AN INDEPENDENT PERSPECTIVE ON THE ELEMENTS OF AN EFFECTIVE OVERSIGHT PROCESS

Remarks made by
B. John Garrick, Chairman
U.S. Nuclear Waste Technical Review Board

Presented at the
U.S. Nuclear Regulatory Commission
22nd Annual Regulatory Information Conference
Bethesda, Maryland
March 9-11, 2010

Good afternoon! It is a pleasure to be back among many old friends and to be able to meet the replacements of so many retired colleagues no longer here from my almost 10 years of serving on the Advisory Committee on Nuclear Waste. I was invited here not as an expert on reactor oversight, which I certainly am not, but more because of my interest in what I might call the tools of risk informing the reactor oversight process, particularly as they relate to the role of risk assessment. So, please forgive me if I sound more like I am talking about risk management than reactor oversight. Also, I tend to flip back and forth between the overall oversight provided by the Nuclear Regulatory Commission (NRC) and the more specialized case of reactor oversight.

My goal is to provide you with an outsider's view of reactor oversight and to share a few thoughts from the perspective of the oversight function I'm now engaged in as Chairman of the U.S. Nuclear Waste Technical Review Board (NWTRB).

I want to emphasize that I am speaking here as John Garrick, risk scientist, and not as Chairman of the NWTRB.

Slide 1 outlines the topics I wish to cover very briefly.

Slide 1

OUTLINE

- **DIFFERENT OVERSIGHT ROLES OF NRC AND NWTRB**
- **CHALLENGES TO BOTH AGENCIES**
- **REQUIREMENTS FOR RISK-INFORMED OVERSIGHT**
- **OUTSIDER'S VIEW OF NRC RISK-INFORMED REACTOR OVERSIGHT**
- **LESSONS LEARNED**

A way to put into perspective the different oversight roles of the NWTRB and the NRC is to examine their statutory mandates and how they carry out their missions, Slide 2.

Slide 2

DIFFERENCES IN OVERSIGHT ROLES OF NRC AND NWTRB • **DIFFERENT SCOPES** • **DIFFERENT DEFINITIONS OF TERMS** • **DIFFERENT QUESTIONS TO BE ANSWERED**

NRC's stated mission is to regulate the nation's civilian use of byproduct, source, and special nuclear materials to provide reasonable assurance of *adequate protection* of public health and safety, to promote the common defense and security, and to protect the environment. NWTRB's statutory mandate is to conduct an ongoing and independent review of the technical validity of the Department of Energy (DOE) activities related to the management of high-level radioactive waste and spent nuclear fuel and to advise Congress and the Secretary of Energy on open technical issues of importance.

I find it helpful to think in terms of the questions that the oversight process is supposed to answer. For NRC and with some help from a Nuclear Energy Institute white paper (NEI 98-W1), my interpretation of the questions are (1) what aspects of the licensee's reactor operation assure adequate protection to the public and therefore merit regulatory oversight, and (2) what are the appropriate attendant regulatory activities, given the aspects of (1).

The fundamental questions on which the NWTRB focuses its oversight activities are (1) does the Department of Energy have a *fundamental understanding* of the technical issues, including operational questions, associated with their proposed high-level nuclear waste facilities, and (2) are those issues being appropriately addressed in a total system sense to achieve reasonable performance goals. The focus of NRC reactor oversight must be on radiation safety. The NWTRB activities extend beyond radiation safety to total systems design and efficiency of operation, including operational risks.

Finally, it should be noted that NRC considers "risk-informed, performance-based" in terms of safety results and outcomes, while NWTRB considers performance in the broader sense of overall system performance.

Notwithstanding these important differences, both oversight bodies face common challenges, Slide 3.

Slide 3

CHALLENGES COMMON TO NRC AND NWTRB OVERSIGHT ACTIVITIES

- **MAINTAINING INDEPENDENCE AND TRANSPARENCY**
- **ACCESSING INFORMATION AND LEVEL OF REVIEW**
- **RESPONSE TO OVERSIGHT FINDINGS AND THEIR IMPACT**

Maintaining independence is probably the greatest challenge of any oversight organization. A key to maintaining independence is the right mix of specialists and generalists on the oversight team and an oversight process that has built in checks and balances that enhance the influence of expert opinion based on data while suppressing personal opinion based on biases. This is why I have always been a proponent of the risk sciences. Properly applied, the risk sciences can be an effective process for filtering out biases, personal opinions, and prejudices. The risk sciences have also contributed to more meaningful engagement of the public as the public often sees such analyses as having a better chance of getting to the truth about issues, rather than just asking to be trusted.

