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THIRTEEN MONTHS OF LEARNING WITH THE NUCLEAR REGULATORY COMMISSION

Remarks by Dr. Peter B. Lyons, Commissioner
U.S. Nuclear Regulatory Commission
at the
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March 8, 2006

It is a pleasure to be participating with all of you - fellow Commissioners, NRC staff, industry and public stakeholders, and international visitors - in my second Regulatory Information Conference (RIC). I especially want to recognize all the staff efforts in the planning and execution of an outstanding Conference.

When I addressed the RIC last year, I had been a Commissioner for six weeks. I was certainly in a learning mode then, and I continue to be now. While my knowledge base is much stronger than this time last year, I've also learned enough to know that my education will continue throughout my service on the Commission.

The NRC staff has been largely responsible for much of my training during the last year, and my appreciation of the dedication and competency of our staff has only increased. I also benefitted from the mentoring of Chairman Diaz, Commissioner McGaffigan, and Commissioner Merrifield, and from comparing notes with Commissioner Jaczko as we learned together over the last year. I found our Advisory Committees to be particularly insightful in key technical areas and, of course, many interactions with public, industry, and international groups have also contributed to my education over the past year. My knowledge of state issues has vastly expanded through interactions with members of the Conference of Radiation Control Program Directors (CRCPD) and the Organization of Agreement States (OAS).

I've also visited the NRC Regional Offices and 11 of the 65 plant sites, along with several of the key fuel facilities. At each plant and fuel facility site, I left confident that each was operated in a manner consistent with public safety. And from a security perspective, I've been uniformly impressed with the substantial improvements made since 9/11. Last year I focused my presentation on three major themes:

- the importance of safety and actions to assure that another Davis-Besse incident does not recur;

- security; and

- human capital issues.

I'm going to continue a discussion of last year's themes from the perspective of the progress we've made as well as the continuing challenges. I will also comment on two other areas that have risen in importance with me over the last year: adequacy of computer models, and our preparations to meet the coming wave of applications for advanced reactor designs and licenses.

Safety of operating plants was my top priority last year, and it will remain there during my tenure on the Commission. Safety is NRC's primary goal, as it should also be with every licensee. The public rightly demands this focus on safety and nothing we do or allow to occur must undermine safety. Many of my experiences over the last year as they relate to safety of nuclear operations convince me that we are making solid progress in the continuous improvement of our regulatory processes.

Davis-Besse was one of the plants I visited last year to better understand the serious problem that occurred there, and to assure myself that the problem was thoroughly corrected. I was reassured by this visit. Additionally, the visit reinforced my understanding that our regulatory framework depends on questioning minds and attitudes from licensee and NRC staff and management to identify future issues long before they approach such severity.

The NRC issued individual enforcement actions for the Davis-Besse incident. I acknowledge the length of time that elapsed before these actions were completed, but I also recognize that the NRC needed to be absolutely sure it had turned over every "rock." I supported the Commission direction to staff for review of our procedures to improve timeliness in such cases in the future.

As I studied the Davis-Besse Lessons Learned Task Force report in the last year, I was concerned by the similarity of some of those findings to the post-Three Mile Island evaluations. In both cases, neither the licensee nor the NRC was asking enough probing questions and we, therefore, were not fully benefitting from lessons-learned and past near-misses. The NRC's operational experience program in place pre-Davis-Besse was not fully successful. To that end, I have fully supported the NRC's initiative to create an internal lessons learned program.

In addition, I've had detailed briefings on our current operational experience program, which includes information from the Davis-Besse Lessons Learned Task Force. I also represented the Commission at the International Atomic Energy Agency (IAEA) meeting in December on this subject. There have been many improvements in that program after Davis-Besse. I'm convinced that now the NRC has a superb program for carefully screening events from nuclear plants in the U.S. and around the world to extract lessons that enhance the safety of our plants. In a similar vein, I hope that all licensees take the frequent operational experience communications from the NRC to heart and carefully evaluate them for relevance to their own plants. The nuclear industry cannot afford to relearn lessons, we must all institutionalize programs that fully extract lessons and use them to maximum safety benefit.

