[Editor's note: Glossary not in original]

032206RWWT.doc March 22, 2006

Replacement Warheads Without Testing?

Richard L. Garwin

15-minute presentation to the AAAS-UCS RRW Workshop
Washington, DC, March 23, 2006

Two useful documents on the Reliable Replacement Warhead program-- RRW-- are of relatively recent vintage.[1,2]

However, the need for replacement warheads goes back many decades and has been fulfilled by various programs in updating, remanufacturing, and occasionally substitution. Since the early 1990s the Stockpile Stewardship Program-- SSP-- has been augmented by the Science-Based Stockpile Stewardship Program-- SBSSP-- by which eleven warheads of each type are removed from inventory each year, one of them totally and destructively disassembled, and lessons learned from the process. The process is detailed in Medalia 2006.

My own involvement with these activities began with my intensive work at Los Alamos in 1950, continuing as a consultant to LANL and more recently to Sandia National Laboratory. This has been supplemented particularly in the last 15 years or so by DOE-sponsored work in JASON, directly involved in stockpile stewardship. In addition, there have been studies by the National Academy Committee on International Security and Arms Control-- CISAC-- and its panels, including the 2002 report on "Technical Issues Related to the Comprehensive Nuclear Test Ban Treaty."

It is essential to understand that almost all of the thousands of parts involved in a modern U.S. nuclear weapon are the responsibility of SNL and not of the weapons labs-- LANL and LLNL. In fact, many of the SNL components are not involved in an underground test, since they must be bypassed or otherwise supplemented for full-scale nuclear testing. Among such are the arming, firing, and fuzing systems, including the radar fuze, much of the hardware that is involved in sensing the stockpile-to-target sequence, and even neutron generators.

Furthermore, the SNL responsibilities are eminently testable and there is no bar to upgrading and replacing them when economically justified. Of course, economic justification depends on the number of warheads of a given type that are to be continued in the inventory, since the revision or refurbishment cost has a per-warhead component.

The Tri-Lab paper essentially assumes its conclusions. These are that the cost of maintaining warheads of existing type will increase indefinitely and be intolerable, and that new-design RRW and a "responsive infrastructure" can be achieved, without nuclear testing, and will not only provide replacements for everything that is in the stockpile but also the flexibility for nuclear warheads for new applications in the future. The benefits are supposed to include reduced cost in maintaining a reliable stockpile, and reduced numbers of weapons in the stockpile, since it will no longer be required or demanded that there be a set of replacement warheads to be deployed in case the reliability of a warhead type is questioned.

Unfortunately, the arguments constitute much more of a lawyer's brief than a reasoned argument.

Some supporters of the RRW do not accept these arguments, as indicated by quotations in an Ian Hoffman article of 03/13/2006 quoting Johnny Foster:

---

[1] **Tri-Lab report of May, 2005.**

[2] "Nuclear Weapons: The Reliable Replacement Warhead Program," by Jonathan Medalia (CRS Report for Congress RL32929 updated March 9, 2006).

Former lab head supports Bush's nuke redesign
Plan raises concerns that weapons may be vulnerable to defects
Inside Bay Area
By: Ian Hoffman March 13, 2006

An influential Pentagon adviser on nuclear weapons threw his support last week behind Bush administration plans to redesign the entire U.S. nuclear arsenal but said the nation needs twice as many new bomb designs as insurance against any one of them failing.

Former Lawrence Livermore National Laboratory director and Pentagon research chief Johnny Foster, now co-chair of a Defense Science Board task force on U.S. nuclear capabilities, said even though weapons scientists have found fixes for defects in U.S. nuclear arms, he fears existing and newly designed weapons could be vulnerable to undetected and unforeseen breakdowns.

"We have discovered warheads that would fail to operate properly," Foster said at Sandia National Laboratories-California. "We have also realized failure modes that were overlooked" as weaponeers carried bomb designs from conception to testing to production.

"But what about the possibility that there are still other failure modes that we have not yet discovered?" Foster said. They are "'unknown unknowns' _ Unk Unks, for short."

His answer is a more rigorous hunt for defects in weapons, as well as studies of why those defects were not discovered originally, and a doubling up of nuclear explosive designs capable of riding on the nation's land- and sub-based intercontinental missiles, its bombers and its cruise missiles.