High quality and timely information are essential for effective oversight. The supporting evidence and its transparency are key with respect to analyses and findings. In particular, transparency of the evidence may be more important than the opinion of the expert when it comes to evaluation of technical content and a basis for effective decision making. Evolution of the evidence has to be part of the process and thus is one of the reasons for oversight organizations needing access to draft and so called pre-decisional information.

Oversight organizations vary in their authority to require organizations to respond to their findings and recommendations. This is not as much of a problem for regulatory organizations as it is for oversight organizations that do not have either regulatory responsibilities or authority. Because Congress wanted the Board to conduct its oversight functions in real-time, as opposed to after-the-fact, the NWTRB was given unusual access to DOE documents in its enabling statute, including the ability to obtain drafts and predecisional materials. However, the Board cannot compel DOE to adopt its findings and recommendations so it must rely on the strength of its reviews to get its desired responses. Even so, over the twenty plus years since its inception, the Board has influenced DOE's technical approach to characterizing the Yucca Mountain site and designing the repository. Issues raised by the Board included decisions about where and how to drive exploratory tunnels, the long-term performance of repository waste packages, the use of multi-purpose waste canisters, the integration and design of the waste management system, and the use of realistic performance assessments.

Let me now offer my view of some of the requirements for being risk informed, Slide 4.

Slide 4

REQUIREMENTS FOR BEING RISK INFORMED

- **RISK-BASED INPUT**
- **CONSISTENCY OF RISK ASSESSMENT METHODS**
- **REPRESENTATIVE RISK ASSESSMENT RESULTS**
- **CONSISTENCY OF APPLICATION ACROSS DIFFERENT PERFORMANCE AREAS (INITIATING EVENTS, MITIGATING SYSTEMS, INTEGRITY OF BARRIERS, ETC.)**

The key to an oversight and inspection program committed to being *risk-informed and performance-based* is assurance that the source material for the oversight is indeed *risk-based*, by which is meant an adequately scoped quantitative risk assessment. Otherwise, in my judgment it is not really being risk informed in the spirit of risk assessment practices in the reactor safety field. This is especially critical, given that the ultimate responsibility for public safety lies with the reactor operators, not the regulators. Given their commitment to a risk-informed, performance-based regulatory practice, the regulators have to depend on the operators and the quality of their quantitative risk assessment to make a finding of reasonable assurance of adequate protection. In my opinion, this could be a weakness in the regulatory process for commercial nuclear reactors, if being risk-informed is considered key to the process. In particular, what measures are in place to assure regulators and, of course, the public that there is compatibility between the two commitments—the industry's commitment to have quantitative risk assessments that are indeed risk-based, consistent in scope, and are current; and the NRC's commitment to make the oversight and inspection process risk-informed based on adequate risk information.

To a risk scientist, the NRC's adoption of a risk-informed, performance-based approach to regulatory oversight of the commercial nuclear power program is the correct approach. In principle, the approach puts the focus on activities where the radiation risks to the public are the greatest and on technical information that is truly plant and site specific. Ideally, the plant quantitative risk assessments should be at the center of the process, which means the plant probabilistic risk assessments (PRAs) together with plant experience become the primary evidence for addressing both risk and performance. The question is, is this really the way it works; is the primary driver the plant and site specific PRA, and has it been updated to account for plant experience? Is the process of becoming risk informed really risk based? The earlier presentations presented evidence that the Regions have been reasonably successful in getting risk knowledge out into the field and that the inspectors have become increasingly informed about the plant risk assessments. As reported the safety culture has improved with more attention to the total system and especially support systems such as service water, component cooling water, and electrical systems—systems not historically classified as "safety related," but clearly important from a risk perspective. This interest of mine in how well the risk assessment thought process is part of the safety culture is of course to my point about how risk-based is the risk-informing process. My take is that the reactor oversight process is making a lot of progress in its quest for a risk informed process, but there is a ways to go for the process to be fully credible.

