Maintaining a Viable Nuclear Weapons Program in a Test Ban Environment: A Strong Technical Foundation in the Laboratories

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- Background: The Administration and Senate are at "loggerheads" over whether the Comprehensive Test Ban (CTBT), as submitted, is the best way to assure US and worldwide peace and security over the long term.

- Nuclear weapons have provided the cornerstone for US national security for more than fifty years, and their role in preventing major global war over this period is undeniable.

- As the world evolves from the bilateral standoff of the Cold War—in retrospect a remarkably stable period—to a multipolar World, what will be the role of nuclear deterrence in preventing wars and capping the level of conflict if a regional war should occur?

- The current stalemate is a clash of views between:

  the far left, who press for the elimination of weapons at the earliest time, and

  the far right, who press for the creation of a missile defense system, in the belief that it could eliminate the threat that nuclear weapons increasingly play to US territory, allies, and interests.

- I represent a more centrist view. I do not know how to eliminate nuclear weapons from the world scene; nor is it obvious to me that the world would be necessarily a better place if nuclear weapons were eliminated, particularly if the world once again became enveloped in world wars.

- It is prudent that the US continue to maintain a robust retaliatory force of nuclear weapons for the foreseeable future.

- The CTBT debate has made the US nuclear laboratories the losers on both sides; even the far right neglects the importance of an offensive retaliatory force, which would surely come into play after a missile attack. Yet if we are to have the option to maintain a nuclear deterrent over the long term, we must maintain robust and capable nuclear weapons laboratories.

- It was the triumph of US science and engineering that placed in our hands this most potent stockpile of nuclear weapons in the first place, and which kept it vital throughout the Cold War years.

- We must not lose sight of the role of the laboratories, and we must find ways to strengthen and revitalize these institutions to fulfill their missions under changing circumstances.

- As we come to a transition point in Presidential administrations, it is appropriate that we examine the condition of the weapons themselves, as well as the condition of the laboratories which design them and maintain responsibility for their safety and reliability. How can we keep both of them not only viable but second to none?

- Studies of the past five months have concluded that the program is "stretched far too tightly." Unfortunately, the debate within the government could not resolve whether this resulted from insufficient funding or "too much program." I would have gone further in suggesting that we are about to hand a new administration a program that I believe is badly under-funded, in DoD, DOE, labs, plants, and the infrastructures that support them. Yet, I do not believe the solution should be to raise the problems within the nuclear weapons program as a partisan, political issue in this, an election year. I've worked throughout my career to prevent this from happening.

- To prevent it, we must go back to examine the choices made in the past, review their rationale from today's vantage point, and come up with a true system solution that preserves for the nation its most valued strategic strength over the long term—30 to 50 years, or more.

- Can you imagine just how hard it is for even the best scientists and engineers to be confident that they can assure the reliability and the safety of US nuclear weapons in a regimen where they cannot design, build, nor test them? Further, how much more difficult does it become:
  - as the experts who design, certify, manufacture, and diagnose them retire?

  - as the components and the weapons themselves age beyond their design lifetimes?
  - with a production complex that can no longer manufacture certain key weapons parts, and no longer has a surge capacity for the rest?

- Our laboratory—Sandia—is responsible for nearly all of the nonnuclear subsystems and for the ordnance engineering required to pair these subsystems with the nuclear subsystem and the military delivery systems. These tasks include the design and development of many electronic systems, whose performance characteristics and reliability must exceed anything available in industry.

- In most parts of our laboratory, we remain at the leading edge of electronics capabilities. In collaboration with our sister labs, Lawrence Livermore and Lawrence Berkeley, we have a multi-hundred million dollar project—financed by US industry—to bring to first production the manufacture of the most advanced microcircuits yet conceived [less than 0.1-micron feature size]. Yet the electronics in the US stockpile are all sufficiently aged as to be either obsolete or "sun-setted" [functional, although nearing the end of their useful life and no longer manufactured]. Some stockpile weapons still have vacuum tubes within them—not for hardness, but because that was the best technology available when they were designed.

- We have put into place an enhanced surveillance capability to monitor the health of these older technology components and subsystems. This is a considerable workload, and it increases each year as the stockpile systems continue to age. We continue to undertake some "fixes" to specific stockpile components each year, but our "watch list" of anomalies is growing a little each year.

- We are developing plans to refurbish the electronics components within the US stockpile, replacing older components with modern ones. Since the most crucial aspect of achieving the extremely high reliability goals is how these components will function together as a system, I have proposed that we adopt a philosophy of replacing only those older systems that are provably better in reliability, safety, or use control. These judgments cannot be made in the same manner as we would have attempted in the past; indeed the new modeling/simulation and test capabilities will greatly aid this task and may well be crucial, particularly in the absence of full systems tests.

