NRC NEWS

U.S. NUCLEAR REGULATORY COMMISSION

Office of Public Affairs Telephone: 301/415-8200
Washington, D.C. 20555-0001
E-mail: opa.resource@nrc.gov Site: www.nrc.gov
Blog: http://public-blog.nrc-gateway.gov

No. S-11-009

The First Year…

Dr. George Apostolakis
Commissioner
U.S. Nuclear Regulatory Commission

23rd Annual Regulatory Information Conference

March 9, 2011

It is a pleasure to be participating with all of you in my first Regulatory Information Conference as a Commissioner of the NRC. First, I'd like to recognize the NRC management and staff efforts in the planning and execution of another outstanding Conference.

During my first year as a Commissioner, I have been in a learning mode. I have had the opportunity to visit some reactor and materials facilities and to speak with diverse stakeholders and interested observers in various settings, including many Commission briefings that involved both NRC staff and external stakeholders. I would also like to acknowledge how wise Congress' decision to establish a five-member Commission was. I always find the perspectives of my fellow Commissioners on policy matters thoughtful and interesting.

I would like to use this first opportunity to provide a sketch of my background so you can understand the views that I bring to this assignment, and to list some of the areas that are of interest to me. With that, I want you to know that my focus is the same as that of the Commission, namely, ensuring the safety and security of all our licensed activities, including operating reactors, fuel facilities, waste disposal, and the use of radioactive materials.

Before joining the NRC, I was a professor of Nuclear Science and Engineering and a professor of Engineering Systems at the Massachusetts Institute of Technology. My primary research interests were in the development of models for the assessment of risks from large technological systems with a focus on nuclear power reactors. I was also a member, and former chairman, of the NRC's Advisory Committee on Reactor Safeguards (ACRS) for over 15 years. My tenure with the ACRS has been invaluable in allowing me to step right into my role as a Commissioner since I had a decade and a half to become familiar with many of the issues the agency has faced in the past, is facing now, and is sure to face in the future. Of course, the roles of the ACRS and the Commission are very different. I now have to make actual decisions as opposed to providing advice. In addition, I am no longer allowed to interrupt speakers who come before me, thus depriving me of one of the great pleasures of being an ACRS member.

In my opinion, the NRC is the preeminent contributor to protection of public health and safety among organizations external to licensees. We must continue to ensure that the public has confidence in the strong and predictable regulatory safety and security framework of the Commission. In this regard, I note that we were given recently a new point of reference. On January 18, 2011, President Obama issued an executive order on Improving Regulation and Regulatory Review. According to this executive order, the *General Principles of Regulation* include the following:

> Our regulatory system must protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation…. It must allow for public participation and an open exchange of ideas. It must promote predictability and reduce uncertainty. It must identify and use the best, most innovative and least burdensome tools for achieving regulatory ends.
>
> To the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt.

Although the NRC, as an independent agency, is not subject to this executive order, I am very pleased to say that our agency has been moving its regulations in the direction of some key aspects of these principles for quite some time now. For instance, we are striving to establish performance-based regulations to the extent possible and to increase our efficiency by utilizing risk insights, as appropriate. Regarding President Obama's call for "least burdensome tools," I note that the Commission stated, way back in its 1995 Policy Statement on the use of Probabilistic Risk Assessment (PRA), that PRA should be used to reduce unnecessary conservatisms associated with current regulatory requirements.

Two success stories that exemplify the benefits of using risk insights are the Reactor Oversight Process (ROP) and the risk-informed In-Service Inspection (ISI) of piping. The ROP has allowed us to respond to inspection findings in a way that is commensurate to the risk significance of these findings. It has also gone a long way toward promoting predictability in the regulatory system. The risk-informed ISI has allowed both the NRC and the licensees to focus the inspections on piping segments that are susceptible to degradation mechanisms and are risk significant, thus improving safety and reducing licensee regulatory burden.

You probably have noticed that my two examples are from the reactor arena. This is because that's where most progress has been made. I would like to recognize that the agency has also made progress in the use of risk insights in its regulation of the use of radioactive materials.