As highlighted in Slide 5, the major pinchpoints for providing adequate protection are considered to be the reactor core, the containment, and evacuation.

Slide 5

PINCHPOINTS FOR "ADEQUATE PROTECTION" OF REACTOR OPERATION

- **REACTOR CORE**
- **CONTAINMENT**
- **EVACUATION**

Of course, there are crosscutting effects such as human performance. But you would like to think that these three pinchpoints are sufficient in their design to provide adequate radiological protection even if human mistakes are made.

Given the history of the emphasis on managing the core damage frequency in nuclear power plants makes one believe that controlling the core damage frequency is where there is by far the greatest effort. To be sure, since the reactor core is the first line of defense it should receive major attention. The concern I have is that the PRA scopes and the attendant NRC reactor oversight are not consistent in their treatment of all three major pinchpoints and thus the performance-based and risk-informed question may be getting compromised, especially when it comes to the treatment of the containment and evacuation. If this mismatch indeed exists, then there is a risk of possible overdependence on core damage frequency as a risk metric. That risk is that actions taken to reduce core damage frequency could in some instances actually increase the radiation risk to the offsite public. This situation comes about because of the non-linearity introduced by having frequency as a measure of risk. For example, suppose the reactor primary system is hardened to reduce the core damage frequency. Now we have a situation where the frequency of losing the integrity of the primary system is decreased with an attendant decrease in core damage frequency, but the threats to the containment are greater per failure of the primary system. As to whether this leads to a greater offsite risk depends on how the two frequencies match up, the frequency of the primary system failure and the frequency of containment failure per failure of the primary system. Now I'm not critical of using "frequency" as a measure of risk as I have been doing the same thing for 5 decades. It is a reasonable choice as long as the uncertainties are visible and the chosen risk measure is interpreted in the context of the total system involved.

This is why I have always been a strong proponent of full scope PRAs, or if you prefer, Level 3 PRAs, providing Level 3 also means true probabilistic treatment of the total system, including the reactor, its containment and offsite consequences, where evacuation can play such a critical role. In this respect, my experience with the NWTRB has been very reassuring because of the emphasis on system-wide analysis and integration. For example, a total systems perspective was critical in the technical evaluation of the through-put capability of the surface facilities of the proposed Yucca Mountain repository.

Crosscutting all of the pinchpoints is the issue of site and plant specificity. While the basic principles of oversight may apply to all plants, the risk information, just like specific plant experience, must be site and plant specific to reap the full benefits of being risk informed. This brings me to my opinion (Slide 6) of the key elements in the supporting evidence to claims of being risk-informed.

Slide 6

ELEMENTS OF EFFECTIVE REACTOR OVERSIGHT

- **SITE AND PLANT SPECIFIC FULL SCOPE RISK ASSESSMENTS**
- **MEANS OF ASSURANCE OF REPRESENTATIVE RISK MODELS**
- **UPDATES OF RISK MODEL WITH PLANT EXPERIENCE**

Now with this slide I am not suggesting that the regulatory process is failing in its objective to provide reasonable assurance of adequate radiological protection. What I may be saying is that in the absence of full scope PRAs on which to base its findings, the regulatory process may be stretching its claims of being risk informed. The absence of a more complete analysis of the total system risk may be forcing systems and operating requirements on the plants that, based on a full-scope PRA, do not necessarily reduce risk. Examples of the past are hydrogen recombiners, start times of diesel generators, and conditions for initiating high pressure injection. Without a full scope PRA, it is very difficult to provide a technical basis for eliminating so called safety systems or changing operating requirements.

I would like to now make a few remarks about lessons learned from oversight activities. Others here are certainly more able than I to speak explicitly to what we have learned about reactor oversight, but I'll offer one or two observations as an outsider mixed in with observations on what the Board has learned from its oversight activities.

