered new and which should not.

The category, *not new,* seems to apply to the following:

- The U.S. is developing replacement warheads that are to be carried on existing *(not new)* weapon delivery systems.
- RRW warheads for existing weapon delivery systems are being developed to accomplish the same *(not new)* missions as the warheads they will replace.
- Existing weapons armed with RRW warheads will provide comparable *(not new)* weapon effects on targets (in certain cases the effects on targets might be slightly diminished).

The category, *new,* seems appropriate for the following:

- Components required for RRWs will be *newly produced*. (Of course, newly produced components are also required for warhead refurbishment programs now underway.)
- The precise configuration of RRW warheads will be *different* from any previous nuclear warheads in the U.S. stockpile. For example, RRWs will not contain some hazardous materials currently in the warheads that they will replace.
- RRWs will be inherently *safer and more secure* in the event that unauthorized intruders gain access to a weapon or that the weapons are involved in accidents (e.g., transportation accidents).

If RRW is Developed, are Science-Based Stockpile Stewardship Capabilities Needed? Yes. The advanced computer simulations and experimental facilities developed over the past decade are essential to develop, certify, and maintain RRWs without nuclear testing. The concept of developing a reliable replacement warhead without testing is based on two fundamental premises.

- First premise: replacement warhead designs can be developed based on aspects of nuclear warhead design that are well understood from the compilation of technical research over the past six decades. In fact, each of the nuclear weapon design laboratories has completed work on a reliable replacement warhead candidate that each lab believes meets this premise.
- Second premise: without resorting to nuclear testing, newly developed, high-resolution computer simulations and experimental facilities, validated against data from past nuclear tests, can be used with confidence to certify that RRWs will perform as intended. While nuclear design experts believe this is feasible, it remains to be demonstrated.

The new science-based capabilities, designed to sustain the existing, highly optimized warhead designs without routine underground nuclear testing, will also be needed to develop and certify RRWs. Without these capabilities, the RRW concept would not be viable.

How will RRWs Contribute to Transformation of the Nation's Infrastructure for Nuclear Warheads? Early in the RRW concept development, the national laboratories recognized the potential for savings from streamlining production capabilities. In 2005, a white paper authored by personnel from Los Alamos, Lawrence-Livermore, and Sandia National Laboratories, featured infrastructure transformation as a key benefit of RRWs:

> To the extent that the United States pursues reliable replacement warheads that are more manufacturable, it can look forward to a smaller, more secure and cost effective production complex. Warheads designed for both manufacturability and certifiability should allow the laboratories and plants to be more efficient and responsive.[16]

In March 2006, in testimony before the House Armed Services Committee on Strategic Forces, Ambassador Linton Brooks outlined his vision for a transformed infrastructure and the role of RRWs in that plan:

> We [NNSA] have worked closely with the DoD to identify initial steps on the path to a responsive nuclear infrastructure.
>
> What do we mean by "responsive nuclear weapon infrastructure?" By "responsive" we refer to the resilience of the nuclear enterprise to unanticipated events or emerging threats, and the ability to anticipate innovations by an adversary and to counter them before our deterrent is degraded. Unanticipated events could include complete failure of a deployed warhead type or the need to respond to new and emerging geopolitical threats. The elements of a responsive infrastructure include the people, the science and technology base, and the facilities and equipment to support a right-sized nuclear weapons enterprise. …
>
> As we and the DoD take the first steps down this path, we clearly recognize that the "enabler" for transformation is our concept for the Reliable Replacement Warhead (RRW). The RRW would relax Cold War design constraints that maximized yield to weight ratios and thereby allow us to design replacement components that are easier to manufacture, are safer and more secure, eliminate environmentally dangerous materials, and increase design margins, thus ensuring long-term confidence in reliability and a correspondingly reduced chance we will ever need to resort to nuclear testing.[17]

What Would be the Consequences if RRW is Not Developed? Since the DoD and DOE report annually that the nuclear stockpile is safe and reliable, why can't we continue with the existing plans to refurbish the current stockpile? Without a program to develop, produce, and transition to a RRW-based nuclear stockpile, the implications would be as follows:

- The nation would be committed to sustaining highly optimized, Cold War-era warheads indefinitely through refurbishments. This would require restoring production capabilities—including some costly, one-of-a-kind facilities and reactivating others that have been dormant for over a decade—to produce replacement components as closely as possible to those created specifically for each warhead type.
- Over time, the cumulative effect of multiple refurbishments may call into question the ability of the national laboratories to certify without testing the proper operation of the resultant warhead configuration.
- A large inventory of backup warheads would continue to be needed in a reserve stockpile. These would serve as replacements in case confidence could not be sustained in the reliability of a type of deployed warhead. Currently, a reserve of different warhead types is retained to manage risk and to provide options, short of nuclear testing, in case confidence in a warhead type falls below acceptable levels.[18] The reality is that, over time, confidence in the backup warheads will gradually diminish as they age and are periodically refurbished.
- The RRW concept is Congress' substitute for the NNSA's Advanced Concepts Initiative (ACI). The ACI was intended to be a catalyst for creativity and competence in nuclear design at the national laboratories. Without such a catalyst, U.S. technical expertise on nuclear weapon technology will likely atrophy.
- The last of the remaining test-experienced warhead designers and engineers are nearing retirement. RRW provides the added benefit of enabling the remaining test-experienced personnel to work closely on RRW design and engineering concepts with the next generation of professionals that will replace them. The nation will depend on the expert judgment of the new team in the decades ahead.

If the RRW program does not proceed and successfully develop and manufacture the kinds of warheads envisioned, the result for the nation will be: 1) a larger total stockpile of nuclear warheads, 2) increased likelihood for nuclear testing over the mid- to long-term, 3) a larger, more expensive research and production complex, 4) a less responsive nuclear weapon infrastructure, and 5) less competent technical experts.

Perspectives on RRW

Expected Benefits of RRW for the Department of Defense

While the RRW program has been championed by the DoD, replacing legacy warheads with RRWs will not substantially change the military's ability to hold targets at risk. Most importantly, the RRW concept provides confidence that the nuclear arsenal can be sustained over the long-term without nuclear testing and with improved safety and security.