In my opinion, all areas under NRC jurisdiction would benefit from greater use of risk insights. I do acknowledge, however, that the application of the methods we have developed for reactors and waste repositories to other NRC activities is not straightforward. This is particularly true for security where events do not necessarily happen because of some random phenomena but, instead, because of the deliberate actions of an adversary. In this regard, I suggest that, instead of trying to transfer risk methods that have been developed for reactors to security, we should go back to the fundamental questions that analysts ask when performing risk assessments: What can go wrong? What are its consequences? How likely is it? Starting with fundamentals is always a good idea when dealing with a new situation.

Now, I would like to share my thoughts on a few specific areas of interest.

The Commission has a long-standing policy of encouraging the increased use of risk information in regulatory programs and processes, to the extent supported by state-of-the-art methods and data and in a manner that complements the NRC's traditional approaches that are based on the defense-in-depth principle and large safety margins.

However, even for reactors, the use of risk information has not yet been fully integrated into the reactor licensing process. Although 10 CFR 52 (the part of the regulations that governs the issuance of early site permits, standard design certifications, and combined licenses for new reactors) requires an applicant to submit a PRA summary, current review programs and guidance are still based on 10 CFR 50 (the traditional way of licensing) and do not fully realize the potential benefits of risk informing the licensing reviews. As a consequence, I believe that the agency faces some special challenges and opportunities as it prepares to receive in the near future applications for design certification of small modular reactors (SMRs). An important question which many are asking is whether the licensing review of such reactors should be the same as that for large reactors.

In July 2010, the Chairman and I proposed to our fellow Commissioners, and they agreed, to direct the staff to provide the Commission with a policy paper that addresses the development of a framework, implementation strategy, and plans and schedules to more fully integrate the use of risk insights into pre-application activities and in the review of small modular reactor applications. Staff was also directed to focus its initial effort on how risk insights would be used to identify risk-significant systems, structures, and components (SSCs) and other aspects of the design that contribute most to safety. Near-term efforts would be focused on integral pressurized water reactor designs. In my view, the results of these efforts should allow the NRC staff to be better prepared to conduct more safety focused and efficient reviews of SMR applications and, thus, be better able to respond in a timely manner to licensing requests.

A long-term objective of this initiative is to develop a risk-informed performance-based regulatory framework building on the SMR reviews, as well as on insights gained from the Next Generation Nuclear Plant pre-application review activities and the lessons learned from the earlier Technology Neutral Framework.

The staff provided its paper to the Commission recently for review and decision. A public Commission meeting on this matter has been scheduled for March 29.

Let me now offer some further thoughts on how risk insights may inform our regulations. There have been numerous PRAs completed for the current generation of Light Water Reactors (LWRs) both in the United State and internationally. I believe it is fair to say that this wealth of knowledge combined with several decades of operating experience has given us a very good understanding of what the likely accident sequences are for LWRs.

The analysis of these potential accident sequences in a PRA is as realistic as possible and, of course, includes the possibility that plant operators may intervene and act correctly or incorrectly. However, as I said earlier, this wealth of information has not been integrated in our regulations to a significant extent. The stylized Design Basis Accidents (DBAs) continue to reign supreme. There are signs, nonetheless, that important issues may not be resolved optimally within the confines of traditional design-basis analyses with their numerous conservative assumptions. An example is Generic Safety Issue (GSI) 191 ("Assessment of Debris Accumulation on PWR Sump Performance").

Following a Loss-of-Coolant Accident (LOCA), the emergency core cooling system (ECCS) is expected to cool the core by recirculating water that has settled at the bottom of the containment. This water, however, may contain debris that could clog the sump strainers that are designed to prevent debris from entering the ECCS system and the reactor core. This clogging could inhibit reactor core cooling.

The industry has argued that using a risk-informed approach would allow for a practical assessment of plant design features and operator actions that could reduce plant dependence on sump recirculation for long-term cooling through better water management, e.g., by refilling the refueling water storage tank and manually operating the containment spray system. A strict design-basis analysis does not allow the consideration of human actions. A question that arises, then, is whether we have sufficient understanding of operator actions to allow a risk-informed approach.

