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Future Trends in Nuclear Safety Research

by

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Good morning, ladies and gentlemen. I am pleased to join you at this opening session of the 25th Annual Water Reactor Safety Meeting. By the large number of attendees here--including those from around the world--I can see that nuclear safety research still commands global interest.

I. INTRODUCTION

This morning I want to discuss with you the challenges, directions and opportunities facing both the nuclear safety research program at the U.S. Nuclear Regulatory Commission (NRC) and, by implication, the research programs of other countries.

We are in a time of rapid change, including changes that many of us have not faced before, and that have direct effects on our research programs. These changes primarily fall into two categories: changes within the nuclear power industry, and reductions in research budgets.

- ◆ Changes in the Nuclear Power Industry: The issues facing the nuclear power industry are different than they were 10 or 15 years ago. In part, this is attributable to the problem-solving contributions made in past years by nuclear safety research programs. In addition, the focus of many nuclear power programs today has changed--from introducing new nuclear plants--to safely and economically generating power from existing plants over their remaining lifetimes. Related issues, such as the aging phenomena associated with extending nuclear plant lifetimes, decommissioning, and

waste disposal are now upon us and no longer just on the horizon.

Along with the technical challenges, the nuclear power industry also faces economic challenges. Chief among these is the deregulation of the electrical generation market, which allows and encourages competition for customers, and increases the pressure to control and to reduce facility operating and maintenance costs. This environment may engender new ownership arrangements and/or new models by which to judge the economics of a facility which, in turn, could lead to new operational entities, the sale of some plants, and the early decommissioning of others. These economic and technical challenges could have unforeseen safety impacts, and research has a role in assessing those impacts.

- ◆ Reductions in research budgets: The increasing pressure to reduce expenditures, as you may well know, is being felt throughout both government and industry. The traditional dominant role of the government in funding research is evolving. Since industry is frequently the beneficiary of the research, industrial entities are playing a greater role. In the U.S., the nuclear safety research budgets of both the NRC and the U.S. Department of Energy (DOE) have declined substantially over the past several years. Currently, nearly the entire NRC budget is recovered through annual fees paid by our licensees. In this environment, how can we ensure that sufficient research expertise and capability is maintained to address current and future issues?

## II. DISCUSSION

The nuclear power industry is not the first industry to face such challenges, and certainly will not be the last. In the U.S. alone, the aerospace, communications, and defense industries have dramatically changed the ways they conduct business. Certain themes can be gleaned from their experiences:

- ◆ First, these industries had to adapt to a different set of rules--and in many cases--to the use of fewer rules as a result of deregulation. This, in turn, produced new market opportunities, the chance to offer new services, but required new ways of doing business. Those companies which recognized and acted on those opportunities did well, and those which did not are, in many cases, no longer in existence.

- ◆ Secondly, competition required vision, new business strategies and new management approaches--rather than simply using the old "cost plus fixed fee" methods.
- ◆ Thirdly, these industries had to learn to do things in a less costly fashion. This included better planning and budgeting, re-engineering old processes to improve efficiency, and utilizing new technology--including improved information management.

The nuclear power industry faces many of these same challenges. At least on the generation side, nuclear utilities are facing competition from coal, gas, and other power producers. As deregulation of the electric utility industry proceeds, nuclear utilities may face increased competition among themselves. These trends increase the importance of holding down costs, improving efficiency, and searching for new opportunities.

At the NRC, we face many of these same challenges. Internally, we are motivated by the desire to improve continually. Externally, as I have partially described, our licensees face a new world. Our other stakeholders are holding us to higher standards. We are being asked to fulfill our health and safety mission with fewer resources. Increasingly, the Congress and our other stakeholders, more than ever, are demanding that we demonstrate value for the money we spend through annual performance reports that focus on outcomes. Our methods of regulation are under constant scrutiny to ensure that we are properly focused on safety-significant issues and on functions that truly are matters of NRC responsibility. They also are demanding that we enforce our regulations more consistently and more fairly.

