Questions for U.S. Nuclear Weapons Policy in the 21st Century
or "Where does a successful Stockpile Stewardship Program lead?"

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The past few years have featured a Robust Nuclear Earth Penetrator, and now the Reliable Replacement Warhead in discussions of the U.S. nuclear weapons arsenal. More generally, there is talk of "transforming the enterprise" of the nuclear weapons complex, and of the United States making significant long-term investments in such infrastructure as a Modern Pit Facility.

It is good that there are ongoing discussions about the U.S. nuclear weapons stockpile, for we cannot let the responsibility of possessing such an arsenal stagnate due to lack of attention. However, the current discussions are severely limited by being overly narrow, and by being pursued without the broader context of a long-term strategy for U.S. nuclear weapons policy (*1*).

The Cold War has been over for more than 15 years, yet many of the features of the arsenal – and its potential use – are legacies of that period. The mandate to U.S. military, intelligence and law-enforcement as of 9/11, to focus first and foremost on countering terrorism, has not been thoroughly factored into the discussion.

For these reasons, key individuals, including General Cartwright, Commander of U.S. Strategic Command, have called for a national debate about our nuclear weapons arsenal (*2*). I applaud the Arms Control Association – and other organizations – for responding to this call. The need is for a broad discussion, informed by technical and military considerations, and spanning the political spectrum as well as the spread of views about arms control and international security.

Stockpile Stewardship

To inform this discussion, let's review the past 10 years' accomplishments. I come to you as a technical person, with experience in science and engineering. An outsider, not directly engaged in the nuclear weapons enterprise, I can only present my personal views based on experience as an advisor and external reviewer of many parts of the enterprise.

With that background, I am pleased to say that the NNSA's Stockpile Stewardship Program has been an amazing success. I had nothing to do with creating this program, and can understand why there may have been concerns as it was being established. Even the most skeptical experts, however, acknowledge the overwhelming success of the program to date. It has indeed confirmed the U.S.' ability to sustain our enduring nuclear weapons stockpile based on a scientific approach.

What supports this conclusion? I can identify at least three key indicators of success. First, there was the success in recapturing the ability to construct certifiable pits – the core of the first stage

of a modern thermonuclear weapon – at Los Alamos. Personally, I had no doubts that this would be possible, but I wish to emphasize the magnitude of the accomplishment by noting that significantly new processes had to be developed. After all, Rocky Flats was shut down because its manufacturing processes were untenable, and ultimately considered illegal. The successful transition to new people running new processes in a new location proves, as much as anything, that the U.S. nuclear weapons complex has significant resilience and capability for sustaining the legacy arsenal.

The second example is the ongoing effort to document the effects of aging of materials, components and even systems within our nuclear arsenal. Advances in the basic science allowing us to understand plutonium, high explosives and the many other components of nuclear weapons are truly impressive. This is not a matter of mindless technicians filling out checklists. To the contrary, there has been an enormous intellectual challenge to the creativity of researchers, for example in identifying new ways of validating results that have previously been poorly characterized: what new experiments can really test (that is, reinforce or refute) results from the past, and how can the assumptions embedded in computer simulations be strenuously evaluated?

The remarkable finding is that key materials making up the nuclear explosive package (NEP) are far more stable and predictable than anyone would have anticipated. Recent developments reinforce the conclusion that Pu pits in the U.S. stockpile are stable over periods of at least 50-60 years (*3*), and probably much longer. To be sure, new phenomena may appear in the future, but these will be uncovered through ongoing work, such as accelerated aging experiments. Meanwhile, the technical conclusion is that we do have time for a thorough and well-informed discussion of U.S. nuclear weapons policy.

Finally, I want to point to the accomplishments of the life extension programs (LEPs), by which individual weapon systems are examined and refurbished so as to be stockpiled in our arsenal for another tour of duty. Humdrum to some, this activity has been at the heart of inserting more science into the U.S. nuclear weapons enterprise. The materials and components, as well as the processes associated with everything from testing to re-manufacturing of components, have been thoroughly vetted and documented at a level that was previously not possible.

Many focus on delays and cost over-runs, neglecting to acknowledge how profound this accomplishment really is. The enterprise has successfully established mechanisms by which objective approaches replace best guesses, engineering judgement and such non-scientific concepts as "unknown unknowns."

Put another way, the enterprise has undergone a major transformation, and established quantitative guidelines that competent staff will be able to follow into the future. The performance margins of weapon systems are now quantified, with uncertainties and even estimates of the reliability of these uncertainties being established. Also, performance margins can be increased, and this is being done in the enduring stockpile as appropriate.

In this light, it is astounding the degree to which key individuals, whether at a laboratory or in Washington, have refused to acknowledge these accomplishments. For example, there are still

some who proclaim that the U.S. is unable to build a modern nuclear weapon – evidence to the contrary notwithstanding. Meanwhile, we have gone a decade with the enduring stockpile being assessed each year as safe, reliable and effective.