One of my concerns raised by the Davis-Besse incident involved the safety culture operative in the plant at that time. The NRC has made significant progress since that incident in improving many elements of the reactor oversight program. Several of those improvements address aspects of safety culture. Today, our increased attention to a safety conscious work environment and other crosscutting issues certainly addresses safety culture.

I appreciate the staff's efforts on approaches to further evaluate safety culture in ways that will not undermine the strengths of the Reactor Oversight Program. Information from the Institute of Nuclear Power Operations (INPO) assessments has been a part of this process, along with excellent feedback from the public and industry. After the recent public meetings, I am confident that the staff is working toward a graded approach that will appropriately identify those situations needing further evaluation of a site's safety culture and provide a range of approaches toward performing that evaluation.

Turning for a moment to the contribution of research focused on reactor safety issues, I had the opportunity last year to participate in the international Halden Reactor Project Meeting - and I have to admit that I didn't even know where or what Halden was before my attendance at this meeting. As most of you probably know, the Halden Reactor Project in Norway is an international cooperative research effort under the auspices of the Organization for Economic Cooperation and Development (OECD) and the Nuclear Energy Agency (NEA) with the goal of improving safety and operational performance of current and advanced reactors. It is jointly funded by 18 countries.

The Halden reactor is well instrumented for measurements of direct relevance to reactor safety. Specific projects range from long-term fuel performance, to transient response of fuels including complex LOCA experiments, to in-core crack growth rate studies of key materials.

In addition, Halden's Man-Machine Lab and Virtual Reality Center are devoted to studies of human performance in control room settings that are directly relevant to optimization of safety for current and advanced reactors. Other projects examine the optimum design of control room systems. To my knowledge, no facility in the United States even approaches these capabilities. This work ranges from safety of digital control systems, to design of human-system interfaces, to measurement of human reliability in virtual control rooms.

At the Halden meeting, I was struck by the low level of participation from the United States. One EPRI representative was present as well as single representatives from a few of the key vendors. I left the meeting with the view that we in the U.S. have the opportunity to further inform our own reactor safety initiatives through greater attention to international studies.

As just one example, human reliability studies are conducted at Halden, which provide input to the NRC's analysis of this key area. But the Halden results are derived from teams of European reactor operators, no U.S. operator has ever traveled to Halden for such studies. Maybe European-trained and U.S.-trained operators behave in identical ways under stressful conditions, but I think the U.S. industry and the NRC, perhaps through EPRI, should explore whether this presumption is really valid.

I also want to mention two generic safety issues that are currently under active NRC and industry evaluation: PWR containment sump performance and electrical grid reliability. Both of these

issues deserve and are getting very careful attention. I appreciate that licensees are also carefully evaluating the potential of chemical effects on sump performance. The NRC is supporting this work, which has demonstrated that situations can arise in which chemical effects degrade sump operation. Industry must assure that new and improved sump systems will withstand foreseeable chemical effect complications. I look forward to continued interaction with licensees and staff to fully resolve sump issues.

Grid reliability is another subject with strong safety implications, as evidenced by the risk importance of the Station Blackout (SBO) precursor. Licensees need to work with their Transmission System Operators to assure that their off-site power conditions have not compromised plant safety. The Commission plans to meet with the FERC Commissioners in the near future to discuss how each regulatory body can best work together to raise the visibility of these issues. Recent, very helpful action by FERC served to clarify the range of permitted interactions between licensees and grid operators to meet these goals.

Evaluation of safety is not an area where we can maintain the status quo; we must sustain continuous improvement. We need to cultivate attitudes that continue to question every aspect of operational safety, and we must continue to improve our tools and our understanding of issues underpinning safety.

In closing my comments on safety, I want to commend the NRC resident inspectors for their "front line" vital role in assuring the safety of our nuclear power plants and fuel facilities. With each of my visits to plant sites, I've spent time with the resident inspectors. They have immense responsibility, and I've been most impressed with the skill and dedication they bring to their jobs. Their daily contributions are essential to the Commission's ability to assure the American public of adequate safety at the 65 reactor sites and the 2 CAT I fuel facility sites.