- We are betting much of our future ability to bring leading-edge electronics once again into the US stockpile on the development of a new complex we call MESA, for Microsystems and Engineering Sciences Applications. This $350 million line-item project will allow us to modernize warhead electronics, optics, and mechanical components in an integrated way, harnessing directly the new computer-based design and collaboration tools and technologies we have been developing over the past five years. This complex will house the best and the brightest workers in advanced electronics, photonics, and microsystems technologies; will connect them to other specialists through large design networks; and will provide advanced prototyping facilities for improving the safety, fusing, and use-control features in the future.

- In the debate over CTBT ratification, much attention was focused on what I believe to be a misdirected question: Is stockpile stewardship working or not?

- Larry Welch, in his paper "A Workable Strategy" suggests that the confusion resulted from a mistaken view that "SSP is a destination. In fact, it is a journey." The US program in nuclear weapons research, development, design, and production has been deeply rooted in scientific excellence throughout its history.

- Sandia has made major steps forward in developing better understanding and better design tools for neutron generators—critical components of nuclear weapons for which we have both design and production responsibility. The advanced computer modeling systems have been combined with aboveground experiments (test simulators)—the pulsed power Z Machine and the Sandia Pulsed Reactor—to do a remarkable job of evaluating the performance of these systems under the conditions of hostile radiation. I have no hesitancy to say that in some ways these recent techniques are giving us better analysis than could have been provided in the underground test environments on which we relied in the past. Unfortunately, this success does not answer the question of whether such approaches will eventually be able to replace all roles for nuclear testing in the future. Presently, no one can answer this question for the long term.

- Let me suggest an analogy. There is an old story about a man who was pushed out of an upper floor of a tall office building. As he passed various floors, he was heard to say, "I'm OK so far." Each year, as we prepare our annual certification statement, we are in somewhat the same position. We can say with some confidence that, "We're OK so far," without having to ask for a nuclear test, as we have now done for the past four years since the new process was brought into being. This is primarily a result of the US stockpile being in superb shape when we began the process. But like the man in free fall, we have been pushed into a "terra incognito," where we have little experience to predict what will happen. We should not be too optimistic that no harm will result from potential changes to the stockpile in the future.

- Perhaps the biggest challenge we face is preparing for whatever the future may hold. I should note, as I did in my Senate testimony on the CTBT, that the first step in approaching certification is to ensure that the scientists and engineers, on whom we must rely to make the complex technical judgments about the condition of the stockpile, are fully capable of doing so. It is here that SBSS faces the greatest challenge. Those who have carried out these design and surveillance tasks in the past were necessarily our most senior veterans. What will be the case in 10 to 20 years when all of these proven experts will have retired? [Back to the man-in-free-fall analogy, it is in 10 to 20 years that we will surely be approaching the "lower floors."] Whether we can create a new generation to pick up the stewardship tasks, and have them function at the same level of competency, without having been "tested" themselves through full-up experiments, is a huge challenge.

- Throughout this Administration, we in the DOE community have been operating under instructions from the September 1994 Nuclear Posture Review. It directed that DOE must maintain the US nuclear weapon capability—but without nuclear testing or fissile material production. Our taskings included:
    - the creation of a surveillance engineering base;
    - the capability to refabricate and certify the enduring stockpile; and
    - maintaining the capability to design, fabricate, and certify new warheads—but with no production of new designs.

What's wrong with that? Perhaps nothing, but perhaps this list is incompatible. Can we really maintain capability without actually doing an activity? I have, in fact, believed throughout my career that in scientific or high-tech pursuits, one can't tread water. "If you're not advancing, you're declining." [This quote is from Edward Gibbon, author of The Rise and Fall of the Roman Empire]. What's missing? To me it seems that they may have made the very human error that "things will stay just as they are today"—or more precisely "as things seem to us to be today." I can't but perhaps worry that quite a few in the Pentagon and the Interagency have themselves turned into wide-eyed optimists, banking the nation's future security on Disney's First Law: "Wishing will make it so."

Although I believe all of us would wish that the US will never need new nuclear weapon designs; based on the past, this is quite unlikely. The US will undoubtedly require a new nuclear weapon, either for a different delivery mode or vehicle or, quite likely, because it is realized that the yields of the weapons left over from the Cold War are too high for addressing the deterrence requirements of a multipolar, widely proliferated world. Without rectifying that situation, we would end up being self-deterred. Will the US then consider the need for a new nuclear weapon to equate with our Supreme National Interest, as President Clinton has said he would do for a problem in reliability or safety of a critical weapon in the current stockpile?

I confess to not being sure of that answer. In fact, this issue and most of the others I raised in this talk are very difficult questions. Yet they are being left on the table for a new administration.