The costs to the military, however, are not insignificant.

- First, the military services will have to pay for development and flight-test costs to integrate the RRW designs on each type of weapon that will carry the warhead.
- Second, the responsible military service may have to develop and procure specific components (such as warhead fuses) that integrate the electronics of the warhead and weapon delivery system.
- Finally, in some cases the military may receive replacement warheads with somewhat reduced military effectiveness in exchange for highly optimized Cold War-era warheads.

On March 29, 2006, General James Cartwright, Commander of USSTRATCOM, testified before the Strategic Forces Subcommittee of the Senate Armed Services Committee. He stated clearly the importance to DoD of the RRW program and the nuclear weapon infrastructure to sustain the nation's nuclear arsenal.

> USSTRATCOM recognizes the importance of an efficient and more responsive nuclear weapons infrastructure to the [Defense] Department's strategy of tailored deterrence. We believe this is an essential element needed to ensure our weapons are safe, secure, and reliable, to ensure that we can respond to both technological and political surprise, and to reduce our stockpile of nuclear warheads. … The key initiative is to determine the feasibility of replacing existing warheads with a Reliable Replacement Warhead (RRW).

For the DoD, the prime motivation for pursuing the RRW is the promise of high confidence that the nuclear stockpile will remain reliable over an extended timeframe without nuclear testing. Military planners appear willing to give up some effectiveness and flexibility for future needs in return for higher confidence. This attitude is dramatically different from the demands of military planners during the Cold War.

Expected Benefits of RRW for the Department of Energy

The expected benefits for the DOE—responsible for developing, producing, and maintaining the nuclear warheads—are significant. By relaxing the demanding warhead performance characteristics of the past and enabling a complete redesign, the DOE can make its job less complex and less costly. Even more important, RRW paves the way for the DOE and the National Nuclear Security Administration (NNSA) to develop an infrastructure that is more responsive to changing national security needs. That was a key point in the testimony of then NNSA Administrator, Linton F. Brooks, before the House Armed Services Committee, Subcommittee on Strategic Forces on March 1, 2006:

> The combination of the RRW and a responsive infrastructure—each enabled by the other—may be genuinely transformational. The reduced stockpile approved by the President in 2004 still retains a significant non-deployed nuclear stockpile as a hedge against technical problems or geopolitical changes. Once we can demonstrate that we can produce warheads on a timescale in which geopolitical threats could emerge, we would no longer need to retain extra warheads to hedge against unexpected political changes.

The transition to a responsive infrastructure for nuclear warheads and to RRW designs will be a long-term undertaking. On April 5, 2006, Deputy NNSA Administrator, Thomas P. D'Agostino, told the House Armed Services Committee, Subcommittee on Strategic Forces that the transformation could take thirty years or more.

> The 2030 nuclear weapons complex that we envision will thus support a smaller stockpile consisting of warheads employing designs and technologies developed in the RRW program as well as legacy warheads from the Cold War that have been refurbished in warhead life extension programs. By that time, we will have gained enough experience with RRW to be in a position to address whether that approach could provide sufficient diversity to permit evolution to a stockpile based entirely on RRW designs. If this is the case, it will likely still take another decade or more to complete that transition. Thus we must be prepared to support some number of legacy warheads and their associated LEPs, even as we seek to evolve to a stockpile consisting primarily of RRW designs.

What are the Views of the American Public Regarding Nuclear Weapons and Modernization? Researchers Kerry Herron and Hank Jenkins-Smith, now at the George Bush School of Government and Public Service at Texas A&M University, have conducted the most complete and balanced surveys of opinions held by the general public regarding nuclear weapons and related security issues. The ongoing series of national security surveys began in 1993, after the end of the Cold War. The surveys periodically revisit important issues to track trends in public opinion or to assess views on emerging issues. While these polls have not specifically addressed public views on

RRWs, results from the most recent survey on the National Security and Nuclear Futures Project, completed in 2005, are relevant to the RRW initiative.[19]

Surveys are typically conducted by asking respondents to rate various issues on a scale from zero to ten (or one to seven in some surveys) with zero corresponding to "strongly undesirable" or "strongly disagree" and ten corresponding to "strongly desirable" or "strongly agree." The following are from the summary of key points from the most recent survey published in 2005.[20]

- Elimination of nuclear weapons: The majority of respondents consider it desirable (above a 7 on a scale of zero to ten) to eliminate all nuclear weapons worldwide; however, most respondents also do not consider elimination feasible (only 3.5 on a scale of zero to ten).
- Relevance of U.S. nuclear weapons: Respondents rated the importance of retaining U.S. nuclear weapons today above a 7 (on a scale from zero to ten).
- Unilateral U.S. reductions: In general respondents were not in favor (about 3.5 on a scale of one to seven) of further unilateral reductions *independent* of the actions of the other nuclear powers (especially Russia and China).
- U.S. nuclear modernization: In general, respondents were slightly accepting, but divided (about 4.5 on a scale of one to seven) on nuclear modernization *in response to actions by Russia or China*.
- U.S. nuclear modernization, if nuclear testing is required: When the probable need for nuclear testing was linked to nuclear modernization, support for modernization tended to drop by about half a point (to about a 4 on a scale from one to seven).

The polling data are remarkably consistent over the past decade and indicate that, while the general public believes it would be desirable to eliminate nuclear weapons, they consider elimination infeasible given the emerging geopolitical environment and believe that the U.S. should maintain a nuclear arsenal appropriate for the environment. The data indicate that the American public is willing to take into account a wide variety of considerations regarding nuclear weapon issues (e.g., What else is going on in the world? Is nuclear testing required or not?).

A recent book, *Critical Masses and Critical Choices*,[21] examines trends in the polling data on nuclear issues. Several findings appear to be particularly relevant to the RRW program. In each survey from 1993 through 2003, respondents were asked to comment on whether government spending should change (be substantially increased or decreased) for a variety of nuclear weapon-related objectives.

