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THE RELIABLE REPLACEMENT WARHEAD

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Thank you for the invitation to provide my view on the RRW and its implications for the broader U.S. nuclear weapons policy and program. I emphasize that these are my personal views.

The RRW program has been presented as a means for ensuring the safety and reliability of the U.S. nuclear weapons stockpile without nuclear explosive testing. It has also been advocated as a means for maintaining the competence of the nuclear weapon complex, and for obtaining major savings in cost. It has also been characterized as permitting substantial reductions in stockpile numbers, to avoid the necessity of having replacement warheads or systems that are not deployed, that could be deployed in case of a major failure in some deployed system. The RRW program has also been seen as a means of introducing greater safety and surety than is available in the current stockpile-- for instance by the introduction of insensitive high explosive-- IHE-- instead of the conventional explosive in our deployed nuclear weapons.

I have worked with nuclear weapons since my first long summer in Los Alamos in 1950 as a consultant to the Laboratory, where I was much involved in matters of nuclear weapon design and testing. I contributed substantially to the design of the first U.S. thermonuclear weapons and have remained a consultant to Los Alamos and more recently to Sandia National Laboratories to the present. I am also a member of the JASON group of consultants that has for the last 15 years at least worked for the Department of Energy and the NNSA on technical matters of stockpile stewardship. The NNSA announcement of November 2006 that the Los Alamos and Lawrence Livermore National Laboratories now conclude that the lifetime of existing U.S. nuclear weapon pits exceeded 85 years rather than the previous assurance of 45 years longevity mentioned also the work of the JASON group endorsing that conclusion and pointing out that the Laboratory data supported a 100+ year longevity if minor modifications were made in the case of a few systems, that are, in fact, in the course of being made.

I address the RRW question in five categories-- confidence, cost, safety and surety, the health of the laboratory design effort, and the question of nuclear testing.

1. CONFIDENCE.

I do not agree with the generally stated assumption that confidence in the reliability of our existing nuclear weapons will inevitably decline with time as weapons age. It is usually stated that the accumulation of minor modifications with time will move the weapons farther from their nuclear test pedigree and thus inevitably reduce confidence in their performance. On the contrary, the Science-Based Stockpile Stewardship Program and in particular the advanced scientific computing capabilities that have been procured at great cost over the last 15 years of the Stockpile Stewardship Program have paid off handsomely, as indicated, in confidence in increased pit longevity. Thus in the case of the essential and sensitive thermonuclear weapon primaries, the passage of time has brought greater, not lesser, confidence in pit longevity.

Over the years I have reviewed the analysis of significant findings in the Stockpile Stewardship Program, most of which, of course, are not related to the nuclear package but rather to batteries, contacts, and other aspects of the nuclear weapon that are not tested in an underground nuclear explosion and that can be thoroughly tested without a nuclear explosion and are subject to correction or replacement. Of course, any substitution or modification of the nuclear weapon must be done with great care and responsibility, in order that there not be unintended consequences on the weapon performance. Now the Advanced Simulation and Computing program--ASC, formerly ASCI, the Accelerated Scientific Computing Initiative-- permits a full assessment of the weapon performance, as a weapon will exist after the proposed change, for comparison with the weapon as it was tested.

In fact, the stockpile weapons, as gradually modified, are closer to the test pedigree than is either of the RRW designs to a nuclear test explosion.

With the passage of time and the improvement in computing tools, I believe that confidence in the reliability of the existing ("legacy") weapons will increase rather than diminish, just as has been the case with the nuclear weapon pits.

It follows that the proposed reductions in stockpile numbers that are supposed to be enabled by the deployment of the RRW could more confidently be obtained with the legacy weapons and such reductions need not wait for the advent and entry into the stockpile of large numbers of RRW, which would not happen, I estimate, before about 2020.

In fact, Dr. John S. Foster, a former director of LLNL, has expressed his discomfort with reliance on any single RRW design, in view of the incidence of "birth defects" or design failures, with which we have had experience in the past[1].

2. COST.

[1] Ian Hoffman, Oakland Tribune, March 13, 2006.

It is claimed that the RRW program will allow a major reduction in cost of the nuclear weapons infrastructure, in view of the elimination of environmentally problematical materials, of which the most prominent is beryllium, not present in either of the RRW designs. Furthermore, the highly wasteful process that has been used for the manufacture of the uranium radiation case for these thermonuclear weapons would not be involved in the RRW.

But the RRW will not replace the legacy weapons until some years after the first production unit of the RRW, and legacy weapons will need to be dismantled for years after that, so beryllium will still be involved for a long time. In order for the DOE or for the Congress to judge the validity and magnitude of projected cost savings, there needs to be a detailed breakdown of costs by activity and year. Ultimately when the legacy weapons on the one hand would need to be remanufactured, or the RRW on the other hand would eventually need to be remanufactured as well, the simplified manufacturing and assembly procedures of the RRW would almost certainly provide a cost saving, but that is a long way in the future.