"We should consider deploying two different competitively designed warhead types for each nuclear delivery system," he said. "Then, should a failure mode be discovered in one type, we would have a better chance that the other half of the warheads in that operational system would be reliable and available."

Although Linton Brooks has testified that the RRW should allow the elimination of many of the warheads maintained as an alternative system, Foster does not buy this argument at all.

Lacking from the Tri-Lab paper is any estimate of cost of maintaining the existing warheads through the period when the fruits of the RRW program not only become available but are fully deployed. There are concerns that the Life-Extension Programs-- LEP-- if carried out as planned will make the RRW unnecessary, at least for 30 years or more. This raises the danger that LEPs will be dropped, in order that the RRW should appear essential.

My own voluminous writings touch on the need for RRW. For instance, in a 2001 paper[3] I quote as follows from a 1979 memo from the then-Director of LANL (Harold M. Agnew) to DOE Heaquarters:

"Will the nuclear device work? The reliability of a nuclear weapon (that has been tested) is determined primarily by the reliability of its non-nuclear components and not by its nuclear components. The non-nuclear components can be demonstrated to be statistically reliable to a desired level, normally 98% or better, by doing a sufficient number of non-nuclear local tests. This procedure has not been altered by the Threshold Test Ban Treaty and will not be altered by the Comprehensive Test Ban Treaty. The reliability of the nuclear performance of a weapon is a different matter. It is not a statistical quantity. After a few key nuclear tests are conducted, it is the judgment of the Laboratories, based upon 30 years of design experience, that the nuclear

---

[3] "Maintaining Nuclear Weapons Safe and Reliable Under a CTBT," 02/16/2001, available at www.fas.org/RLG/010216-aaas-htm.

performance is guaranteed if the non-nuclear components function as desired and the nuclear components are maintained in their as-built condition. A very important conclusion, then, is that there has been no reduction in nuclear weapon reliability as a result of the TTBT and that there will be none under a CTBT if we utilize current nuclear systems which have been tested or utilize previously tested nuclear components as subsystems."

Indeed, I challenge the assumption of the Tri-Lab paper and believe that the fruits of the SBSSP are such that the costs of maintaining warheads of existing design will diminish with time, if NNSA so desires, while the assurance of reliability will increase. It is generally agreed that the plutonium pits are extremely well behaved and that accelerated aging tests show that they will last at least 45 and more probably more than 60 years from the time of manufacture. Furthermore, LANL has shown that it can manufacture certifiable pits.

The argument that dangerous materials such as plutonium and beryllium are involved really holds no water in a vital national security program such as maintaining the U.S. nuclear deterrent. Beryllium is an article of commerce, and means for handling it in the nuclear weapons support structure are well established. There is no need to eliminate beryllium from the process.

There is a general confusion as to whether the purpose of the SBSSP is to ensure totally reliable warheads or to ensure that they are as reliable as they were when they were relatively new and validated by underground nuclear testing. There is a significant difference between these two goals. I am quite sure that the nuclear warheads can be maintained as reliable as when they were tested. That does not preclude problems that would have arisen if the warheads were actually called upon to explode near their targets, and it continues to be essential that warheads be tested without nuclear explosion in circumstances that precisely mimic their stockpile-to-target sequence. Much has been learned from such precision tests, and they are in no way precluded by the ban on nuclear explosion testing.

I have long urged that Sandia move aggressively to modernize its processes and product, thoroughly testing the developments and batching the improvements according to what is economically justifiable. In case the SSP shows an unexpected need for early modification of some of the Sandia systems, Sandia should have the flexibility of providing the economically justifiable batched upgrades, which might not be foreseen in the LEP program.

In a 1995 Sandia document[4] there are indications of great peaks in the required remanufacturing capability, but these derive from the assumption that weapons would be remanufactured 30.00 years after they entered into service. Sandia is long overdue in providing an unclassified supplement to that report that smooths the peaks in remanufacturing rate, by remanufacturing some weapons a couple of years earlier (and some a few years later) in order to reduce the investment cost in facilities.