The specific categories for which the public voiced strongest support for increased funding were "training to ensure the competence of those who manage nuclear weapons," and "research to increase the safety of existing nuclear weapons."[22] In addition, the authors reported that over the decade from 1993 to 2003, support

increased for investments to "maintain the ability to develop and improve U.S. nuclear weapons in the future."[23]

The objectives of improving the competence of nuclear weapons personnel, increasing safety, and improving the infrastructure are important goals of the RRW program. These objectives are nuclear weapon-related goals that are supported most strongly by the U.S. public. From more than a decade of polling on nuclear weapon issues, it is reasonable to expect at least moderate support for RRW by the general public in the U.S.

What are the National Policy and International Issues Related to the RRW Program? The next section of the paper addresses a spectrum of policy issues regarding the RRW program.

- International Affairs: What issues and concerns have critics in other countries raised regarding the U.S. RRW program?
- Nuclear Testing: Would developing an RRW make it more or less likely that, in the future, the U.S. would have to consider nuclear testing?
- Terrorism: Would RRW warheads, either deployed or in storage sites, be more or less vulnerable to terrorist attacks?
- Arms competition: Would the RRW program send the wrong signal to other countries—that the United States is modernizing and improving its nuclear arsenal—at a time when we are seeking to convince countries such at North Korea and Iran to give up their nuclear weapon ambitions?
- Extended Deterrence: How might RRW affect extended deterrence guarantees provided to allies by the United States?
- NPT Compliance: Is development and production of an RRW permitted under the NPT? Would it be viewed by non-nuclear weapon states as compliant with Article VI of the NPT?

Views on RRW from Outside the United States

Any U.S. initiative regarding nuclear weapons is certain to be discussed in the international press, and RRW is no exception. To date, reaction to the RRW program from those outside the United States is mixed.

Some Russian writers have expressed a clear understanding of the reasons for RRW and have opined that this U.S. initiative will not pose a threat to Russian interests. A Russian research analyst currently at the Monterey Institute, Nikolay Sokov, states that U.S. actions in restoring its nuclear complex and the RRW program to extend warranty life and reduce costs are not surprising given the condition to which the U.S. nuclear infrastructure was allowed to deteriorate.[24]

An article by Russian authors, Sergey Rogov, Viktor Yesin, and Pavel Zolotarev, discussing nuclear issues and threats to global security took a circumspect approach:

> … the problem of the aging of the nuclear warheads and their replacement with new warheads can be a subject of the consultations. In conditions of the rejection of nuclear tests, the problem of reliability can, in a few years, become acute due to the lack of the possibility to test new nuclear warheads. It cannot be ruled out that all five of the official nuclear states, including China, may show interest in the clarification of the technical parameters of the resolution of this problem.[25]

Writers in countries in which U.S. nuclear weapon programs and policies are less well understood have expressed fear and uncertainty. According to the Chinese newspaper, *Renmin Ribao*, the RRW program is a new nuclear weapons development program that has gone beyond the scope of fighting terrorism and will retard the international non-proliferation regime and lead to further nuclear proliferation. The author speculates that RRW will lead to an "arms race" and an "action-reaction" dynamic once the U.S. begins nuclear testing, which the author asserts it must. Also argued is that nuclear weapons are vital to the U.S. national security strategy and this strategy will lead other states to pursue nuclear weapons.[26]

The most common criticism of RRW found in the international press deals with those struggling to accept the grand agreement codified in the Nuclear Nonproliferation Treaty (NPT) of 1968. The NPT accorded continuing nuclear weapon status to the five nuclear weapons states at that time while also implementing measures to limit the proliferation of nuclear weapons. According to articles from the UK newspaper, *The Guardian*, the decision by the British government (Prime Minister Blair) to replace the Trident missile and upgrade the nuclear facilities at Aldermaston will lead to the destruction of the NPT. Also criticized in *The Guardian* is the U.S. decision to build new weapons under the RRW program which, they claim, will invariably lead to underground testing. These actions, according to the articles, will lead to further proliferation and a possible lowering of the nuclear threshold with low-yield nuclear weapons and proliferation.[27]

Issues raised within the U.S. and in the international press provide a basis for examining the case for RRW in the current geopolitical context. In a recent report the Congressional Research Service provides a concise summary of concerns.

> As the RRW program has developed, opponents have emerged. They raise a number of concerns. In their view, RRW could lead to nuclear testing; it would run counter to a U.S. commitment under the Nuclear Nonproliferation Treaty; it would be costly, as it would require building perhaps thousands of warheads and could require reconfiguring the nuclear weapons complex; it would demonstrate the continuing value that the United States places on nuclear weapons, undermining U.S. efforts to tell other nations that they should not develop such weapons; and it could lead to new weapons capable of performing new military missions.[28]

Nuclear Testing: Will development of RRW concepts make it more or less likely that the United States will have to consider nuclear testing in the future? Critics of RRW point out that each warhead in the current nuclear stockpile has been certified based on several underground nuclear tests. They question why the U.S. would abandon these designs in favor of warhead concepts for which no nuclear test history exists. Some have even asserted that relying on RRW concepts would make the need for a nuclear test more likely rather than less likely. They argue that issues are almost certain to arise that will not be able to be resolved by computer simulations and non-nuclear experiments.