It is our nation's responsibility, as long as we have a nuclear arsenal, to ensure that it is supported by capable people – incompetence in this domain would be a disaster. It is therefore essential that the U.S. retain core capability in nuclear weapons technology. Stockpile Stewardship has been remarkably successful, not only in maintaining our enduring arsenal but also in sustaining that technical capability.

Reliable Replacement Warhead

Given the success of Stockpile Stewardship, is there a rationale for the Reliable Replacement Warhead (RRW)? In my view, the answer may be "Yes," but it is too early to tell because the concept is as yet ill defined. Congress has established the following characteristics for RRW, as the concept is being explored: 1) it is to make the U.S. nuclear weapons enterprise less costly, more effective and generally more efficient; 2) it is to avoid requiring the nation to resume underground nuclear-explosion testing (which I will also call "underground testing" for short); and 3) it is to involve no new military requirements. That is, no new military missions are being considered.

A rationale one can understand for RRW is that something new is needed in order to respond to the policy decision, supported by the 2002 Treaty of Moscow, to significantly reduce the U.S. nuclear weapons arsenal over the coming years. Given that Stockpile Stewardship has successfully demonstrated our country's ability to sustain the enduring arsenal, the added requirements imposed by reducing or eliminating the need for a non-deployed responsive force – reducing the *total* arsenal to 2000 and perhaps smaller numbers thereafter – could well justify a new program such as RRW. In some sense, the smaller the arsenal the greater the reliability required of each individual weapon, as distinct from each class (or design) of weapon.

The key motivation for RRW would therefore be to support the decision to significantly reduce the arsenal. Without that reduction, there is no widely-accepted motivation for a new Reliable Replacement Warhead Program. As citizens, we all want the enterprise to be as efficient and cost-effective as possible, but it is unclear that a new program is the best approach for accomplishing this. Technical issues such as the presence of conventional high explosives in certain systems are red herrings. Similarly, plutonium aging does not force us to a decision point at present.

Along these lines, the claim that RRW will help maintain nuclear-weapons design expertise is limited and perhaps counterproductive. After all, if the condition is to avoid underground testing, the RRW has to be well within design parameters that have been thoroughly established through past underground nuclear-explosion tests; technically put, they have to be interpolated between, rather than extrapolated from, validated parameters, no matter how much one enhances margins or performs high-end computer simulations.

In my view, this means that the appropriate terminology is to label RRW, not a new design or a re-design but a limited modification of existing designs: that is, limited within experimentally established design parameters. To be sure, one is potentially extending the concept of a modification from the region outside the nuclear explosion package, to the deep interior of the NEP – if that is feasible, which has yet to be determined. I say this forcefully because it will not be up to the present laboratory directors, NNSA or DoD leadership, or even the current President to decide if an RRW has to be proven through an underground test. That will be the responsibility of a future President.

Therefore, the only way for RRW – as presently defined – to succeed is to ensure that it is not a "new design," but is instead well within the design parameters that have a test pedigree. This approach is fully compatible with, and may depend on, the requirement of no new military missions. Best of all, Stockpile Stewardship has demonstrated that the nuclear weapons complex is in principle up to the task of providing the necessary objective requirements – the scientifically established parameters – which could assure any responsible individual, now or in the future, that the RRW design does not require underground testing.

To clarify, I do not rule out the possibility that the U.S. will perform underground nuclear-explosion tests in the future. There may be various reasons for calling on the resumption of such tests, including purely political ones. My only point is that RRW can, if properly managed, be pursued without imposing a technical requirement for such testing in the future. I fear, however, that some who discuss RRW are not using the kind of language that would reassure one on this count.

Moreover, we have precious little objective analysis of the influence exerted worldwide, on attitudes about nuclear weapons, on nuclear proliferation and on global security, as we in the U.S. discuss – or fail to discuss – various options regarding our nuclear arsenal and policies. Why does our dialog often amount to no more than personal opinions about whether and how what we in the U.S. do have influence on others? Why have we failed to develop a more complete and nuanced understanding of how pursuing new designs, reinvigorating our nuclear complex and maintaining reliance on our nuclear deterrent does – or does not – contribute to global proliferation and insecurity?

Future Stockpile

Given that RRW is connected with a greatly reduced stockpile, where are we headed with the U.S. nuclear weapons arsenal? The over-arching strategy has yet to be debated, but it is possible to lay out many of the key issues that need to be addressed.

I would emphasize that it is in any case essential for the U.S. to maintain core technical capability – that is, knowledge and expertise – in nuclear weapons. This is so, not only in order to ensure responsible stewardship of our future arsenal, whatever it becomes. But also in order to maintain awareness of the very real threats that can emerge worldwide. The technology associated with nuclear weapons is inexorably spreading, and many new countries are likely to

be latent nuclear-weapons states – that is, have the capability to develop a nuclear arsenal even if they don't have one – within the coming generation.