I acknowledge that many people are uncomfortable with the perceived large uncertainties associated with the probabilities of operator errors. However, the NRC has expended considerable resources developing guidance for the evaluation of operator actions. For example, we have published reports on "good practices" (NUREG-1792) and we have evaluated existing human reliability analysis (HRA) methods vs. these good practices (NUREG-1842). The NRC's Office of Nuclear Regulatory Research and the industry are currently working on a consensus HRA method. The use of such a method would improve the validity, consistency, transparency and traceability of human error evaluations. Lessons learned from a series of experiments conducted at the Halden Reactor Project's human performance simulation laboratory in Norway and an international effort on better understanding the strengths and limitations of the existing HRA methods are both inputs to the effort to develop a consensus HRA method. So, the question in my mind is, given that human performance is an integral part of nuclear power operations, why do we continue to ignore the products from these research activities in our regulatory decision making? Furthermore, without feedback from regulatory decision making, how do we know we are spending our HRA research resources in the most intelligent way?

In our efforts to risk-inform the regulations, we have introduced the critical concept of the transition break size (TBS), which divides pipe breaks into two intervals. The Commission has directed the staff to define the TBS as the pipe size that is expected to fail with a frequency of 10^{-5} per year. Breaks below the TBS are subject to the current requirements in 10 CFR 50.46 for the Emergency Core Cooling System (ECCS). Breaks above the TBS are subject to new requirements described in the proposed rule 10 CFR 50.46a. This voluntary proposed rule is of great significance in that it uses risk information and insights to revise the requirements associated with mitigating the stylized design basis double-ended guillotine break. A question, then, is where did the numerical value for the TBS come from?

The answer is that, because the frequency of failure of large pipes is very low, expert judgment was used to estimate LOCA frequencies. These frequencies provided the basis for selecting the TBS. And this leads me to another topic of interest to me: the utilization of expert judgment by the NRC.

The formal utilization of expert judgment in significant engineering issues has been pioneered by the NRC. It is a process that provides either (1) quantitative estimates for the frequency and/or significance of physical phenomena, or (2) qualitative insights into the nature, scope, and/or significance of physical phenomena. Expert judgment is used when the following conditions are present: the available data or operating experience is sparse or not directly applicable, the subject is too complex to model accurately, and the phenomena or issues have significant safety or regulatory implications.

Expert judgment has been a principal component of the technical basis for many important regulatory decisions, and its use is expected to be more prevalent in the future as issues become more complex and as technology evolves. There are many similarities but also significant differences in the approaches used in previous studies that can impact regulatory decision making

For example, a unique feature of the LOCA frequency study was the adjustment of results to account for the well-known overconfidence that is typically present in individual expert judgments. The study also recommended a less-common scheme for aggregating the individual expert results into group estimates. Sensitivity studies indicated that the selection of the aggregation scheme affected the results significantly. When the recommended, but less-common, aggregation scheme is used, the TBS for a pressurized water reactor is approximately 6 inches while aggregating using more-common methods leads to a TBS of approximately 11 inches. I believe that the NRC would benefit from formal guidance to assist the staff in choosing the method for obtaining and utilizing expert judgment to avoid the pitfalls of the past and ensure the appropriate level of effort. Selecting and documenting the appropriateness of the methods of analysis ahead of the regulatory decision should increase transparency, public confidence, and the objectivity of the results.

I would like to end this speech by telling you of an important recent initiative. Several weeks ago, the Chairman asked that I lead a Task Force for the Assessment of Options for a More Holistic Risk-Informed, Performance-Based Regulatory Approach. The Task Force is charged with developing a strategic vision, as well as options for pursuing such a regulatory approach for reactors, materials, waste, fuel cycle, security, and transportation that would continue to ensure the safe and secure use of nuclear material. The Task Force is to propose specific actions that the NRC could pursue to achieve a more comprehensive and holistic risk-informed, performance-based regulatory structure. The Task Force is expected to provide its recommendations within one year.