Former Deputy Defense Secretary John Hamre has gone even further. In May 2005, he endorsed the RRW program and advocated one or a few nuclear tests of RRW designs to confirm the accuracy of nuclear simulation codes on supercomputers at the national laboratories. He implied that it may be worth conducting a few nuclear tests to demonstrate that the RRW designs work, that supercomputer calculations are accurate, and that the United States retains a credible nuclear deterrent. Then, Hamre asserted, we can proceed into an era of no nuclear testing with confidence. Dr. Hamre wrote:

> … the current inventory of nuclear weapons is grossly oversized and ill-suited for whatever the future might bring. These weapons were designed for an earlier age. While the force is quite capable today and provides a reliable deterrence, its credibility will erode as it ages.
>
> … we do better to hedge an uncertain future by maintaining competent design teams and building new weapons at low production rates than by holding on to a massive inventory of aging weapons.
>
> Almost all technical experts believe we probably do not need to test new-design [RRW] weapons to have high confidence in their effectiveness. But if we completely retire all existing systems, I think we should test the new weapons to demonstrate to the world that they are credible. Such testing need not be extensive. And while I acknowledge that testing is widely seen as a provocative act, it can be made acceptable internationally so long as it is preceded by a commitment to retire our entire existing inventory.[29]

Earlier, this paper addressed the RRW program goal of developing and certifying RRWs without nuclear testing and listed reasons why it appears feasible that the NNSA will be able to develop RRWs without nuclear testing.

Terrorism: With RRW warheads, would U.S. nuclear weapons, either deployed or in storage sites, be more or less vulnerable to terrorist attacks? Current warhead designs

were not developed from requirements that included the kinds of threats from terrorists that we face in the contemporary environment.[30] The current terrorist threat is more demanding.

Suicide bombers could seek to gain access to weapons, either deployed or in storage, with the goal of exploding the weapons in place. Modern security features in U.S. weapons would help prevent an unauthorized nuclear detonation; however, an explosion near a nuclear warhead could scatter radioactive materials from inside the warhead. Such an act of terrorism could close down operations at the site for an extended timeframe while the tedious and expensive process of cleanup was conducted.

Dr. Bruce Goodwin, Associate Director for Nuclear Weapon Technology at Lawrence Livermore National Laboratory, was quoted in a *Los Angeles Times* news article on the subject of RRW designs and terrorism:

> "It is essential that we make sure our weapons are impossible for terrorists to use," said Bruce Goodwin, chief of nuclear weapons design at Livermore. The weapons produced during the Cold War, he said, were not designed for an Age of Terrorism.
>
> … weapons scientists inside the labs say their goal of "absolute surety" is not only the right policy but is clearly achievable. "We know how to do it," Goodwin said. [31]

Arms Competition: Would the RRW program send the wrong signal to other countries that the United States is modernizing and improving its nuclear arsenal at a time when we are seeking to convince countries such as North Korea and Iran to give up their nuclear weapon ambitions? Some argue against any development and production of nuclear warheads by the United States because it would signal the continued value of nuclear weapons, compel others with nuclear weapons to expand and modernize arsenals, and encourage those without nuclear weapons to seek them. This argument is a holdover from the Cold War in which it was assumed that a new development by either the U.S. or the Soviet Union would spur development by the other in order to keep pace.

This is one of the myths from the past addressed by former Deputy Assistant Secretary of Defense Keith Payne:

> …this arms race theory was inadequate to explain U.S. or Soviet motives during the Cold War, and today it mistakenly attributes the same motivation and dynamic to rogue states. Rogue states seek nuclear capabilities for their own unique purposes, such as the ability to intimidate or attack their regional neighbors and to deter with nuclear threats an overwhelmingly strong U.S. conventional response to such actions. These nuclear aspirations do not require rogues to mimic U.S. nuclear

> programs quantitatively or qualitatively, nor do they need U.S. signals to appreciate the value of nuclear weapons for their own purposes. North Korea and Iran, for example, see considerable value in nuclear weapons.[32]

Another who explicitly rejects the action-reaction "arms race" dynamic as the explanation for contemporary proliferation is Professor Jacques Hymans. In his recent book, *The Psychology of Nuclear Proliferation*, Hymans concludes that some leaders possess unique traits that lead them to seek nuclear arsenals.[33]

In his analysis of why some countries, when faced with the same external circumstances, seek nuclear weapons while others do not, Hymans concludes that an analysis of the psychology of individual leaders is simply unavoidable. He notes that the source of the differences in motives to acquire nuclear weapons lies primarily in the character and disposition of individual leaders, and not in the "external structure."[34] Thus historical research of both Payne and Hymans teaches that the Cold War theory of action-reaction dynamics driven by U.S. nuclear weapon development is not supported by the empirical evidence. Consequently, a priori assertions that RRW will ignite a new nuclear arms race are similarly ill-founded.

Development and production of RRW warhead components are no more likely to affect nuclear activities in other countries than other possible drivers; the action-reaction dynamic is an inadequate basis for expecting otherwise. If the U.S. cancelled the RRW program, it would be unlikely to change the motivations of other countries to modernize or acquire nuclear arsenals.

Compliance with the NPT: Some critics of RRW oppose any development and production of nuclear warheads by the United States. Citing the obligation of the NPT-recognized nuclear weapons states to work toward nuclear disarmament, they view any new production of warheads as inconsistent with that goal.

Under the NPT, both nuclear weapons states and non-nuclear weapons states have responsibilities for a variety of NPT objectives. For example, Article VI of the treaty states that:

> Each of the Parties undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control.

Note that the responsibility for compliance with Article VI is shared by nuclear weapons states and non-nuclear-weapons states alike. The specific context for nuclear disarmament is a treaty on *complete* disarmament. Most discussions of U.S. NPT

obligations ignore this linkage, criticizing U.S. progress toward nuclear disarmament without comment on the NPT's specified context for that goal.

The contemporary global environment is far from conducive to the general disarmament goal. And states most critical of progress toward nuclear disarmament show no apparent interest in general disarmament.

Enormous progress has been made over the past two decades in ending the nuclear arms race and reducing U.S. nuclear forces.[35] Nonetheless, it is unrealistic to expect that the U.S. and the other NPT-recognized nuclear weapons states would shelve their nuclear arsenals at a time when states such as North Korea and Iran—that pledged to remain non-nuclear-weapons states in return for receiving benefits under the NPT regime—are developing nuclear weapons using nuclear technology subverted from civil nuclear applications. A world in which approximately twenty countries currently possess chemical or biological weapons is not a safe environment—especially for countries that have foresworn such weapons.

The nuclear arsenal is an important element of a comprehensive U.S. strategy to combat the proliferation of nuclear weapons and other weapons of mass destruction.