We all acknowledge that the enduring U.S. arsenal is a legacy of the Cold War. The conclusion that "we have the wrong arsenal" does not follow, however. Of course we would build a different arsenal, or perhaps no arsenal, were we to start now, in the post-9/11 era, to consider arming ourselves with nuclear weapons for the first time. In particular, we would no doubt see the world in very different terms than was the case when atom bombs were first developed, during World War II, or during the Cold-War buildup of the 1950s through the 80s. We now see many countries that can soon develop, or acquire, the requisite technologies, and the concept of latency increasingly blurs the separation between nuclear and non-nuclear weapons states.

In fact, there is only one characteristic of our present arsenal that we all agree is wrong, and that is its size. It is notable, in this regard, that Congress has repeatedly taken the position that no new military requirements are to be contemplated for our nuclear weapons; more generally, Congress has acted on the basis that what the U.S. says and how we act do have a significant impact around the world.

That said, if we take a total projected arsenal size of 2000 as "status quo," we can ask if there are any conditions under which we would feel compelled to increase it again. Presumably, this would only happen in response to a significant collapse in international relations. But would another nation developing an arsenal of similar or greater size necessarily lead us to building up our stockpile, as in the Cold War?

To answer that, one needs a clear idea of why the U.S. possesses a nuclear arsenal. The traditional response is that it acts as the ultimate deterrent in case the existence of the Nation is at stake. However, in the post-9/11 era, focused on terrorism and – quite appropriately – concerned with nuclear proliferation, it is not at all obvious that repeating the Cold-War buildup would in any way be to our benefit.

Similarly, one can ask how small the nuclear arsenal should be, or even if the U.S. should have one. Here I would challenge my colleagues who advocate the U.S. relinquishing our nuclear arsenal to clarify what this would mean, both to us and to the rest of the world. Who would assume other than that the U.S. could quickly reconstitute a small arsenal in an emergency, and a substantial arsenal if international relations were in the process of dissolving?

I am reminded of a senior member of one of the national security laboratories describing the ultimate with regards to the new triad's "responsive infrastructure," namely that the U.S. would have no nuclear arsenal at all but would have the capability to produce weapons if urgently needed. In fact, considering the hypothetical scenario that the U.S. abolishes its nuclear weapons, there would presumably be a period of time – perhaps extensive – during which weapon components would still exist. Would this represent a close approach to our stated obligations under Article VI of the Nuclear Non-Proliferation Treaty?

Short of abolishing the stockpile, how small an arsenal is compatible with our 21st Century security needs? Is 1000 the right number, as has been advocated in an Arms Control Association

publication and elsewhere in the past year (*4, 5*)? Or is 200 enough, a number comparable to or larger than the reported sizes of most other nuclear stockpiles? And what would we expect of our international partners in return for such reduced stockpiles? What specific technical requirements would need to be met within our own nuclear weapons arsenal and complex to allow us to contemplate such reductions?

In any case, evolution of stockpiles – ours and others – below 2000 would presumably require a strategy for staging reductions. This has led to strong calls for much enhanced transparency, and for more straightforward accountability, eliminating for example the distinction between "operationally deployed" and "responsive" or reserve forces. The role of non-strategic weapons around the world also needs to be clarified, with a strong incentive to eliminate smaller nuclear systems that are perceived as being especially vulnerable to theft or loss.

Of course, numbers are not the only consideration. Are there any post-Cold War scenarios under which the U.S. would need to launch a nuclear attack in less than, say, 1 day? How about 1 week, or 1 month? What tradeoffs exist between the size and constitution of our enduring arsenal, and the anticipated time-scales over which a decision would be made to use it? The logistics of the platforms carrying these weapons is, of course, an important part of the calculus.

To close, I have not come here to provide specific answers to these questions. My purpose, instead, has been to highlight the capability and resilience of the U.S.' nuclear weapons enterprise, which gives us the opportunity – and the responsibility – to thoroughly discuss post Cold-War nuclear weapons policy. And I have touched on a few of the questions that need to be addressed, openly and honestly as we and other nations of the world address the role of nuclear weapons in the 21st Century.

Thank You

1) Committee on International Security and Arms Control, National Academy of Sciences, *The Future of U.S. Nuclear Weapons Policy*, National Academy Press, Washington, DC, 110 pp. (1997).
2) J. E. Cartwright, Statement before the Senate Armed Services Committee, Strategic Forces Subcommittee, on *Strategic Forces and Nuclear Weapons Issues in Review of the Defense Authorization Request for Fiscal Year 2006* (April 4, 2005).
3) R. Jeanloz, Science-based stockpile stewardship, *Physics Today*, 53, 44-50 (2000).
4) S. D. Drell and J. E. Goodby, *What are Nuclear Weapons For? Recommendations for Restructuring U.S. Strategic Nuclear Forces*, Arms Control Association, Washington, DC, 32 pp. (2005).
5) J. Deutch, A nuclear posture for today, *Foreign Affairs*, 84, 49-60 (2005).

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