

**Peer Review and Design Competition in the NNSA National Security Laboratories
Congressional Hearing Testimony
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Thank you for the opportunity to discuss the results of our National Academies report, *Peer Review and Design Competition in the NNSA National Security Laboratories*, which I had the privilege to co-chair. My co-chair, Dr. Jill Dahlburg, and I have prepared this joint statement.

At the end of this statement you will find a list of the committee members and their affiliations. Their bios are in an Appendix to our report, which itself has been entered into the hearing record. This was a very strong committee whose members have extensive experience and excellent credentials in this area.

The Statement of the Task given to the National Academies for this study was specified in the FY2013 National Defense Authorization Act and reads as follows:

The study will assess the following:

- The quality and effectiveness of peer review of designs, development plans, engineering and scientific activities, and priorities related to both nuclear and non-nuclear aspects of nuclear weapons;
- Incentives for effective peer review;
- The potential effectiveness, efficiency, and cost of alternative methods of conducting peer review and design competition related to both nuclear and non-nuclear aspects of nuclear weapons, as compared to current methods;
- Known instances where current peer review practices and design competition succeeded or failed in finding problems or potential problems; and
- How peer review practices related to both nuclear and non-nuclear aspects of nuclear weapons should be adjusted as the three National Nuclear Security Administration (NNSA) laboratories transition to a broader national security mission.

The study was supported by the National Nuclear Security Administration, which went out of its way to provide the committee with full information relevant to these Tasks.

Let's begin with the bottom line: The state of Peer Review at the DOE Weapons Labs is healthy and robust, but the state of Design Competition is not. The NNSA complex must engage in robust design competitions in order to exercise the design and production skills that underpin stockpile stewardship and are necessary to meet evolving threats.

Recent competitive design studies such as the Reliable Replacement Warhead (RRW) were useful design and modeling exercises, but were not true design studies, because they did not result in the production of an engineering prototype—a step necessary for essential feedback on the viability and practicality of a design.

This observation led the committee to develop the following recommendation:

To exercise the full set of design skills necessary for an effective nuclear deterrent, the NNSA should develop and conduct the first in what the committee envisions to be a series of design competitions that integrate the full end-to-end process from novel design conception through engineering, building, and non-nuclear testing of a prototype. These competitions should be implemented with the clear understanding that the resulting prototype would not enter the stockpile.

To elucidate what the Committee means by a prototype nuclear device, the prototypes produced by the design competitions should have the following characteristics:

- The design and fabrication of the prototype should exercise the full range of skills the nuclear weapons complex needs to produce a new weapon;
- The design should be able to be certified in a manner consistent with the nuclear testing moratorium;
- The prototype Nuclear Explosive Package (NEP) should be fully integrated with all Sandia National Laboratories components needed for a warhead. If the NEP design requires new Sandia components, prototypes of those components should be designed and produced in parallel; and,
- It should be a “nuclear device,” not a warhead. That is, stockpile-to-target-type scenarios should be considered via simulation or testing, but there should be no expectation of flight testing.

Maintaining nuclear weapon design skills through design competitions at the NNSA laboratories—as well as production skills within the NNSA complex—is essential if the nation is to achieve three critical objectives:

- Maintain a credible nuclear deterrent workforce that is fully capable of designing and building weapons to meet evolving threats;
- Understand the status and direction of foreign nuclear weapon programs, thus strengthening the nonproliferation regime;
- Determine the best and most cost-effective approaches to resolving problems that arise during stockpile weapon surveillance and life extension programs.

We wish to emphasize that all of the scientists and engineers who designed and built the weapons currently in the stockpile have retired or soon will retire, and these design-and-build competitions are essential to train the next generation of weapons designers and transfer the knowledge from the current generation to future generations.

The Committee made other recommendations. I would like to bring three of these to your attention.

First, the community has learned from experience that design competition between independent teams that use different approaches and methods is extremely valuable, especially in a system as complex as a nuclear weapon where we do not have sufficient knowledge to solve the problem from first principles.

Innovations produced by design competitions during the Cold War, as well as increased confidence in the safety and reliability of stockpile weapons that result from current assessment processes, such as the Independent Nuclear Weapons Assessment Process (INWAP), illustrate the value of having independent teams, using different approaches and methods, tackle common problems.

These observations led the committee to recommend the following:

Los Alamos and Lawrence Livermore National Labs should continue to maintain independent design capabilities, using different approaches and methods, to enable independent peer review of critical technical issues. Sandia National Labs should likewise carry out, for high-priority issues, competitive designs with independent teams that use different approaches followed by peer reviews of components, sub-systems, and full systems.

Next, while the Committee found that Peer Review processes at the NNSA Labs are basically healthy, the Committee felt they could be improved with two minor changes:

- Los Alamos and Lawrence Livermore should ensure they have a short, written guidance for a graded approach to peer review with the rigor appropriate to the stage of work and range of technical activities being reviewed.
- Sandia Labs should strengthen and broaden the use of outside experts on its peer review teams, as articulated in written guidance that SNL recently finalized.

Finally, the Committee heard a lot about the Reusable, Reliable Warhead competition. We hesitate to call it a design competition, because it was not. In addition, its execution was flawed. Although it succeeded in producing innovative weapon designs by the competing teams, its value was reduced because technical experts from the competing laboratories were not given the opportunity to critique one another's ideas through inter-laboratory peer review and to address criticisms at the science and engineering level before the final designs were formally presented to NNSA and potential end users. This precluded the full benefits of technical competition and was a set-back to inter-laboratory cooperation. Therefore, the committee makes the following recommendation:

To guide future design studies and design competitions, the NNSA should provide a formal written statement articulating the design requirements and objectives, along with the selection

criteria, in advance of any authorized work. The NNSA should also ensure that inter-laboratory peer review takes place, and that competitors have an opportunity to address criticisms at the science and engineering level before the results are formally presented to stakeholders outside of the NNSA.

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