- The United States lowers the incentives for its closest allies to acquire nuclear weapons of their own by extending its nuclear umbrella to those allies. U.S. nuclear security guarantees to NATO and Asian-Pacific allies are long-standing commitments and remain valid.
- Additionally, the United States has implemented a comprehensive strategy to devalue nuclear, chemical, and biological weapons in the hands of potential enemies. Defensive capabilities, both active defenses and passive, and offensive capabilities such as nuclear and conventional weapons contribute to that goal.

As discussed earlier, the RRW program will actually enable further reductions in the U.S. nuclear stockpile.

Extended Deterrence: How might RRW affect extended deterrence guarantees provided to allies by the United States? For decades the United States has provided extended deterrence guarantees to NATO and to Asian-Pacific allies such as Japan and South Korea. As noted, this has been an important element of the U.S. nonproliferation strategy. The reasoning has been that as long as the U.S. nuclear arsenal remains effective and credible and U.S. security commitments remain valid, these allies would have little incentive to seek indigenous nuclear weapon programs for security. To date, this extended deterrence commitment by the United States has been an effective measure in limiting the spread of nuclear weapons; allies who have been the

beneficiaries of U.S. extended deterrence guarantees have not developed nuclear arsenals.

However, in the contemporary environment some allies are reportedly reconsidering their need for nuclear weapons. Reasons for this change include the following:

- Some U.S. allies are increasingly concerned about the growth of threats in their region. For example, recent North Korean tests of ballistic missiles and of a nuclear warhead create serious concerns for Japan, a key U.S. ally.
- With nuclear threats on the rise, Japan and other allies have openly questioned whether long-standing U.S. extended deterrence guarantees will remain valid. At the same time, Japan and other allies have witnessed dramatic reductions in the U.S. nuclear arsenal and debates in the U.S. over nuclear modernization and the ability of America to sustain confidence in the nuclear stockpile without testing.[36]

If Iran and North Korea successfully continue nuclear weapon development efforts, a new round of nuclear proliferation may result. Iran and North Korea have undermined the NPT regime, subverted its civil technologies for military applications, and continue to ignore UN Security Council resolutions. In addition the leaders of both Iran and North Korea have demonstrated willingness to transfer dangerous weapons to others—both state and non-state actors. It is not surprising that several U.S. allies are threatened by the prospect of nuclear weapons in the hands of such leaders.

This concern is explored by authors Campbell, Einhorn, and Reiss in their book, *The Nuclear Tipping Point*. In this book, they explore case studies of countries that may reconsider the need for nuclear weapons. They conclude:

> The case studies suggest that the perceived reliability of U.S. security assurances will be a critical factor, if not *the* critical factor, in whether such countries as Japan, Saudia Arabia, South Korea, Taiwan, and Turkey reconsider their nuclear options.[37]

A successful effort by the United States to develop, produce, and deploy RRWs and make continued progress on a responsive nuclear infrastructure would help to shore up allies' concerns over perceptions that the U.S. may be neglecting its nuclear force and that the U.S. may not be able to sustain confidence in the Cold War legacy stockpile over the long-term.

Status of Nuclear Warhead Development and Production in Other NPT-Recognized Nuclear Weapons States

What is the Status of Nuclear Warhead Development and Production in Each of the Other Nuclear Weapons States Recognized by the NPT?

Some oppose the RRW program because they oppose *any* nuclear weapon development and production by the United States. They allege that others will follow suit and a new era of nuclear arms "racing" will result. This section addresses the allegation—often implicit in criticisms of any action by the U.S. to improve or modernize its nuclear arsenal—that U.S. actions would be needlessly provocative and inconsistent with the activities of other nuclear weapons states.

For this paper a survey was conducted of open-source information on nuclear weapon modernization programs and warhead development and production activities in each of the other NPT-recognized nuclear weapons states: the United Kingdom, France, Russia, and China. The findings of this survey will be documented in a future paper to be issued by the Nuclear Strategy Forum. Key findings are summarized below.

The U.K., France, Russia, and China all have issued formal statements or documents that detail the post-Cold War military strategy of each and the role of nuclear weapons. Each of the four countries has initiated post-Cold War nuclear weapon modernization programs that vary in scope and characteristics. For example:

- **U.K.:** For the British an independent nuclear deterrent is stated to be "an essential part of our [U.K.] insurance against the uncertainties and risks of the future."[38] In December 2006, London announced plans to replace its existing deterrent force of ballistic missile-carrying submarines with a new generation of submarines, missiles, and either new or refurbished warheads in the early 2020 timeframe.
- **France:** In February 1996, President Chirac announced a portfolio of reforms and initiatives to implement a French post-Cold War defense strategy. Subsequently, President Chirac clarified Paris' strategy to deter major powers, regional powers, and state sponsors of terrorism. To implement its new strategy, France initiated nuclear modernization programs that include: a new, longer-range, air-delivered missile for both Navy and Air Force use; a new nuclear-capable delivery aircraft (the Rafale); a next-generation submarine-launched ballistic missile; and "more employable nuclear options" to strengthen deterrence.[39]

- **Russia:** The military strategy of Russia includes an expansive role for nuclear weapons and a diverse collection of nuclear weapon capabilities. "The Russian Federation must have nuclear forces capable of delivering specified damage to *any* aggressor state or coalition of states in *any* situation" (emphasis added). The Russian strategy calls for "the use of all available means and forces, including nuclear weapons, … to repel armed aggression when all other means ... have proved ineffective."[40] Russia has an impressive collection of advanced nuclear weapon development programs underway to include: a new type of ballistic missile submarine and next generation submarine-launched ballistic missile, silo-based and mobile Topol-M ICBMs, maneuverable warheads, and new cruise missiles for the strategic bomber force. In addition, Russia maintains and is modernizing the world's largest inventory of tactical nuclear weapons.[41] President Putin has personally ensured that Russian nuclear weapon modernization accomplishments have received high visibility.[42]
- **China:** China stands out as the only one of the five NPT-recognized nuclear states that is *both* modernizing and expanding its nuclear arsenal. China's strategic forces modernization programs are intended to provide a more survivable and lethal nuclear deterrent and strike capability in response to its perception of an increasingly complex nuclear environment.[43] China is fielding mobile, more survivable missiles capable of targeting the United States, Japan, India, Russia, and other targets in Asia and the rest of the world. By 2010, China's strategic nuclear forces will likely comprise a combination of enhanced silo-based CSS-4 ICBMs; CSS-3 ICBMs; CSS-5 MRBMs; solid-fueled, road-mobile DF-31 (IOC in 2006) and DF-31A (IOC 2007); and JL-1 and Jl-2 SLBMs (IOC 2007-10). China is also developing air- and ground-launched cruise missiles that could have a nuclear capability.[44] China has not clearly explained the reasons for its comprehensive nuclear weapon modernization and expansion.