The Office of Management and Budget has long provided a mechanism for evaluation of a particular program by means of the discounted present value of the stream of costs and benefits, and that is what NNSA needs to use in making its decision, and the Congress needs to review such a detailed assessment in arriving at its own responsible judgment.

3. SAFETY AND SURETY.

Present nuclear weapons have conventional high explosive-- CHE. They are "one-point safe" in that no significant nuclear yield would be obtained by the accidental detonation of the explosive at any point, as by a rifle bullet or other accident. The LLNL design for the RRW, like the LANL design, uses insensitive high explosive-- IHE-- so that it would not be detonated by a rifle bullet. Furthermore, a new design could use a fire resistant pit, which is not universal among deployed nuclear weapons. This would avoid the scattering of plutonium that would otherwise occur and that would necessitate costly cleanup such as performed at Palomares, Spain, following the accident in which four thermonuclear weapons were dropped and in two of them the CHE exploded and scattered plutonium.

U.S. nuclear weapons are much safer since that time, since we no longer practice airborne alert, there are a lot fewer nuclear weapons, and handling procedures have been improved. Since there is no possibility of nuclear explosion with existing weapons according to the stringent design criteria, the safety concerns and costs of accidents can be folded into the stream of costs and benefits.

Surety is another matter. This is the resistance of a nuclear weapon to being fired with full or very substantial nuclear yield, without proper authorization. Bombs and other tactical weapons have Permissive Action Links and every U.S. nuclear weapon must require its explosive system to be initiated at two or more points, else it would not be one-point safe. A concern is that a nuclear weapon might be stolen or otherwise obtained by terrorists or some other group, and over the course of hours, days, or months, might be disassembled in an effort to defeat the PAL or other surety mechanisms that are built into the weapon. A new design such as the RRW gives the opportunity of surety features that were not or could not have been incorporated into the legacy weapons. On this topic I cannot say more. However, this question of preventing adverse use of our own weapons is important. "Nirvana for me is if the wrong person gets a hold of it, it's a paperweight," General James Cartwright has said.   "That's where we need to be."

However, whether a terrorist acquires a couple of legacy weapons such as the W-76 or the RRW, the weapon could ultimately be disassembled and the plutonium metal recast to make the plutonium sphere for a first-generation bomb such as that used to destroy Nagasaki. Whereas 6 kg of plutonium was used in the first implosion weapons, the average nuclear weapon has less Pu, so a single modern weapon would probably not suffice. Neither the RRW nor the legacy weapons are likely to be proof against being used in this way as a source of weapon material. However, a weapon may be a more difficult target than the hundreds of tons of highly enriched uranium and military and "civil" plutonium that could also be the target of terrorist activities.

Just as LLNL has indicated that it may incorporate into the RRW program some of the features of the LANL design, some of the lessons of surety learned from the RRW design program could be used to further improve surety for existing weapons by their incorporation in the transport container, for instance. Whether RRW goes forward or not, such technical transfusion might significantly increase the surety of the existing weapons, and at an early date.

4. THE HEALTH OF THE LABORATORY DESIGN EFFORT.

For at least three decades directors of weapon laboratories have told me that a major concern is their ability to attract and motivate outstanding individuals for the weapon design effort. In the CTBT era and after the end of the Cold War, we are not actively designing new nuclear weapons, but the situation may change and the laboratories feel their responsibility to maintain the capability to design new nuclear weapons.

In the 1970s and 1980s, the Laboratories resisted a ban on nuclear explosion tests, in good part because they felt that the designers needed the ultimate confrontation with reality provided by such a test in order to keep the design effort from spinning off to nuclear packages that might depart farther and farther from reality. The enormous development of computing capability, in the context of the test moratorium since 1992 and the CTBT of 1996 have substituted computational and laboratory tests for nuclear explosion tests, but we are still rightly reluctant to depend on the computations for anything that departs very far from what has been confirmed by nuclear testing.

The RRW competition has been a source of intense stimulation and excitement for the Laboratories. It has revivified the design community and by its nature has opened and strengthened communication between the nuclear weapon designers and the engineering and production complex. This has been of great benefit to the U.S. nuclear weapon complex.

I point out, however, that this benefit would not be much further strengthened by continuing to production of the RRW. Nor would this one-time benefit be adequate if there were no further RRW designs.

Paradoxically, this stimulation could be obtained by a new design effort every 5-8 years, independent of whether a design moved to production or not.