Turning now to the topic of security, I've specifically focused on the security programs at every nuclear power plant and other sites that I visited. The changes implemented by licensees since 9/11 are extremely impressive. Certainly every site is different and that leads to different demands placed upon security operations, but in every site visited, I left convinced that appropriate actions had been taken to greatly enhance security.

The "readily available mitigative strategies" required by the NRC's February 2002 Order to nuclear power plant licensees are being assessed by the NRC in three phases. Based on these assessments to date, significant enhancements to safety and security have been made. I appreciate that plants took appropriate actions under Phase I. Where beyond readily available enhancements have been identified in subsequent phases of this effort, I encourage licensees to carefully evaluate the potential safety benefits gained from further improvements.

During the last year, my views on design basis threat issues have evolved. Today, I more fully appreciate that the NRC must work with our federal counterparts in DHS and other agencies to optimize the overall federal and private integrated response to terrorist threats. This is an issue that extends beyond the nuclear sector and into other areas of the nation's privately-owned critical infrastructure. As a nation, we must utilize carefully evaluated, fully integrated approaches to all security challenges. Where one agency has a responsibility to defend against and/or prevent specific threats, we should not demand that every critical element of our infrastructure retain duplicative

capabilities to defend against that same threat. The NRC has a carefully evaluated Design Basis Threat (DBT) and, in coordination with other federal agencies, should work to assure that any beyond-DBT potential threat to our licensees is appropriately defended by this overall integrated system.

At this time, I am not persuaded that it is in this nation's best interest to require private defensive organizations to increase their capabilities beyond the current levels. For the future, I strongly support the Commission's expectation that the new advanced reactor designs consider security enhancements and the safety/security interface throughout the design process so as to optimize both the safety and security posture of a plant.

And to those who would suggest that the solution to this dilemma is to federalize each private guard force, I will respond that a year of plant visits has solidified my view that the interface between safety and security must be carefully considered and respected. I believe that federalizing these guard forces would undermine integration between safety and security and could compromise plant safety in the name of security.

On a related subject, in the past year significant effort has also been devoted to security of sources, particularly in Agreement States. I first learned about this issue during my Senate service when some States suggested that they play a strong role in the security of sources, in addition to their role in public health and safety.

This sensitive topic has been examined by the Commission in recent months. I believe that we responded appropriately with an inclusive and thoughtful approach to involve the States and achieve our common objective to enhance controls over certain radioactive materials while enhancing protection of public health and safety. The approach involves recognition of the integrated nature of safety and security. I believe that the Agreement States' response to this Commission initiative will define for many years the level of mutual trust and partnership between the Agreement States and the Commission.

Both NRC and the Agreement States will continue to issue the requirements for licensees authorized to possess material above threshold quantities. The Agreement States will inspect and enforce the requirements for their licensees. NRC will continue to coordinate with the States to assure consistent implementation. As of this meeting, NRC and all 34 Agreement States have issued legally binding requirements for increased controls.

Finally, I intend to carefully follow the process that DHS is using and the progress they are demonstrating for comprehensive reviews. I am particularly interested in the results of those reviews as they extend beyond the nuclear sector into other elements of our nation's critical infrastructure. Cross-sector comparisons of security issues associated with these widely varying types of facilities should help the nation best allocate attention and resources among all sectors and provide a framework for the integrated national response that I discussed earlier.

Human capital issues were the third of my three focus areas last year, and the challenges in this area have only increased. The NRC announced this year its goal of hiring 350 new employees - a gigantic undertaking. Our progress to date is good, with about 75 new hires onboard and 85 additional accepted offers, but we have a long way to go. In addition, we are working hard to find the physical space to accommodate the new staff.