The survey of the other nuclear weapon states found that each has a complete set of research and development capabilities for nuclear warheads as well as a fully operational warhead production infrastructure. The size and characteristics of the nuclear weapon infrastructure of each reflect the specific roles for nuclear weapons, and number and types of nuclear weapons in the security strategy of each country. Findings that bear on the RRW program are summarized below:

- First, each of the other NPT-recognized nuclear weapons states has unique national security concerns and has already made decisions on the role of nuclear weapons in its post-Cold War security strategy. Nuclear weapon modernization programs to implement the national security strategy of each are underway in the U.K., France, Russia, and China. The U.S. RRW program is unlikely to affect the motivations of these countries for retaining and modernizing nuclear weapons.
- Second, the capabilities for and status of the nuclear warhead infrastructure of each state reflect the unique national security needs of each and the nuclear weapon and warhead technologies on which each relies. Nuclear warhead

development and production are active in France, Russia, and China. The U.K. is modernizing its infrastructure to be better prepared to develop and produce warheads for its next generation deterrent. RRW development and production will not result in the United States conducting activities that are unduly provocative or inconsistent with those of the other nuclear weapons states.

- Third, of the five NPT-recognized nuclear weapons states, the United States is the only one without a fully functional nuclear warhead production capability. Most notably lacking in the U.S. is the absence of a production facility for plutonium pits for warhead primaries sized to meet the nation's long-term needs.[45] The RRW program provides a basis for a commonsense consolidation and modernization of the U.S. nuclear warhead infrastructure.

Table 1 compares the status of nuclear warhead development and production in the United States with that of each of the other NPT-recognized nuclear weapons states.

	U.S.	**U.K.**	**France**	**Russia**	**China**
Warhead R&D Capabilities	Complete	Complete (modernization underway)	Complete	Complete	Complete
Status: Warhead Development	Not active*	Not active**	Active **	Active	Active
Warhead Production Capabilities	Not fully operational (selected modernization underway)	Operational (modernization underway)	Operational	Operational	Operational
Status: Warhead Production	Not fully active* (selected component production)	Active intermittently**	Active**	Active	Active
Fissile Materials	Production halted; adequate supply	Production halted; adequate supply	Production halted; adequate supply	Production halted; adequate supply	Production halted; adequate supply

Table 1. Nuclear Warhead Infrastructure Characteristics for Each of the Five NPT-Recognized Nuclear Weapons States

* Development of RRWs by the U.S. would change Table 1 by making the status of U.S. warhead development and warhead production "Active."

** For the U.K. and France warhead development and production are activated intermittently, when needed.

Warhead R&D capabilities: Each of the NPT-recognized nuclear weapon states including the U.S. has a complete set of infrastructure capabilities needed for warhead design and development. The U.K. recently initiated upgrades to its R&D infrastructure as a key element of its plan to replace the existing U.K. nuclear deterrent force.

Status of warhead development: Nuclear warhead development is active in France, Russia, and China. The U.K. has announced that it will either refurbish or replace the existing warheads for U.K. Trident missiles when the warheads reach the end of service life. Other than the RRW study, no nuclear warhead development is underway in the U.S.

Warhead production capabilities: Each of the other nuclear weapon states has a fully operational nuclear warhead production capability sized to meets it unique needs. The U.S. production capability is not complete and not fully operational. Most notably lacking for the U.S. is the lack of a replacement-scale, plutonium pit production facility.

Status of warhead production: Nuclear warhead production is active in France, Russia, and China and intermittently in the U.K. In addition, U.K. plans calls for it to produce either components for warhead refurbishment or complete replacement warheads for U.K. Trident missiles when the existing warheads reach the end of service life (about 2020). Other than producing replacement components for selected warhead refurbishment programs, no warhead production is underway in the U.S.

Availability of fissile materials for nuclear warheads: Each of the nuclear weapons states has ceased production of fissile material. Each is judged to have adequate materials to sustain its nuclear arsenal. China is believed to have adequate fissile material to double or triple its nuclear arsenal.[46]

Summary

For the U.S., a national consensus has not been achieved on the specific programs for nuclear modernization that are appropriate in the contemporary geopolitical environment. Since the beginning of the current administration a variety of studies and advanced concept initiatives have been debated and shelved due to insurmountable barriers at some point in the legislative process. The lone exception is the Reliable Replacement Warhead (RRW).

By design, the RRW program does not result in new or improved military capabilities; it is not being pursued to implement a new approach to deterrence. The RRW program promises benefits for the nation that include safety and security improvements in the nuclear arsenal, long-term confidence without nuclear testing, and cost savings once the RRW concept has been proven. In addition, the RRW program will help reenergize the warhead design and engineering communities and provides a basis for streamlining, modernizing, and ultimately reducing the size and cost of the production infrastructure.

RRW is unlikely to be controversial with the American public because the objectives of the RRW program coincide with the nuclear weapon-related goals most broadly supported by the public.

