Remarks by

Larry W. Brown, Member, DNFSB

to the DOE Nuclear Safety R&D Forum

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Good morning. Let me begin by saying that the opinions I will be expressing this morning on Nuclear Safety Research and Development (R&D) are mine, and mine alone. The Defense Nuclear Facilities Safety Board, of which I am a Member, has a written record on this subject, and nothing I say today amends or changes that record; just as I expect that the conclusions of this workshop will not change or amend the Secretary of Energy's commitments in the Implementation Plan for the Board Recommendation 2004-1.

It is important to make that clear, because DOE's commitments to develop a Nuclear Safety R&D program are part of a formal process, governed by law. My objective this morning is to help you in your work - by explaining the Board's thinking on the "why" and the "what" of nuclear safety R&D in the context of expectations for the National Nuclear Security Agency and the Department of Energy.

Given that caveat, it is always useful, and particularly on this subject, to begin with first principles. And by that I mean the statute that governs both DOE, NNSA and the Defense Nuclear Facilities Safety Board. The Atomic Energy Act of 1954:

> Chapter 1, Section 2. Findings. Part e. Source and special nuclear material, production facilities, and utilization facilities are affected with the public interest, and ***regulation by the United States*** of the production and utilization of atomic energy and of the facilities used in connection therewith is necessary in the national interest to assure the common defense and security and ***to protect the health and safety of the public***. (emphasis added)

Permit me to restate the law in my words. DOE and NNSA are self-regulating in the conduct of complex work involving high-hazard nuclear operations. Self-regulation confers a special degree of responsibility. Because DOE is self regulated, safety oversight must be exercised with the utmost care at every level within the federal organization. The complexity of your work, as well as the hazards associated with this work, requires extraordinary vigilance.

Extraordinary vigilance - - not only in the planning, initial authorization and execution of such work, but also in monitoring work and promoting continuous improvement throughout project lifecycles in the DOE programs. There is no room for either complacency, taking things at face value, or being satisfied with the status quo. An attitude of "we've always done it that way" poses unacceptable risks to the worker and public health and safety.

Why is that? The key attribute in achieving, maintaining, and continuously improving safety is a questioning attitude. Questioning the adequacy of hazard characterization and identification, questioning the adequacy of how controls are defined, and questioning the adequacy of how controls are maintained are all grounded upon a solid understanding of the underlying scientific and technical basis. From my perspective, validation of the underlying scientific and technical basis is the central reason for a robust nuclear safety research and development program. For those of you with programmatic responsibilities, there are additional reasons for a healthy NSR&D program.

The key role and importance of nuclear safety research and development was highlighted in the Board's Recommendation 2004-1, *Oversight of Complex, High-Hazard Nuclear Operations*. The genesis of Recommendation 2004-1 was NNSA's proposal over five years ago to institute a new line- oversight/contractor assurance system motivated by a desire for improved productivity and efficiency. While the Board recognized that this policy change was well intentioned, the Board reasoned that the potential for a high-consequence, low-probability accident became more likely if the contractor's focus on productivity and efficiency was not balanced with a healthy dose of safety oversight.

I want to emphasize my use of the singular – accident, not accidents – because one accident of high-consequence nature would likely have far reaching national security implications and environmental impact. In my view, our stewardship responsibilities for the defense complex and the environment are summarized by a proverb attributed to Native Americans that is on a sign at the DOE Pantex Plant. It says "We did not inherit the earth from our ancestors; we borrow it from our children."

I believe that to meet its stewardship responsibilities, DOE and NNSA must:

1. Strive for Excellence in nuclear safety standards.
2. Nurture a proactive safety attitude.
3. Apply world-class science and technology to safety.
4. Reliably and responsibly operate defense nuclear facilities
5. Dedicate adequate resources to support nuclear safety
6. Ensure rigorous performance assurance, and

7. Maintain public trust and confidence.

Nuclear safety research and development plays a critical role in several of these elements. Three relevant points were made in the Board's Recommendation 2004-1:

- Excellence in nuclear safety standards. The Board observed that standards must be based on sound engineering fundamentals and robust technical foundations. DOE must employ safety standards and practices that incorporate the most current lessons learned and safety research.

- A proactive safety attitude. This is the questioning attitude essential to safety. The Board observed that DOE needs improvement in encouraging a questioning attitude and fostering constructive skepticism. In other words: challenge conclusions. This is the driving force behind what brings issues needing research and development to the forefront for action.

- World-class science and technology. This means technical excellence. It demands safety analyses based on sound engineering judgment and grounded in solid science. The Board observed that DOE has neglected its responsibility to employ an integrated nuclear safety research program.

In the context of nuclear safety research and development, the Board stated:

"That to ensure that any features of the proposed changes will not increase the likelihood of a low-probability, high-consequence nuclear accident, DOE and NNSA take steps to:

a. empower a central and technically competent authority responsible for operational and nuclear safety goals, expectations, requirements, standards, directives, and waivers ;
b. ensure the continued integration and support of research, analysis, and testing in nuclear safety technologies; and
c. require that the principles of Integrated Safety Management serve as the foundation of the implementing mechanisms at the sites."