As many of you are aware, during the past 2 years we painstakingly have conducted an agency-wide Strategic Assessment and Rebaselining, methodically analyzing what we do, how we do it, and what we can do to improve our overall efficiency and effectiveness. Within this Strategic Assessment, one of the Commission focus areas was Direction-Setting Issue (DSI) 22, which dealt with nuclear safety research. The review of this issue identified several areas for improvement in order to meet expected future challenges: (1) we must delineate our research goals for the future, and understand what capabilities must be maintained at the NRC to ensure that these goals are met; (2) we must find ways to use NRC research funds more efficiently and effectively, to share costs and to avoid duplication; and (3) we must ensure that NRC research programs focus on the most risk-significant issues and result in products that are important to issue resolution. I would like to expand briefly on each of these three areas, and to discuss what we are doing to prepare for the future.

#### A. Research Goals

Simply put, our research goals for the future are:

- To anticipate and explore problems proactively, rather than reactively,
- To identify and focus on the most risk-significant issues, and
- To maintain sufficient expertise and capability to respond to our future needs.

Relative to the changes occurring within the nuclear power industry, meeting these goals will be a complex and constantly evolving endeavor. Consider several elements that will shape this undertaking:

- Plants are aging and new technical issues continue to emerge (such as the recent concern over cracking in BWR internals);
- Licensees continue to push for improved plant economic performance (including longer refueling cycles, higher fuel burnups, and higher power levels);
- Some licensees would like to extend the lives of their plants;
- Older plants are being decommissioned; and
- Spent fuel storage is becoming a significant problem for some licensees.

Considering these industry directions and considering the relative risk significance of various issues, the NRC is attempting to define its core research needs. This entails identifying what expertise and facilities should be maintained, and whether they should be maintained in-house, or by using NRC contractors. Maintaining expertise in any given area requires several ingredients.

First, there must be meaningful, useful work to be done--practical research of real importance that will produce either information or a product which, in turn, will help to resolve important and longstanding safety issues, or will be used to advance beyond the current state of knowledge or practice. The approach should treat the issues comprehensively, and may involve a mix of experimental and analytical activities--that is, more than simply running an experiment or developing a computer code. Secondly, the program must be stable. If researchers are constantly uncertain of their own futures, their research is less likely to be focused and productive. In addition, programs that are continually reduced eventually reach a point where termination is preferable to maintaining a pretense of viability. Thirdly, a "critical mass" of individuals must exist, with the right mix of skills, to promote interaction and the development of ideas. Finally, the work should

allow for professional recognition, and participation in conferences and professional societies.

B. Cost Sharing and Cooperation

As resources diminish, sharing costs becomes increasingly essential. Cooperative research programs that serve regulatory needs must be sought out, information and experience shared, and common solutions to common problems identified. At the NRC, we are actively seeking ways to expand our cooperative research with other government agencies, other countries, and industry. Organizations like the Electric Power Research Institute (EPRI) (domestically) and the Nuclear Energy Agency (NEA) (internationally) play an important role. They have been and can continue to be leaders in proposing and facilitating the establishment of cooperative research programs.

In fact, the NRC is nearing the completion of a memorandum of understanding (MOU) with EPRI to better coordinate and to increase our cooperative research. Under this MOU, EPRI will act as a point of contact for our cooperative research with the U.S. nuclear power industry. We also are promoting the use of consensus standards, where practical, as a way of standardizing approaches and solutions to common problems. Some of you are aware of a number of international cooperative activities that are being held in conjunction with this Water Reactor Safety Meeting (WRSB). These include the semi-annual meetings of the NRC Code Applications and Maintenance Program (CAMP), the Cooperative Severe Accident Research Program (CSARP), and the first meeting of a cooperative research program on probabilistic risk assessment (PRA). In addition, two NEA-organized meetings are being held this week--the bureau meeting of the Committee for the Safety of Nuclear Installations (CSNI) and the RASPLAV Management Board meeting. I am pleased to see that, in addition to sharing research results, the WRSB also facilitates expanded and enhanced cooperation in a number of areas.

