Presentation to the 18th Regulatory Information Conference
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"Contributions and Challenges of Nuclear Regulatory Research"

Good morning. Mr. Chairman, Commissioners, NRC staff and stakeholders, I welcome you again to the 18th Regulatory Information Conference.

The Office of Nuclear Regulatory Research (RES) exists to support the Commission and the other NRC Offices with information not readily available and needed for licensing and related regulatory functions. If other offices did not license, write rules, inspect or evaluate performance there would be no need for the Office. Since the Office supports the entire agency, it is very technically diverse. NUREG-1635, which details the annual review of RES products and projects by the Advisory Committee on Reactor Safety (ACRS), identified 15 disciplines in which the Office does research for the reactor program alone. I would add an additional five to seven in support of radioactive materials, waste and security programs. Furthermore, the level of expertise needed to do the work is very high. The research staff has the highest average educational levels in an agency that itself has a very high educational level.

As I will discuss later, RES staff makes extensive use of domestic and foreign collaboration to develop and obtain the information needed to accomplish its mission. As an example, at a Commission meeting in January 2006, the Advisory Committee on Nuclear Waste (ACNW) remarked on the high quality and effectiveness of environmental and decommissioning research that was completed with limited funding but which was enhanced by domestic and international cooperation.

The Office processes a volume of information far beyond that represented by the contract budget and performs a significant amount of research internally, especially with respect to the development, modification, verification and validation of computer codes. Some of this are on display during the RIC at the RES Posters.

Research supports the reactor arena in a significant number of areas. At this meeting, there are sessions on nuclear fuel, severe accidents, seismic issues and digital I&C. There is a session on material degradation, a topic of a joint staff/nuclear industry Commission briefing a few weeks ago. There is also a session on advanced reactors.

RES has the lead for pre-application reviews of advanced reactor designs such as the Pebble Bed Modular Reactor, the Next Generation Nuclear Plant and similar advanced designs. For instance, in October 2005, RES delivered the thermal-hydraulics (T/H) code set needed by NRR for analysis of the Economic and Simplified Boiling Water Reactor (ESBWR). RES was also heavily involved in the certification of the AP1000 design.

Chemical effects testing has been a significant budget driver for the past year. RES expects to complete all currently planned testing by April 2006. As fast as we can, we will post the results of this testing on the NRC's website.

The testing of the HEMYC fire wrap produced important safety results in the past year. There was a poster yesterday on our fire research program, which described the extensive domestic and international collaboration on this subject. Working collaboratively with EPRI, RES published draft NUREG-1824, which provides verification and validation information for advanced fire models used to implement the recent revision of 10 CFR Part 50.48 and National Fire Protection Association, NFPA 805. RES staff have also prepared guidance on fire PRAs.

RES has provided NRR analyses for grid reliability.

RES is involved in developing the technical bases for rulemakings, regulatory guides and other guidance documents. A few examples of these would include the 10 CFR 50.46 LOCA break size, revisions of the cladding performance requirements in §50.46, and revision of the PTS rule (§50.61).

The Office of Nuclear Materials Safety and Safeguards is also supported in a number of areas. Although one of the programs RES supports is called decommissioning, the research actually deals with dispersion, reconcentration, and detection of radionuclides in the environment. Although the initial application is to decommission, the work is relevant to models used to evaluate potential doses in environmental impact statements (EIS), as well as dealing with routine, accidental, and malevolent releases of radioactive material and LLW and HLW disposal.

RES has done dry cask storage PRA's to support risk-informing the regulations for and licensing of dry cask storage facilities. We are working to get data to support fission product burn-up credit for transportation casks. This will support the more efficient use of spent fuel transportation casks. However, this data could be used for criticality calculations anywhere spent fuel is manipulated, such as a disposal facility or reprocessing facility.

RES also conducts technical licensing reviews for NRR and NMSS and inspection support where the specialized skills of the RES staff are needed. RES supports the NRC post 9/11 security activities and incident response activities.

As I started this presentation, I stated that RES supports the licensing offices. How is this done? There are several ways. One of the oldest is a "User Need" memorandum. The Office Director sends me a memo requesting research on a given topic. More recently, and the method I prefer, is the development of a Technical Advisory Group, or a TAG as we say. This is a technical coordinating group made up of RES staff and staff from the organizations we are supporting. In this way, the problem being researched receives the benefit of rapid feedback from the users and the results of the research are more easily communicated to the user. Further, as frequently happens, insights into the nature of the issue of concern evolve as studies progress, so the TAGs help to ensure that the research into these areas remains focused on areas that are of regulatory significance. As I said yesterday, I regard communications between researchers and the operationally-oriented staff very important.

In addition, almost all RES results are published as NUREG's. Most are accessible on the NRC public web site or through ADAMS. This information is thus made publically available to all stakeholders.

I want to talk about computer codes and their role in knowledge management. You will note that many of our poster presentations at this meeting deal with computer codes. Computer codes capture and embody a great deal of what is known about a given phenomenon. For example, the MELCOR code incorporates more than 20 years of severe accident and source term research, both domestic and international research, into the various models used in the code. Documentation of computer codes, the experiments that support and validate code results, and the distribution of and training in these codes are all parts of knowledge management as well as being the tools used by the NRC to evaluate license applications and risk-inform regulatory activities.