As for the concern that the cold-war nuclear stockpile is not "optimized" for the post-cold-war era, no one can argue with that assertion. But one can argue with the conclusion that a whole new set of weapons needs to be developed and deployed in order to have such an optimum system, or that the optimum would be much better than what we have.

Of course that optimum would include a large component of non-nuclear strategic strike-- something that I have long supported-- and that is most easily realized by non-nuclear weapons on precision maneuvering RVs carried by the existing ICBM or SLBM missiles.

An early entry into the RRW literature was the 2000 paper by Steve Younger, who argued that the factor 5 improvement in U.S. strategic ballistic missile accuracy would allow a factor 125 reduction in explosive yield for destroying a hard target such as a missile silo. So a 500 kt warhead could be

---

[4] K. Johnson, J. Keller, C. Ekdahl, R. Krajcik, L. Salazar, E. Kelly, and R. Paulsen, "Stockpile Surveillance: Past and Future," Sandia Report SAND95-2751.

replaced by a 4-kt new-design warhead that could be deployed without testing and that would be reliable and safe.

I discussed this matter with Steve Younger, pointing out that the U.S. already had "5 kt" warheads in essentially every one of its strategic weapons. This could be achieved by using the boosted primary yield without any secondary yield, if one so wished. Indeed one should review the stockpile yield-select choices and make modifications to those weapons that do not have at least the three readily attainable yields-- unboosted primary, boosted primary, and full-up secondary yield.

In general, I believe that when the assumptions for the RRW program are replaced by analysis, and the necessary overlap between existing nuclear warheads under their LEPs are included, together with the costs, that the RRW will offer only risk in comparison with a more measured modernization of the nuclear weapon infrastructure and a program based on the SBSSP and remanufacture of nuclear weapons to fit the initial parameter spread as built.

Bureaucratically there is a great appeal to a vision such as the RRW, but we have too many examples of such approaches sinking without a trace, such as the Moon-Mars Initiative of President George H.W. Bush. What we need is to encourage flexibility in the DOE/NNSA budgeting and programming, so that the future is not mortgaged to a defined set of LEPs that are as much workload leveling as driven by need.

Recognizing that at some time in the future some specific weapons might be more reliable than others of that same type, we need also the military flexibility to use first the weapons that are in better shape, despite the desire that all be perfect at all times.

RLG:jah:6081RWWT:032206RWWT

[Editor's note: glossary provided by Nuclear Watch New Mexico]

GLOSSARY

ICMB- Intercontinental Ballistic Missile

JASON- a group of eminent scientists who have long advised the federal government on nuclear weapons issues

kt- kiloton, unit of explosive force equal to 1,000 metric tons of TNT. For example, the nuclear weapons that destroyed Nagasaki had a yield of around 15 kt. Modern nuclear weapons can have yields of 1,000 kt (a megaton) or more.

LEPs- Life Extension Programs, current programs seeking to extend the operational lifetimes of US nuclear weapons to 30 to 40 years and in some cases "improve" their military characteristics.

LANL- Los Alamos National Laboratory, responsible for nuclear designs
Linton Brooks- head of the National Nuclear Security Administration (NNSA), the semi-autonomous nuclear weapons agency within the Department of Energy.

LLNL- Lawrence Livermore National Laboratory, responsible for nuclear designs

RRW- Reliable Replacement Warhead
(for more, see http://www.ananuclear.org/dc_days06/RRW2006.pdf)

RVs- Reentry vehicles that carry nuclear warheads after re-entering the atmosphere during the trajectory of an ICBM or SLBM.

SLBM- Submarine Launched Ballistic Missile

SNL- Sandia National Laboratories, responsible for nuclear weapons engineering

SSP- Stockpile Stewardship Program, whose purported purpose is to ensure nuclear weapons reliability. Despite $68 billion spent since 1994, the weapons labs are now claiming that the program is no longer sustainable and that the Reliable Replacement Warhead program is needed.

Steve Younger- Nuclear weapons theoretician and scientist, mostly at LANL
(for more see http://www.nukewatch.org/importantdocs/resources/NuclearWeaponsIn21stCentury.pdf)

Tri-Lab Report- "Sustaining the Nuclear Enterprise", LANL, LLNL, SNL, May, 2005 (see http://www.nukewatch.org/facts/nwd/SustainingtheEnterprise.pdf)