DOE's first implementation plan did not meet these challenges. The Board's reply to the Secretary of Energy on February 14, 2005, said that "The Board is also concerned that the nuclear safety research and development function is not adequately defined, and the mechanisms through which the results of safety research will be utilized are not specified. DOE needs to establish a sustainable capability that will maintain and advance the scientific and engineering understanding of nuclear safety."

Our August 5, 2005 letter, accepting DOE's revised implementation plan provided insight into the key measures of success. Among those highlighted was: "The creation of a viable and fully supported nuclear safety research program, providing value-added and timely enhancements to nuclear safety."

Under that implementation plan, the nuclear safety research component was assigned to the Assistant Secretary for Environment, Safety and Health (ES&H) who immediately established the Office of Nuclear Safety Research (ONSR) with a full time staff of five scientists/engineers. By October of 2005, procedures for operation of the office and review of proposals had been approved, and ONSR had established outreach activities to other national and international organizations involved in nuclear safety research – including: NRC, EPA, ONR, IAEA, NEA, and INPO. A database to inventory ongoing nuclear safety research was begun. Approximately 30 research proposals were received, reviewed, and prioritized on the basis of urgency of need and feasibility. A program with a first year budget of $2M, increasing in future years to respond to the identified "gaps" in the safety net was developed. At this point, the overall Board impression of this approach was favorable.

ONSR was headed in the right direction. We believed it was on track to:

1) Maintain an active inventory of ongoing nuclear safety research worldwide,
2) Continuously identify knowledge gaps in the safety base and seek funding for and manage the required nuclear safety research
3) Ensure the rapid and wide dissemination of the research findings to potential users
4) Be prepared to immediately address causes of safety issues in DOE/NNSA operations,
5) Analyze major non-DOE safety related incidents for lessons learned applicability to DOE/NNSA activities.
6) Provide state-of-the-art research and testing capabilities to ensure the continuous improvement of complex activities such as facility safety design, safety analysis, testing, construction, and operation
7) Maintain a constant awareness of the science and engineering underpinning of safety directives and standards so these important tools are current, safe, efficient, and cost effective, and
8) Continuously explore ways to support the role of the CTAs in ensuring safe operations in all DOE/NNSA activities.

Despite the progress made and the promise for value-added contributions to overall nuclear safety, the budget did not win top management support, and the program did not get funded. This lack of support resulted in the resignation of the Office director, who accepted a top safety position with DoD, and reassignment or resignation of the remaining staff. This caused concern at the Board regarding the future viability of this important element in the Board's Recommendation.

In this same time frame, DOE top management decided to reorganize the structure of DOE's health, safety and security components and revise the commitments made in the June 2005 implementation plan. In August 2006, the DOE's health, safety and security components were combined under a Director of Health Safety and Security who was also designated as the Corporate Chief Safety Officer, and the position of Asst Secretary for ES&H was abolished. Simultaneously, DOE submitted a revised implementation plan for Recommendation 2004-1 transferring the ONSR to NNSA without personnel and without funding.

Over the last two and half years, the Board has sought to encourage DOE to implement a funded nuclear safety research and development program. We wrote in the Board's 2008 Report to Congress:

> The Board remains steadfast in its belief that research in nuclear safety is essential and should be carried out by DOE. Such research can be directed at many worthy safety objectives, among them reducing uncertainties in safety analyses, validating analytical models and methods, improving operating practices, and advancing the fundamental understanding of nuclear safety science and technology. DOE has already identified a variety of specific nuclear safety research projects, thirteen of which are listed below. The Board believes these projects need to be funded and executed.

The thirteen projects we listed were those that the now defunct ONSR had developed before being disestablished, but that DOE had not funded. I hope that you have been provided that list. I won't repeat the entire list here, but I think it is useful to at least mention the first two, for illustrative purposes.

> 1. Deflagration/Detonation of Hydrogen/Volatile Organic Compounds in Nuclear Waste Drums, Pipes, and Vessels Containing Nuclear Materials.

This one is particularly interesting to me. Not long ago a senior and very well known scientist asked me why the Board imposed such stringent hydrogen safety requirements. He said "don't you know that the scientific basis for all those controls is flawed?" I corrected him, and you should know too, that the Board relies upon DOE

safety standards; we have no independent standards. What we expect, is that DOE will meet its own standards and that DOE take steps to ensure the standards are technically accurate. It gets back to self regulation. We simply provide oversight and comment on DOE's compliance with its own orders and standards.

Complying with DOE hydrogen safety standards is very expensive. The consequences of a hydrogen deflagration involving radioactive materials could be catastrophic. Last year when the contractor building the Salt Waste Processing Facility (SWPF) at the Savannah River site used assumptions - without providing adequate technical justification - that would have limited the worst-case dose release so that expensive "safety class" controls were avoided, the Board objected. (Staff Issue Report dated June 5, 2008)

And just yesterday we learned that at Hanford the Office of River Protection (ORP) and the contractor Bechtel (BNI) are re-evaluating the Waste Treatment Plant (WTP) safety design strategy for hydrogen. We have very little information regarding the specifics of this effort, but it has significant safety implications because of the paucity of available data to support reducing the design's conservatism to mitigate flammable gas loading in tank vapor space and process piping.