Whether viewed from the perspective of the NRC, or licensees, or any of the many other entities requiring new hires with expertise in fields related to nuclear technologies, human capital issues are going to be a serious issue for years to come. At the NRC, almost half of our current staff are 50 or older and 36% are eligible to retire within the next five years. Other government organizations are in similar straits.

Studies at the Oak Ridge Institute for Science and Education have shown that the number of programs to train students in nuclear technology fields has been falling. In 1975, there were 77 nuclear engineering programs in the country. In 2003, there were 33. In a parallel decline, today the number of university research reactors has fallen by about half since the mid-1980s.

The number of nuclear engineering degrees, at all levels, in the U.S. declined from more than 800 in 1995 to 345 in 2001 and only recently has shown a modest improving trend to 448 in 2004. Oak Ridge studies for health physicists also show similar trends. For this profession, "the number of job openings for new graduates will exceed the number of new graduates . . . by more than 2 – 1 over the next . . . four years."

I'd like to relate one response that I heard too often in my plant visits in the last year. At several plants, where the need for improvements in aspects of operations had been identified, a Chief Nuclear Officer or plant Vice President proudly listed the personnel with past superb track records that were being enticed to move to his facility from another highly successful nuclear facility. With these comments, I was to be reassured that the licensee was striving to improve operations.

But I view these comments in quite another light. While it's very positive for the best minds in the industry to share their knowledge and experiences with others, my view of the nature of the personnel crisis in the industry is reinforced every time the only solution to an operational challenge is to "steal" someone from another plant that has demonstrated success. The simple fact is that the industry needs more new experts entering the industry and coming up through the ranks who can address complex issues. If our main problem-solving approach is to play musical chairs with a few industry stars, we are not building a foundation for future sustained excellence.

Human capital in the nuclear arena is a subset of a much larger national issue. We should have serious concerns with the current state of our nation's workforce preparation for jobs in science and technology fields in general. This issue was recently discussed in significant detail in a comprehensive report issued by the Task Force on the Future of American Innovation.

This report noted that the number of science and engineering positions in the U.S. workforce has grown since 1980 at almost five times the rate of the U.S. civilian workforce as a whole. In contrast, the number of science and engineering degrees earned by U.S. citizens is growing at a rate below the growth in the total U.S. civilian workforce. Further, our preparation of qualified science and engineering graduates is falling further behind other nations with each passing year. As Craig Barrett, the Chairman of Intel, noted when discussing science and engineering concerns in the report, "It's a creeping crisis, and it's not something the American psyche responds to well. It's not a Sputnik shot, . . ."

When the report documents that U.S. graduate enrollment in these areas has declined for U.S. citizens by 10% from 1994 to 2001, while enrollment of foreign students has increased in our schools by 25% in the same period, the crisis is very real. While it's to be commended that our schools are a magnet for foreign students to improve their training, and while I believe we should welcome these students to stay on in this country for their careers, the fact remains that many foreign students do return to their native countries. Our own citizens need to become better prepared to compete in the global marketplace of the future.

Another measure of this issue, collected in the compendium of Science and Engineering Indicators compiled by the National Science Board, is the ratio of initial university science and engineering degrees to the population of 24-year-olds. In 1975, this ratio for the U.S. exceeded most of the surveyed nations, except Finland and Japan. By 2000, our ratio was exceeded by 16 nations, including again Finland and Japan, plus France, Taiwan, South Korea, UK, Sweden, Ireland, and Italy, to name a few.

The magnitude of this national issue was highlighted when the distinguished Norm Augustine testified before the U.S. House of Representatives on behalf of the recent National Academy of Sciences report entitled, "Rising above the Gathering Storm," which discusses the loss of competitive edge by the United States because of a lack of investment in education and research. To quote just a bit of his very sobering testimony, he said:

> *It is the unanimous view of our committee that America today faces a serious and intensifying challenge with regard to its future competitiveness and standard of living. Further, we appear to be on a losing path.*

Recently, however, a package of three bills, known as the "PACE" Act, for Protecting America's Competitive Edge, has been introduced in the Senate with widespread bipartisan support (at least 60 cosponsors so far, including both the Senate Majority and Minority Leaders). If passed, this Act will support and complement the President's American Competitiveness Initiative (ACI) announced during his State of the Union address that, among other things, will substantially increase investment in research and development, education, and tax incentives to encourage innovation. Of particular interest would be the proposed doubling of basic research funding more than ten years starting with an average of 9.6% funding increase in FY2007 for the DOE Office of Science, the National Science Foundation, and the National Institute for Standards and Technology.