Realizing there were similar efforts in the past, I would like to offer my vision as to why we are pursuing this effort now and what outcomes we seek. As I said earlier, I believe the fundamental concept of risk analysis – what can go wrong, what are the consequences and how likely is it – is broadly applicable to all aspects of our regulatory functions. This set of risk triplets helps us to frame the information we need to make decisions systematically, transparently and in an integrated fashion.

A risk-informed approach is designed to focus the licensing and inspection efforts on the most risk-significant areas, thus increasing effectiveness and efficiency. With current projections for continuous flat budgets for the foreseeable future and the expected increase in the number of new reactor applications and licensing activities, I believe that the agency must adjust the way it does business. The agency must find a way to risk-inform its decision-making processes so that it can effectively prioritize its licensing reviews and inspections and focus its resources on areas of high risk significance.

If we were to predict what the nuclear industry may look like 20 to 30 years in the future, we can probably all agree that it may look very different than the way it does today. Consider the number of new reactor designs with passive safety features and digital instrumentation and controls, the small modular reactors, the aging issues associated with life beyond sixty years for the light water reactor fleet, the new fuel cycle facilities, and advances in the medical uses of nuclear materials, as well as changes in the security threats. With these likely changes in mind, we can easily conclude that the regulatory environment must change and adapt to ensure proper oversight and responsive licensing and inspection activities for adequate protection and regulatory enforcement. Our work on risk-informing the licensing reviews of SMRs is a good step in this direction.

Over the next 11 months, the Task Force will look candidly at where we have effectively and successfully transitioned to a risk-informed performance-based regulatory process and where we can and must do better. Armed with these insights, we will be able to provide options and formulate strategies for the next 10 or 15 years. Although I firmly believe there is always a role for probabilistic risk analysis, I am also prepared to accept the fact that, in some of our activities, there remains work to be done to make it practical. In fact, there may be instances where the explicit use and documentation of a probabilistic approach may just not be realistic for the foreseeable future.

Clearly, this effort could not be successful without meaningful stakeholder input. We plan to start within the agency and, at the appropriate time, solicit input from external stakeholders. Recognizing that the regulators and the regulated industry have different sets of considerations and different roles and responsibilities, external stakeholder input will help us in designing sound and effective long-term strategies. I believe the NRC and the stakeholders will agree that licensing reviews that align the review focus and resources to risk-significant areas and other aspects of the design that contribute most to safety will enhance the effectiveness and efficiency of the review process. The questions to which the Task Force will seek answers include the following:

1. Are the current practices adequate for accomplishing the goal of a holistic risk-informed and performance-based regulatory structure?
2. How effective have past and on-going risk-informed initiatives been? What are the relevant lessons learned from these initiatives?
3. Should the use of risk information continue to be voluntary?
4. How effective have recent major deterministic licensing actions (i.e., license renewals, power uprates, B5b mitigation strategies) been? What are the relevant lessons learned from these actions?
5. What are the visions for a holistic risk-informed, performance-based regulatory structure for reactors, materials, waste, fuel cycle, and security?
6. How can the transition from the current system to a more holistic risk-informed, performance based regulatory structure be optimized?
7. What is the schedule for achieving this regulatory structure?
8. How should this structure be implemented?
9. How should stakeholder input be considered?
10. In each area, what are the capabilities and limitations of current probabilistic risk assessment methodologies?

I have talked a lot about bringing more risk information into the agency's decision-making processes. I don't want to give you the impression that I do not appreciate the value of traditional approaches. The pioneers who developed nuclear power used the traditional engineering approach of requiring large safety margins and they established the philosophy of defense in depth to help manage uncertainty. I am fully aware of the value of defense in depth and safety margins in protecting us against unknown unknowns. I am also fully aware of the limitations of risk assessment. The challenge before us is how to develop a system that would increase the benefits of both approaches for managing uncertainty.

I appreciate your attention and I look forward to working with you during my time as a Commissioner. Thank you.