A credible, effective nuclear deterrent is an important element of the U.S. national strategy to counter weapons of mass destruction. U.S. nonproliferation goals would be seriously damaged if key allies, currently protected by U.S. extended nuclear deterrence commitments, lost confidence in the willingness of the U.S. to sustain the reliability and effectiveness of the weapons that underpin that commitment. RRW will help support U.S. nonproliferation goals and extended deterrence commitments by sustaining confidence in the U.S. arsenal. The RRW program will enable this to be accomplished while also reducing the likelihood that nuclear testing will be required to validate warhead performance.

There is little evidence to suggest that developing and producing RRW warheads will undermine nonproliferation objectives or spark a new “arms race.” The Cold War’s action-reaction thesis simply lacks credibility as an explanation of post-Cold War nuclear proliferation. Countries currently seeking nuclear weapons, such as North Korea and Iran, will likely continue to do so regardless of U.S. action on RRWs.

Of the five NPT-recognized nuclear weapons states, the other four have already embarked on nuclear weapon modernization programs for the post-Cold War environment. In particular, Russia, China, and, to a lesser extent, France are actively developing and producing new nuclear warheads. In the next few years the U.K. will consider whether it needs to develop and produce a new warhead for its deterrent replacement program. In contrast, the United States has been unable to develop a consensus on an appropriate strategy to adapt U.S. nuclear forces to the new geopolitical environment.

RRW is a program at a narrow nexus of nuclear weapon activities on which political consensus can be achieved. For the near-term, RRW will serve as a catalyst to retain the U.S. technology base and infrastructure for nuclear warheads. If a national consensus on nuclear weapon modernization emerges sometime in the future, the U.S. will be better prepared as a result of the RRW program. If the RRW program does not go forward successfully, the result for the nation will be: 1) a larger total stockpile of nuclear warheads, 2) increased likelihood for nuclear testing over the mid- to long-term, 3) a larger, more expensive, and less responsive warhead research and production complex, and 4) less competent warhead technical experts.

Notes

[1] For example: The Congressional Research Service Report for Congress, *Nuclear Weapons: The Reliable Replacement Warhead Program,* March 9, 2006; and the Department of Defense Report to Congress, *Interim Report on the Feasibility and Implementation of the Reliable Replacement Warhead Program,* March 1, 2006.

[2] The Congressional Research Service report, *Nuclear Warheads: The Reliable Replacement Warhead Program and the Life Extension Program*, December 13, 2006, provides a detailed history of congressional activities and the goals Congress has imposed on the RRW program.

[3] In written testimony before the Senate Armed Services Committee on March 7, 2006, NNSA Administrator Linton Brooks stated: "As we continue to draw down the stockpile, we must consider the long-term implications of successive warhead refurbishments. Each refurbishment takes us further from the tested configurations, raising concerns about our ability to ensure stockpile safety and reliability over the very long term."

[4] National Nuclear Security Administration press release on RRW issued on December 1, 2006.

[5] The term *legacy* is used in this paper to denote any of the current types of warheads that were developed during the Cold War and are being retained for future service.

[6] DoD has directed that the first RRW program will produce warheads to replace existing W76 warheads carried on Trident missiles. At this time, there is no yield or weight penalty anticipated from the replacement of W76 warheads with RRWs.

[7] A history of the Plowshare Program by the Department of Energy is available online at www.osti.gov/opennet/reports/plowshar.pdf.

[8] The reductions now in progress will result in a force of operationally deployed nuclear warheads in 2012 that numbers only about one-third of the deployed warheads in 2001 (when the reductions were initiated) and about one-fifth of the warheads deployed in 1991 (the end of the Cold War).

[9] Paul White, *The Reliable Replacement Warhead: Catalyst for Change*, Los Alamos Science and Technology Magazine, January 2007.

[10] The Nuclear Weapons Council is a congressionally directed body of senior officials from the DoD and the DOE. Among other things, this council has the responsibility for coordinating programming and budget matters pertaining to nuclear weapons programs between the DoD and the DOE.

[11] Note: Ambassador Linton F. Brooks, Under Secretary for Nuclear Security and Administrator, National Nuclear Security Administration, U.S. Department of Energy, testifying before the House Armed Services Committee, Subcommittee on Strategic Forces, March 1, 2006, maintained that this interim pit production capacity "will be insufficient to meet our assessed long-term pit production needs."

[12] On November 29, 2006, the National Nuclear Security Administration issued a press release, *Studies Show Plutonium Degradation in U.S. Nuclear Weapons will not Affect Reliability Soon*. Quotes from the press release include: "Overall, the weapons laboratories studies assessed that the majority of plutonium pits for most nuclear weapons have minimum lifetimes of at least 85 years." "...the degradation of plutonium in our nuclear weapons will not affect nuclear reliability for decades. It is now clear that although plutonium aging contributes, other factors control the overall life expectancy of nuclear weapons systems."

[13] Paul White, *The Reliable Replacement Warhead: Catalyst for Chang*e, Los Alamos Science and Technology Magazine*,* January 2007.

[14] In the October 1997 Congressional Research Service report, "Nuclear Weapons Production Capability Issues," CRS analyst, Jon Medalia, documented this controversy in the following way: "No definition is possible for two terms that appear throughout this [CRS] report, *new weapon* and weapons maintenance, because the terms are

themselves weapons in a struggle over the role and future of nuclear weapons. The debate over the definitions, which masquerades as a matter of semantics, cloaks this larger struggle. … a spectrum of activities might or might not, depending on one's point of view, produce a *new* weapon … those who would de-legitimize the use of nuclear weapons, shrink the stockpile, and abolish these weapons as soon as possible, … use *new weapon* inclusively in hopes that broadening the list of new weapon activities will narrow the scope of U.S. weapons activities." [emphasis added]

[15] Currently, aspects of public law call for a distinction between what is new and not new for nuclear warhead activities. Public Law 107-314, section 3143, calls for budget requests for warhead activities for "new" or "modified" nuclear warheads to be explicitly called out. Section 3143, however, allows for exceptions and that this line item reporting "shall not apply to funds for purposes of conducting, or providing for the conduct of, research and development, or manufacturing and engineering, determined by the Secretary [of Energy] to be necessary—(1) for the nuclear weapon life extension program; (2) to modify an existing nuclear weapon solely to address safety or reliability concerns; or (3) to address proliferation concerns." By this definition, RRW may be considered to be *not new*.