Within the NRC, I've been very impressed with and have personally supported the range of staff development and recruitment programs that are underway. The Commission has provided fellowships and scholarships, as well as cooperative education programs. In addition, we have strong staff participation in the NRC's various development programs. In previous years, through these initiatives, the NRC met its targets for staff recruitment.

Legislation incorporated in the Energy Policy Act of 2005 provides additional tools to develop and attract qualified new staff. But it remains to be seen if we can meet our ambitious goal for this current year and similar goals in the future.

Knowledge management is an important part of staff development, and this program is being

emphasized at the NRC. By knowledge management, I mean the process by which knowledge gained over decades of work by senior scientists and engineers is translated in ways that facilitate its transfer to, and utilization by, a new generation of workers. The NRC Inspector General's Safety Culture Survey noted that our knowledge management approaches need better definition, development, and accessibility to staff. The NRC is working to assure that such approaches are well defined and consistently applied in order to achieve more effective knowledge transfer. I hope knowledge management programs are being similarly emphasized by each licensee.

In summary on this issue, I'm very pleased that the Commission sponsors a wide range of programs to encourage new graduates in specialities appropriate to our own needs. But the issues of workforce development and human capital are hardly unique to the Commission. The entire industry faces severe shortfalls. If the advertised interest in new plant construction is confirmed with COL applications, there will be increased needs and increased competition for new staff. While any new plant construction will help inspire more students to view nuclear technologies as a secure, long-term career choice, it's unlikely that the supply of new candidates can increase very quickly.

The challenge of workforce development is faced by every industry and every organization represented in this room. For that reason, every one of your organizations should be actively helping students to develop an interest in nuclear science and technology careers. I challenge each licensee to strongly support basic science and technical educational programs at all levels. All of us need to redouble our efforts in conveying to students the excitement and opportunities that await them in science and technology.

Last year, I also highlighted my interest in computational approaches to technical issues confronting the NRC. In a similar vein, a recent article in Physics Today provided strong evidence for the importance of computational methods in virtually all fields of science and technology. The article described computational simulation as having "the potential to join theory and experiment as a third powerful research methodology" – a point of view to which I subscribe. But it also pointed to the need to further improve this important area.

The article noted that the tendency toward larger and larger codes, which couple more and more phenomena together, can lead to inappropriate applications or misplaced confidence in conclusions. The article emphasized the vital importance of accurate physical data.

As a cautionary note to all of us who utilize computational modeling, I'd like to provide a brief quote from G.F. McCormick, in Dr. Nancy Leveson's book "Safeware - System Safety and Computers, A Guide to Preventing Accidents and Losses Caused by Technology":

> *Software temptations are virtually irresistible. The apparent ease of creating arbitrary behavior makes us arrogant. We become sorceror's apprentices, foolishly believing that we can control any amount of complexity. Our systems will dance for us in ever more complicated ways. We don't know when to stop. . . . We would be better off if we learned how and when to say no.*

As it applies to adding greater complexity to our computer models and codes, these are concerns that I've expressed in various speeches and are related to issues that I experienced during my days at Los

Alamos. With this background guiding my own work, I will constantly seek opportunities to validate our codes.

These concerns contributed to my previous comments that we, as a technical community, should assure that we are gaining every possible bit of validating information from complex experiments like those of the Halden Project. It's also why I've pressed for analysis of the fuel damage incident at the Paks plant in Hungary, which may provide validation data for computations describing fuel behavior under accident conditions. It's why I visited the ongoing NRC-funded experimental work on spent fuel storage at Sandia last year and why I've pressed for a full-scale, realistic package performance test.