Slide 7

LESSONS LEARNED
IT IS ESSENTIAL TO HAVE:
• CURRENT "ON POINT" INFORMATION AND TIMELY REVIEWS
• SITE AND FACILITY-SPECIFIC RISK ASSESSMENTS
• INTERACTION BETWEEN PARTICIPANTS CONDUCIVE TO GOOD PRACTICES IN TECHNICAL OVERSIGHT
• SELF ASSESSMENT OF PERFORMANCE AND INDEPENDENCE OF OVERSIGHT ORGANIZATION

One constant question is always the quality and timeliness of information that provides the basis for oversight activities. In the case of reactor oversight, always at issue is how current and complete is the PRA serving as the source material for risk informing the oversight process, particularly given the absence of a regulatory requirement for keeping the PRAs current. Further, how do the oversight evaluations take into account the different approaches to risk assessment implemented by the different utilities? A big issue for the NWTRB in the Yucca Mountain project was linking the technical information presented to the Board to such anchors as the site characterization program and the science program supporting their analyses.

The lesson I have learned about the importance of site and facility-specific risk assessments is really a carryover from my many years of being directly involved in many large scope risk assessments of nuclear power plants. In fact, I truly believe that the most important lesson learned from my nuclear plant PRA experience is how site and plant-specific risk really is. To emphasize the point, we found differences in risk levels between side by side units of nuclear power stations. The differences were brought about by such factors as differences in personnel and work practices, differences in interactions with other structures and systems, and differences in landscaping that impacted such phenomena as earthquake response and external fires.

We have learned from the NWTRB's interactions with DOE and other organizations involved in the Yucca Mountain project how necessary it is to be creative on the extraction of highly technical and complex information without compromising the transparency of the process. What seems to work is an appropriate mix of small group fact finding meetings, not necessarily with the public, sometimes involving discussions at extreme technical depth, followed by public meetings to present and challenge the results.

The Board is considering how it can best capture and communicate its experience and insights related to the Yucca Mountain program. We expect to issue a report that includes some of the lessons learned during the development of Yucca Mountain and other repositories worldwide in the near future. We think at this point that the lessons-learned report will be in part a self-assessment in that it will address not only what DOE may have learned but also what the Board has learned.

Finally, I would like to conclude with what might be a point of controversy.

Something we hear very little about these days is the NRC "safety goals" for nuclear power plants. The Three Mile Island accident was a singularity in our reactor safety experience. It was a severe accident and yet there were no fatalities or even any known radiation injuries. The protective barriers worked and in the context of the safety goals, the NRC was completely accountable. And yet both the NRC and the industry lost considerable credibility and the consequences of the accident to the nuclear power industry were profound and nearly catastrophic. Why this loss of credibility, why was it nearly the death blow to nuclear power when from the point of view of the safety goals nothing significant happened and what is the point I'm raising?

I mention the safety goals because they seem to have lost their focus by NRC as being the foundation of the regulatory process in terms of what constitutes acceptable radiation safety. I do so because I believe the safety goals together with a truly risk-informed regulatory practice provides the best hope that the nuclear industry could withstand another accident not involving a significant release of radiation. For sure, we should expect that these types of accidents will occur in the future. Let us hope that our inability to focus the public view of just what the NRC oversight accountability is does not turn out to be one of those lessons we failed to learn.

In closing, Slide 8 is an attempt to summarize my main points. Thank you for your attention.

Slide 8

SUMMARY

- **THERE ARE IMPORTANT DIFFERENCES IN WHAT OVERSIGHT MEANS AND HOW IT IS CONDUCTED. INSIGHTS, HOWEVER, CAN BE DRAWN FROM ONE SITUATION AND APPLIED IN ANOTHER.**
- **CURRENT EMPHASIS ON RISK-INFORMED AND PERFORMANCE-BASED APPROACH TO REACTOR OVERSIGHT IS A SOUND STRATEGY**
- **RISK-INFORMED CAN ONLY HAVE MEANING IF IT IS RISK-BASED AND MECHANISMS ARE IN PLACE TO ASSURE QUALITY SITE AND PLANT SPECIFIC RISK ASSESSMENTS**
- **CORE DAMAGE FREQUENCY HAS LIMITATIONS AS A RISK METRIC AND CAN MASK THE TRUE RISK TO THE PUBLIC. A TOTAL SYSTEM APPROACH, SUCH AS A LEVEL 3 PRA, CAN BE MORE INFORMATIVE.**
- **THERE ARE SEVERAL STEPS OVERSIGHT BODIES CAN TAKE TO MAKE THEIR PERFORMANCE MORE EFFECTIVE.**