C. Risk-Informed Research

One of my early initiatives as the NRC Chairman was to push for greater use of risk information and, where appropriate, a performance-based approach in our regulatory activities--risk-informed, performance-based regulation. I believed then, and continue to believe, that a risk-informed, performance-based approach to regulation benefits the agency, the industries we regulate, and the public--through better decision-making, more judicious use of resources, and the reduction of unnecessary burdens.

In developing a proposed strategy for the reassessment of regulatory requirements, and for moving to risk-informed, performance-based regulation, our fundamental objective is to incorporate more risk-informed thinking into regulations and activities which are directed at controlling contributors to risk, so that requirements and actions are consistent with the actual risk importance of the contributors. The most severe requirements and the highest resource commitments should be directed at the highest risk contributors. Less severe requirements and lesser amounts of resources should be directed at less important contributors. I believe it is important for us to have a common understanding on the meaning of the term "risk-informed, performance-based regulation." A "risk-informed" approach means that, in the decision-making process, risk information is considered along with other factors such as the need for defense-in-depth and good engineering practice. Risk information does not become the sole basis for a decision, but rather provides a systematic way of identifying what is important and where uncertainties exist.

Recently, increased attention has been focused on performance-based regulation. Performance-based initiatives should be selected where objective performance criteria can be established for performance monitoring, and where failure to meet the performance criteria results in tolerable conditions for which appropriate corrective action will be taken. Of course, if failure to meet performance criteria could result in intolerable conditions, we will continue to pursue a more prescriptive approach.

An essential component of the risk-informed, performance-based initiative is the feedback of actual experience into the risk-informed activities. As data from performance monitoring of structures, systems, and components are accumulated, the NRC expects licensees to evaluate the impact of the performance data on activities.

As part of its efforts to develop guidance on risk-informed, performance-based decision-making, the NRC staff is developing criteria to judge the contributions to risk of licensees' proposed regulatory changes. These criteria may reference various elements of the Commission's safety goals or their subsidiary numerical objectives, and thus become, in effect, plant-specific applications of the goals and subsidiary objectives.

The development of Regulatory Guides and Standard Review Plans will enable the staff to establish and to standardize industry applications and staff reviews--in anticipation of the increased use of risk-informed, and, where appropriate, performance-based regulatory approaches.

I am pleased to see that a panel discussion is scheduled for tomorrow on risk-informed regulation. This panel discussion will provide an opportunity to exchange views on this important topic.

I believe that assembling leaders from the regulatory, industry, and risk arenas to share their views and experiences with risk-informed regulation will stimulate some lively discussion, and will help to give focus to risk-informed and performance-based regulatory approaches.

The Commission intends to use risk analysis in all relevant regulatory matters, to the extent supported by the state of the art in risk analysis methods and data, and the law. This philosophy was articulated in the 1995 Commission Policy Statement on the use of PRA methods, and is being implemented in NRC functions ranging from inspection to rulemaking. Likewise, risk considerations also must be taken into account in research, as well.

First, as operating experience or the results of other research identifies new issues, each such issue must be evaluated in terms of its relative importance. Risk analysis provides a consistent, systematic framework for this evaluation, since it provides an integrated look at plant systems and potential accidents. Secondly, in planning research on a specific issue, the systematic use of risk information can help to identify what is needed to answer the open question or to reduce uncertainties associated with it. For example, shutdown operations involve a wide range of activities. Which of these pose the greatest risk? What is the level of risk? What could and should be done to reduce this risk? Risk assessment is a useful tool in answering such questions--and, in fact, the NRC staff is proposing to initiate such a study to improve the assessment of shutdown safety issues. Thirdly, risk assessment work itself can identify areas in which research is needed to improve the quality of data or analysis methods. Finally, assessment of risk can be useful in prioritizing research programs. As resources and issues change, difficult choices have to be made as to which programs to continue, and which to reduce or terminate. On a very practical note, recent Congressional action on the NRC FY98 budget may affect some of our research programs, and if any such changes are necessary, we will endeavor to make them in a risk-informed fashion.