[16] K. Henry O'Brien (LLNL), Bryan L. Fearey (LANL), Michael R. Sjulin (SNL), and Greg A. Thomas (SNL), *Sustaining The Nuclear Enterprise—A New Approach*, UCRL-AR-212442 (May 20, 2005), page 8.

[17] Statement of Ambassador Linton F. Brooks, Under Secretary for Nuclear Security and Administrator, National Nuclear Security Administration, U.S. Department of Energy, before the House Armed Services Committee, Subcommittee on Strategic Forces, March 1, 2006.

[18] The DoD *Quadrennial Defense Review Report*, February 6, 2006, stated: "…the Reliable Replacement Warhead … could enable reductions in the number of older, non-deployed warheads maintained as a hedge against reliability problems in deployed systems …" (page 49).

[19] The complete history of survey results for the National Security and Nuclear Futures Project is available on-line at www.bush.tamu.edu/research.

[20] *American Views on Nuclear Security and Terrorism: Comparing Phone and Internet Surveys: 2005,* The George Bush School of Government and Public Service, Texas A&M University, pages 52-53.

[21] Kerry G. Herron and Hank C. Jenkins-Smith*, Critical Masses and Critical Choices*, University of Pittsburgh Press (2006).

[22] Ibid., page 54.

[23] Ibid., page 55.

[24] Nikolay Sokov, "Geopolitics: Polemics," *Voyenno-Promyshlennyy Kuryer*, 12 July 2006, CEP20060711436002.

[25] Sergey Rogov, Viktor Yesin, and Pavel Zolotarev: "Problems of Control over Nuclear Arms in the 21st Century. Military Experts Propose a Concept for the Security Council of the UN and the 'Big Eight'," Moscow *Nezavisimoye Voyennoye Obozreniye*, June 9, 2006, CEP20060609466003.

[26] Fan Jishe, "Super Nuclear Powers Should Perform Their Duties," *Renmin Ribao*, June 22, 2006, CPP20060623715020.

[27] George Monbiot, "The Treaty Wreckers," *The Guardian,* August 2, 2005, EUP20050802031017.

[28] Jonathan Medalia, "Nuclear Weapons: The Reliable Replacement Warhead Program," *CRS Report* #RL32929, March 9, 2006, page 21.

[29] John J. Hamre, *Toward a Nuclear Strategy,* Washington Post, May 2, 2005.

[30] Existing warheads and security systems were developed to guard against theft of a warhead and with the expectation that the goal of the thief, working for a government at war with the United States, would be to circumvent the weapon security systems and explode the nuclear warhead at a time and place of its choosing.

[31] "U.S. Nuclear Labs Working on Weapons Safeguards," *Los Angeles Times*, December 5, 2006.

[32] Keith B. Payne, *The Nuclear Posture Review: Setting the Record Straight*, United States Nuclear Strategy Forum (2005), page 12.

[33] Jacques E. C. Hymans, *The Psychology of Nuclear Proliferation*, Cambridge University Press (2006), page 204.

[34] Ibid., page 208.

[35] For recent summaries of U.S. actions that support its NPT Article VI commitments, see the statement by Ambassador Jackie W. Sanders to the 2005 Review Conference of the Treaty on the Non-Proliferation of Nuclear Weapons, *U.S. Implementation of Article VI and the Future of Nuclear Disarmament*, May 2005. Also, John R. Harvey, *U.S. Nuclear Weapon Programs: Implications for Nonproliferation*, Proceedings of NATO Defense College Conference on NATO and the Future of the NPT, September 12, 2006.

[36] Concerns over the growing threat to Japan and uncertainty over U.S. extended deterrence guarantees were featured in "*An Image of Japan in the 21st Century*," a report from the Institute for International Policy Studies, headed by former Japanese Prime Minister Nakasone, issued on September 5, 2006. The report noted the potential for tremendous future change in the international situation. "Japan, maintaining its position as a non-nuclear weapons state and working to strengthen the Nuclear Non-Proliferation Treaty system, should study the nuclear issue in order to be prepared in the event of tremendous future change in the international situation." Former Japanese Prime Minister Nakasone, when questioned by the press on the report, noted that Japan was currently dependent on U.S. nuclear weapons but it is not necessarily known whether that U.S. attitude will continue.

[37] Kurt M. Campbell, Robert J. Einhorn, and Mitchell B. Reiss, *The Nuclear Tipping Point*, Brookings Institute Press, Washington, D.C. (2004) page 321.

[38] U.K. White Paper, "The Future of the United Kingdom's Nuclear Deterrent," December 2006.

[39] See speeches by President Chirac on June 8, 2001, and January 19, 2006.

[40] Russian National Security Strategy: English translation from *Rossiiskaya Gazeta*, January 18, 2000.

[41] *Non-Strategic Nuclear Weapons – Problem of Control and Reduction*, Center for Arms Control, Energy and Environmental Studies, Moscow Institute of Physics and Technology (2004) pages 15-17.

[42] See Russian President Putin's annual address to Russian parliament, in Moscow, May 10, 2006, Translated by Foreign Broadcast Information Service, CEP 20060510950166, Moscow, Rossiya TV.

[43] For example, National defense white papers released by Beijing in 2004 and revised in December 2006 state that China's nuclear force is "responsible for deterring the enemy from using nuclear weapons against China, and carrying out nuclear counter-attacks and precision strikes with conventional missiles."

[44] Department of Defense Annual Report to Congress on the Military Power of the People's Republic of China, (2006), pages 26-27. "IOC" stands for "initial operational capability."

[45] A plutonium facility at Los Alamos National Laboratory is being modified to provide an interim, limited-capacity (30 to 50 pits per year) pit production capability by 2012.

[46] Nuclear Threat Initiative web site (www.nti.org) from China's "Nuclear Profile," sub-heading "Fissile Material," accessed on January 29, 2007.

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