Similarly, we need to be ready to jettison computational conclusions that reflect previous lower levels of model sophistication. Sandia's 1982 siting study is widely quoted by many groups to describe the radiological consequences of reactor accidents. But that study was done with codes that are antique by modern standards, using non-credible, very conservative assumptions in order to provide bounding values. Use of codes for bounding studies may be useful in limited cases, but users should assure that the extent of the conservatism in such outputs is well understood and carefully stated.

In the past year, I have encouraged efforts to reexamine the 1982 siting study with modern codes, and in many cases codes that have far better validation than those available 25 years ago. I'm pleased that this consequence analysis study will be redone under NRC supervision. The results from this reevaluation will provide invaluable guidance to the NRC, to industry, and to the public in understanding credible accident scenarios from which, if necessary, we can optimize emergency planning and on-site mitigation strategies.

I'd like to close with a discussion of the challenges the NRC, the industry, and the public will face if the number of reactor license applications approaches the levels announced by industry. Industry has briefed the Commission on their tentative plans for COL license applications, plans that currently total about 17 reactors, each with the stated goal to be operational by about 2015.

The NRC is going to be incredibly challenged to respond to any number of applications that approaches these plans advertised by industry. On the one hand, the NRC must and is doing all it can do to build the human capital resources and the infrastructure to accommodate this number. But there are many actions that industry should be taking if their expectation is that the NRC can successfully evaluate this number of licenses.

Industry must maximize standardization of license applications, designs, and construction activities so that the NRC can leverage, to the extent practicable, similar standardization in its review process. This "design-centered" approach will directly contribute to the success of the NRC as we strive to operate with a "one issue-one review-one position" approach. I also stated in a recent Commission meeting on new reactor licensing that the NRC must docket only applications meeting very high quality standards and that we must not compromise our standards to expedite approvals. The burden is on industry to provide that level of quality.

As was also noted in that meeting, staff anticipated an orderly progression of licensing actions starting with a certified design and an Early Site Permit, culminating in an application for the COL.

But it's clear now that few, if any, of the industry's plans are following this model, and that is going to seriously impact the timeline for completing licensing activities.

One component of these new licensing activities involves international activities. I am highly supportive of the proposal developed by Chairman Diaz for the Multinational Design Approval Program, or MDAP. We will exercise Phase 1 of MDAP during our evaluations of the EPR, and I look forward to working with the regulatory bodies of Finland and France in that process.

The Chairman has proposed that MDAP proceed through 3 phases. The first phase involves only sharing of regulatory evaluations and knowledge among international partners involved with similar designs. I anticipate no insurmountable obstacles in successfully demonstrating the Phase I process. Beyond the first phase, I think we must recognize that the process will evolve over time and will benefit from views of our international partners during the process.

But I feel strongly that we must start on the MDAP process now. Each successful phase of MDAP provides greater assurance that plants built in other nations will benefit from the regulatory practices and demands that we impose on our own plants. And if we delay our role in MDAP beyond Phase I, some form of an MDAP will evolve without us. It is far better for us to be involved in the global realization of MDAP than to be faced with some form of MDAP that does not meet the regulatory standards we demand.

As a nation, it is certainly in our national interests to have all nuclear plants around the world operated in a way to provide high assurance of public health and safety. MDAP is an excellent step toward that goal. To the extent that we progress through the phases of MDAP, we will achieve, together with international partners, greater global regulatory stability while striving for the highest levels of public health and safety around the world.

I want to mention in closing that last year provided the opportunity for my first visit to the Institute of Nuclear Power Operations (INPO). I was previously aware of the goals of INPO, and the visit further increased my admiration for that organization. INPO clearly plays a key role within the nation's industry in promoting safe operations of nuclear plants.

During my visit, I saw the granite block used at INPO to describe their key focus. That block – with the word "excellence" partially cut into the stone, representing the idea that achieving excellence is a never-ending task – struck me as a superb way of describing not only the role of INPO, but also that of the NRC. We too must strive for excellence in the management of all our activities and interactions.