### III. INTERNATIONAL COORDINATION AND COOPERATION

As you know, the safe generation and effective regulation of nuclear energy and reactor byproduct materials are topics that transcend national boundaries. Changes to a particular aspect of how business is conducted in one country--such as the current

trend in electric power industry competition and restructuring--can have a direct impact on the world electricity market, and, by implication, on the nuclear power industry around the globe. Emergent issues related to nuclear regulation--for example, the effects of exposure to low-level radiation, challenges associated with decommissioning standards and costs, or waste disposal methods and developments--command attention throughout the world. Therefore, we each must understand our own domestic issues, but, at the same time, we must work within the larger sphere of international energy demands and regulatory activities. This requires sharing knowledge to broaden international perspectives on nuclear issues, and to enhance a global nuclear safety culture.

In the Fall of 1996, a group of regulators from various countries reached consensus on the need for a working group to meet and to discuss the possible formulation of a free-standing, independent international organization specifically focused on the needs of national nuclear regulatory bodies. The most senior nuclear regulators from eight countries--from Canada, France, Germany, Japan, Spain, Sweden, the U.K. and the U.S.--met in Washington in January of this year, and met again in May, in Paris, to negotiate and to constitute formally the International Nuclear Regulators Association (INRA). Emphasizing that nuclear safety must remain the responsibility of the nation states in which the technology is utilized, but believing in the value of sharing regulatory perspectives at the highest policy levels, the Association determined that its aims and objectives would be as follows:

- To establish a forum for the most senior nuclear regulatory officials to exchange views on broad regulatory policy issues (including technical, legal, economic, and administrative issues);
- To build a global nuclear safety culture;
- To encourage the most efficient use of resources in areas of common interest;
- To work to enhance the stature of nuclear regulatory organizations worldwide;
- To seek consensus on how nuclear regulatory issues can be approached and implemented;
- To facilitate international cooperation in regulation;
- To work to advance nuclear safety through cooperation among its members, cooperation with relevant existing intergovernmental organizations (such as the IAEA, or the OECD/NEA), with other national nuclear regulatory organizations, and other groups and organizations, as appropriate; and
- To identify emerging nuclear regulatory challenges.



The INRA will act by consensus to meet these objectives, and will make recommendations to international and national bodies on nuclear safety issues. At the constituting meeting in Paris, the founding members of INRA elected me to serve a 2-year term as the Association's first chairman. Within this role--as well as within my role as Chairman of the U.S. Nuclear Regulatory Commission--I intend to bring forward, for discussion, policy matters related to increasing research cooperation, sharing of research results, and maintaining research capability. Such policy discussions could prove to be useful to organizations such as the NEA which are involved in establishing cooperative research programs and in attempts to address the maintenance of research capabilities and facilities.

#### IV. CONCLUSION

To conclude, let me summarize what I see for the future for nuclear safety research. Clearly, increased cooperation is essential. This includes the increased sharing of costs, information, and issue resolution. It includes both cooperation between industry and government, and cooperation among countries. The role of organizations like EPRI, and the NEA, in facilitating such cooperation will become increasingly important. The development of common solutions to common problems not only will reduce duplication, but also will lead to better solutions through the increased interaction and stimulation that results from the sharing of ideas. We must ensure that adequate expertise and capabilities are maintained, working together within the global nuclear community. Research priorities must be established, based on risk analyses of the issues in question, as well as on the need for information and tools to ensure safe operation in the future. These considerations should guide us in meeting the challenges and opportunities that lie ahead.

In closing, let me again express my appreciation for your interest in our work and to invite your active participation in this important meeting. Thank you for your attention.