5. THE QUESTION OF NUCLEAR TESTING.

The March 2, 2007 NNSA announcement of the RRW selection quotes NNSA Acting Administrator Thomas P. D'Agostino:

> *"Both teams developed brilliant designs," said D'Agostino. "Because of the superior science across the nuclear weapons complex with assets like supercomputers, and the early design engagement with the production facilities, the laboratories were able to develop designs in nine months that were much more mature than they would have been after two years of work during the Cold War. This is an amazing scientific accomplishment that should not be overlooked."*
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> *The two nuclear weapons laboratories both submitted designs that fully met all RRW requirements. However, D'Agostino noted that higher confidence in the ability to certify the Livermore design without underground nuclear testing was the primary reason for its selection. That design was more closely tied to previous underground testing. While one of several factors, it was an especially important one to assure long-term confidence in the reliability of the nuclear weapons stockpile.*

The technical question as to whether the weapon can with confidence be placed into the stockpile after development but without nuclear explosion testing deserves more study, and I must state that the JASON group is under contract to study this for NNSA, with the bulk of the work to be completed this summer. But two comments may be made right now.

The first is a narrow comment reflecting the prominence given to the requirement to put the weapon into service without testing-- that the "primary reason" for selecting the Livermore design over the Los Alamos design was that it was closer to the test experience. One can have more confidence, and even much more confidence, in A than in B, but that is still not absolute confidence.

Beyond the technical judgment of engineers and scientists, however, is the question whether at some future time after the weapon enters into service there may be political questioning by some president or presidential hopeful, or even by some future STRATCOM commander about the wisdom of having a growing stockpile of untested nuclear weapons. It seems likely that such high-level concerns would lead to a nuclear explosion test, despite the U.S. being a signatory to the CTBT, without having yet ratified that Treaty. Even if two or three years later the stockpile RRW passes its nuclear explosion test with flying colors, the United States will have incurred the political, proliferation, and security costs of having its rivals and perhaps other countries conduct nuclear explosion tests that will very substantially advance the state of the nuclear weapons art in their countries.

For instance, it is widely believed that China would require a nuclear test before deploying MIRVs on a mobile ICBM. Like the U.S., China is a signatory but has not yet ratified the 1996 CTBT, but it is difficult to believe that China would not conduct a nuclear test if the United States did so. And with a U.S. nuclear test in prospect, China and potential proliferators might not wait until the U.S. actually tested an RRW. By virtue of the test readiness maintained by the United States and the calls for reducing the delay that would ensue after a decision to test, China or other states might not find much solace in the present U.S. conviction that the RRW will not require a test to put it into the inventory.

The French weapons establishment, the CEA, in its annual report stated with pride that the CEA had been able to accept a new warhead for its submarine fleet into the inventory without nuclear testing, by virtue of the highly competent calculation facilities available to CEA. Nevertheless, with the change of administration from Francois Mitterand to Jacques Chirac, France decided to conduct a quick series of eight nuclear explosion tests at their site in the Pacific.

The series was terminated after six tests. I had commented on international radio and television that this test series was not a bad thing if it could lead France to sign the CTBT, and indeed France and the U.S. were the first signatories to that Treaty. In a CTBT era, however, a nuclear explosion test by the United States would have major adverse security consequences.

I now summarize my review of the RRW. As for CONFIDENCE, I do believe that the legacy weapons and their life extension programs-- LEPs-- provide us with confidence in the reliability of the existing stockpile. The November 2006 NNSA announcement of pit lifetimes in excess of 85 years gives us another 40 years to validate the pit production facility at LANL or its reproduction elsewhere. RRW has yet to earn that confidence. I urge that the life-extension programs not be curtailed in anticipation of an RRW.

The COST of the RRW program is unknown and the program must be broken down into work packages with costs attached to each. Fundamentally, though, there will be a long period of overlap between traditional U.S. nuclear weapons and a full RRW fleet, during which the cost of both programs will be incurred. In particular, DOE and the Congress need a discounted present value analysis of the nuclear stockpile with and without RRW.

RRW can incorporate advances in SAFETY and SURETY. In my judgment, legacy weapons are safe enough, especially in view of their reduced numbers and the lack of airborne alert. Surety improvements in the RRW are sound but not absolute, and the vulnerability of legacy weapons must be placed in context with other means for acquiring weapon-usable material. In any case, legacy weapons are going to be with us for a long time and whatever surety improvements can be incorporated into the handling facilities, if not into the weapons themselves, should be justified and pursued, if cost-effective.

The laboratory DESIGN EFFORT has been reinvigorated by the RRW competition. However, those benefits come in the design activity itself, and to my mind would not be much increased by carrying the RRW to production and deployment. The weapons plants and infrastructure do need attention, but I have not studied them sufficiently to compare what could be done, for instance, by a sound management approach to partial consolidation and improvement of the infrastructure, in comparison with essentially full centralization.

Finally, the question of NUCLEAR TESTING is important. U.S. national security would almost surely be impaired if after RRW was deployed it had to be tested. In a CTBT era this would be nothing short of disastrous and would not only call forth nuclear explosion tests by some of our rivals such as China and Russia, but would largely destroy the era of restraint among those countries choosing to remain without nuclear weapons.

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