A number of our codes are the result of collaborative research and development. The sharing of these codes is also part of knowledge management. Because many of these codes are publically available, although some are export-controlled, they are used in educational institutions and thereby support the infrastructure needed by both government and industry.

RES has collaborative arrangements with the Electric Power Research Institute (EPRI), numerous federal agencies, and more than 20 foreign countries and international organizations. We also have limited grant arrangements with a small number of national and international organizations.

The NRC and the nuclear industry face a number of challenges over the next several years. One such challenge is ensuring that we use the most realistic assumptions and up-to-data when making regulatory decisions. Realism is driven by a number of forces. Some of these are economic while others are driven by other constraints. The use of bounding and very conservative assumptions in either design or evaluations involve trade offs between costs resulting from these assumptions and the costs and technical complexity of analytical methods that go beyond the bounding assumptions. Let us look at two examples.

One example is burn-up credit for spent fuel. Storage for spent fuel must be designed to be subcritical under all conditions. This is routinely based on fairly sophisticated computer modeling validated against certain benchmarks. One bounding assumption is that the fuel has the isotopic composition of fresh fuel. Criticality control is one major constraint that limits the amount of fuel in a given volume. Costs could be reduced if more fuel could be placed in the same volume. This might be achieved if we could accurately factor in the fact that the fuel is less reactive because a great deal of the fissile material U-235 is depleted and some of the fission products poison chain reactions by capturing neutrons. However, this is complicated by the fact that some Pu-239 is produced along with other transuranic elements that either are fissile or poison the reaction. Further complications are caused the decay of both the transuranic and fission product elements with time and thereby changing the reactivity of the fuel with time. In fact, some elements grow in that are either fissile or poisons. Furthermore, there are uncertainties in both the cross sections and yields of transuranic and fission products. I'm not saying that it can not be done, I am saying it will require research.

Another example is decommissioning. When I first became a health physicist in 1970, the public dose limit was generally regarded as 500 mrem/year. Demonstrations of compliance almost always were based on very conservative bounding assumptions. Calculating doses from infinite planes and infinite volumes in soil is far, far easier than finite distributions, some of which are subsurface. However, as public dose limits dropped, compliance could not be demonstrated with these assumptions. We now have to consider trade offs between the costs of waste disposal of very low concentrations of contamination and our ability to more realistically model dose, especially considering the addition of ground water and agricultural pathways.

In both of these examples, criticality and environmental modeling, while the costs of computer hardware have dropped and even the costs of developing computer software has dropped, the costs of developing the experimental data needed in these models and to validate these models has not dropped. In some cases, experimental facilities to get this information are disappearing. In both of these areas, international cooperative research helps us to attain our goals by sharing the costs.

A second challenge is information sources and knowledge management. This challenge is twofold. One is the growth and globalization of knowledge. How do I identify information that would benefit my work that has been done and published by someone else? The other side is how do I make available to new staff the results of all the work that has been done to date. In many cases, the older work is not well documented. This seems to be more of a problem in engineering than science since peer reviewed scientific publication is the major way scientists achieve recognition. I have some references on this issue but I will add, from personal experiences, that experimental scientific procedures -- at times -- are not all that well documented, either. RES is piloting a Knowledge Management internal web site for high-temperature gas-cooled reactor information and the NRC as an agency is initiating efforts in Knowledge Management to try to address these problems. This is an area in which international collaboration is very useful.

The third challenge is new technology, which will drive both the way we work -- computers, for example -- and the issues we must respond to. Reflecting on my 30 years with the NRC, the technology that has changed the most in this period has been in the medical use of radiation and radioactive material. This, in part, is the reason the NRC had to revise Part 35. Between 1975 and 1995, the radioisotopes in use changed, the way they were used changed and the infrastructure that used them changed. I believe that if the expected growth occurs in the power reactor sector and new designs come forward, along with reprocessing and recycling, we may see similar changes. This will likely feedback into the realism challenge.

Human capital, under which I subordinate knowledge management, is our most critical challenge. The NRC's business is processing knowledge. People and their knowledge, skills and abilities is our most significant -- some might say only -- resource. The demands for greater realism, the incorporation of new technology, and the expansion of information sources requires not only the replacement of knowledge, skills and abilities as staff retire but growth in these areas. Yesterday's skills will not solve tomorrow's problems.

The Office of Nuclear Regulatory Research has focused on critical skill hiring and has piloted a K-M portal, but much more needs to be done. We have initiated efforts to build relationships with university graduate science, engineering and applied mathematics programs both to perform work for us and to attract students with advanced research degrees to the NRC. I think the industry, as well some other federal agencies, face similar challenges and needs to undertake similar activities.

I hope I have helped you understand what the Office of Nuclear Regulatory Research does. Many of you interact with a Regional Office, NRR or NMSS. For some, RES sounds like a bunch of ivory tower people. While our offices are on top of Two White Flint, I think we are grey or dirty-white rather than ivory. Our work is directly focused on the agency's mission but as a side benefit provides substantial benefits to stakeholders outside the NRC.

Thank you for your attention. I will now take questions.