Notwithstanding the conservatism in DOE Standards, it seems to me that DOE could benefit from a better understanding of the safety aspects of hydrogen deflagration, and that DOE would place a priority on further research. This has not been the case.

Another relevant area of safety research is the second one from the list:

> 2. Fire Hazard and Potential Nuclear Material Damage Ratios, Airborne Release Fractions, Respirable/Non-Respirable Fractions and Facilities Leak Path Factors in Fire Initiated Accident Scenarios

Frankly, the limited scientific basis upon which DOE extrapolates its safety requirements is sometimes amazing. For uranium, it is based upon experiments that were done by Mr. Jofu Mishima more than a decade ago. We have spoken to him, and he questions the relevance of the purposes to which his research has been extended. But it is … what it is. Again, because of a lack of a strong scientific basis, conservative assumptions based upon available data must be used in developing the controls to bound the hazard.

Finally, let me use one additional example that is not from that list to illustrate the costs of not doing nuclear safety research. The Department of Energy's "Nuclear Air

Cleaning Handbook" establishes a ten year life for HEPA filters. A conservative limit has been accepted "despite the difficulty of determining HEPA-filter life based on research data." In his report on "Maximum HEPA-filter Life," Werner Berman of the Lawrence Livermore National Laboratory (now with Washington River Project Solutions) said that "the age limits in this report are based on highly variable data, but more accurate age limits can be derived from controlled experiments in real time over 5 to 10 years using specific filter-media roll. Until such long-term studies are conducted, establishing a 5- and 10-year HEPA filter life for wet and dry ventilation systems, respectively, will ensure that most (although not all) filters will not suffer a significant loss in strength due to age." That report was written in June 1999.

What's the impact of that limit? The Board recently found HEPA filters in the Pu Finishing Plant (PFP) in Hanford that are twenty-two years old. At $8,000 per filter, the cost of replacing over a hundred filters in just one of the eleven PFP filter banks exceeds $800,000. It seems to me, considering DOE's widespread use of HEPA filters throughout the complex, that ignoring the cost-benefit of doing the research suggested in DOE's own "Nuclear Air Cleaning Handbook" is as they say – penny-wise and pound foolish.

The Board is not alone in the importance it places on nuclear safety research and development.

The Nuclear Regulatory Commission has long emphasized its importance. In an article published in Nuclear News nearly ten years ago, then NRC Chairman Shirley Ann Jackson wrote that "[j]ust as a sound policy framework clearly is the key to making prudent decisions, a vigorous, focused safety research program is fundamental to achieving a robust foundation for risk-informed regulation."

Similarly, last year, a Committee of the National Academy of Sciences, after visiting Oak Ridge, Hanford, Idaho, and Savannah River observed in its interim report to DOE's Office of Environmental Management (EM) that a "significant ongoing research and development program" is required in order for EM to meet all its cleanup responsibilities. The Committee's final report is due this month (Feb 2009).

In closing, I know that our host today, Dr. Greenaugh, has been working to integrate a comprehensive Department wide response to this Board recommendation.

The closing paragraph of the October 2008 report from his office on completing Commitment No. 8 in the Secretary of Energy's Implementation Plan for Board Recommendation 2004-1, is worth reading verbatim.

Quote
When operations and mitigation measures must be defined and implemented in regimes where we lack knowledge or have high uncertainties, the response may depend strongly on technical expertise/judgment and may result in very conservative measures to mitigate risks. Thus, the impact of nuclear safety knowledge gaps is typically high uncertainty regarding residual risks being accepted in operations, and high costs for operations due to conservatism in mitigation measures. Projects which increase knowledge or reduce uncertainties have the potential to increase our understanding of risks (and thus our confidence in safe operations), and, consequently, may reduce the cost of operations. Those projects which have the potential to improve understanding of risk (or reduce/eliminate risks) while reducing operational costs should receive strong consideration for special funding.
Unquote

That concludes my remarks. It seems to me that your challenge is not simply to find worthy research projects. DOE's organization finds and funds many R&D projects that fit within the stove-piped programs of NNSA, EM, NE and Science. Your challenge is to illuminate those R&D projects which have cross-program benefit. Particularly those where the programs perceive only a small individual benefit, but if undertaken would reduce the overall DOE complex regulatory burden. The competition for programmatic funding is fierce and has left these R&D projects on the cutting room floor. I would say that hydrogen deflagration and thermolysis, airborne release fraction, and HEPA filters fall into the category of worthy regulatory R&D.

But I am not suggesting that these are the only, or the most worthy projects. What we expect is that the process in which you are participating will identify and prioritize cross-cutting nuclear safety R&D, and that measurable results from the resulting research will be available to the DOE complex in the foreseeable future.

As you begin your work over the next two days, I extend my warm wishes for a successful forum. Are there any questions?