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Office of Public Affairs Telephone: 301/415-8200
Washington, DC 20555-0001 E-mail: opa@nrc.gov
Web Site: www.nrc.gov

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THE DYNAMICS OF NUCLEAR POWER TECHNOLOGY AND REGULATION

Remarks of Commissioner Nils J. Diaz
U.S. Nuclear Regulatory Commission

at the

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Activities in and of a free society are either regulated or unregulated. Activities in totalitarian societies are all regulated. It is, therefore, fundamental to a free society to not only have both regulated and unregulated activities, but to ensure that regulated activities are beneficial to society, and that they change, as needed by society.

Regulation is a tool of society to frame what society needs, in an orderly, equitable and fair manner. I believe that the role of regulation is to provide a meaningful and useful framework for the protection of rights and the discharge of responsibilities in the areas of health, safety and the environment. Regulation is to be done only for the people, with their best interests as their essential objective; it is to be done for the common good, with full consideration of the national interest.

Regulation does not make you safe; the safe execution of the regulated activity does.

Good regulation provides for the proper exercise of democratic and free market processes to enhance the common good. It is established to provide a framework that allows for the conduct of individual, industrial, commercial, financial, and other activities. Although all regulations restrict, regulation should not deter beneficial activities, but frame them and guide them. Regulation must be dynamic and keep pace with the technology it regulates. Thus, the minimal amount of regulation that achieves what society needs is best for our society.

Science, engineering and technology are mostly “free” until they become part of a regulated activity. I am not going to discuss these interfaces per se, so let me jump directly to nuclear technology and

regulation. It is more than obvious that regulation, or overregulation, had a deleterious effect on the development of nuclear technology. It is not so obvious that a static nuclear technology had the same effect on regulation. This impasse, probably could not have been helped prior to the present, eventually, but not without pain, the technology and the regulations wiggled its way to the presently high performance and high level of safety of existing nuclear power plants. But they both stagnated over the most rapid pace of technological improvements in the history of mankind. A bit of history would help to emphasize these points:

- the core of nuclear reactor technology is about 40 years old
- the core of nuclear reactor regulation is about 30 years old
- the technology is defined by a docketed design basis, which lasts the plant lifetime, amended slightly by 50.59 changes and a bit more by license amendments

For example, the key reactor safety criteria and regulations, like 10 CFR 50 Appendices A and B, ECCS criteria, etc. are 30 years old and have stood the test of time.

Surprisingly -or perhaps not surprisingly- the industry performance gains from 1985 to 1996 were achieved without technological or regulatory breakthroughs, but by steady, systematic improvements. The overall performance gains, including improved economics, then enabled the industry to make major commitments for stabilization and prosperity, like license renewal, power uprates, and technological improvements; but all of them still bounded by the traditional design basis and accident criteria, and all they entail. The safety performance then enabled major regulatory improvements, like the revised 50.59, the revised Maintenance Rule, Reg. Guide 1.174, and the Reactor Oversight Process. I might add that there is one proven technological fact whose significance probably has not been well understood or well utilized: leak-before-break, but that is the topic of a future speech.

The S curves of nuclear power plant performance have turned for the better and are now approaching asymptotes. For example, capacity factors are in the 90 percent range (see attached figure), and safety indicators are approaching limits of performance. The SYSTEM has learned. The only way to get out of asymptotic behavior, i.e., to improve performance, is to change either the equations or the constants in the equations. No small fiddling with parameters will affect an asymptotic curve. What this nation needs now is a new system of equations to improve the safety and overall performance of nuclear power, to better serve the people in improving energy independence, the economy and the environment. We are expecting new reactors and we cannot afford to wait another 20 years to have "learned systems." Thus the interaction between the technology and the regulations must advance hand-in-hand, that is, in an in-phase manner.

There are a few lessons in the last 30 years that should not be lost to those seeking to reduce to practice what has been learned. One is very apparent to me: nuclear technology and its regulatory framework must be in-phase, compatible and predictable.

It is obvious that the development and sustainability of nuclear power requires careful attention to political, economical, technological and regulatory factors, so that society can benefit the most. Since the "engineering" of all of these is beyond a regulator's scope of activities, I am going to concentrate on one point: the need to have in-phase, compatible and predictable technology and regulation. Let me up the ante: the need is to achieve and maintain state-of-the-art technology and regulation, with a built-in capability to upgrade both by quantifiable discrete steps, without significant lag by the regulator, so the next improved state-of-the-art technology and regulatory framework levels can be reached effectively and efficiently.

Why is there a need to have a built-in capability to upgrade technology and regulations in discrete steps? Competition over long periods of time coupled with the need for top notch safety performance! One fact has unfolded recently in the US to add to the stage: most existing nuclear power plants in the US are expected to operate for 60 years, an eternity in the on-going technological revolution. And new nuclear power plants might be designed and constructed for even longer periods of time.

There are many other reasons, some quite technical. For example, the Large Break LOCA is no longer useful as the dominant accident sequence, and neither conventional defense-in-depth nor the design basis have allowed for significant technological and regulatory innovation.

Does it make sense to operate in 2002 with technological and regulatory constraints 30 or 40 years old? Of course not; no matter how conservative you are - I am particularly conservative myself. It is not good regulatory policy - nor is it good business - to ignore the new goods or not to discard the not so good old ones.

I say it will make even more sense to think of new deployable nuclear technologies and their regulatory framework in non-rigid design basis terms, but as time-dependent upgradable systems --- both hardware, software and management systems --- that are safer, better, more reliable and more economical for the country and its people. I believe that there is a need for dynamically, strongly coupled technological and regulatory systems, that can stand the test of time because they change with time, and they are developed in-phase, using similar wavelengths. Some might question the need for independence. I maintain that the independence of a regulator is exercised at decision-making time and suffers not from a proactive regulatory development that is technology-based nor from strong interaction with the industry and other stakeholders.

My friends, that is why I advocate risk-informed and performance-based regulation for nuclear power . There is really no alternative. A risk-informed, and performance-based regime is more quantifiable and more amenable to change as scientific knowledge, engineering, technological and regulatory know-how increase. By defining integral safety envelopes we allow the technology and the regulation to achieve better performance as the systems learn and improve. It is time to think and eventually implement regulatory policies that are as dynamic as the country needs, policies that do not hamper or delay, but serve the people, based on **reasonable** assurance of protection of public health and safety. The key is that **reasonable** is not a stagnant criterion but one that is dynamic and quantifiable. And therein lies the challenge, to solve the coupled technological and regulatory equations simultaneously, while maintaining independent regulatory decision- making conducive to reasonable protection.

We have experienced what happens when regulation is imposed after the fact on a technology being deployed. It was not possible to do it any other way thirty years ago. But it is now possible to jointly develop nuclear technology and its regulatory framework. There is relevant and extremely valuable experience that has been gained from the Advanced Reactors certification program. This program allows for the resolution of substantive technological and regulatory issues during pre-application and application process. It produced better reactors with minimal patchwork requirements. This experience is the right stepping stone for a new way of doing things.

And, I strongly believe that a new way is needed. The current state of regulation may be acceptable for plants operating today; however, a totally new and complete risk-informed and performance-based regulatory regime is needed now to address the possible deployment of new reactors in the USA, if we are to achieve comparable levels of safety and performance, or better, without waiting 20 years to get to

that asymptotic portion of the curve. I applaud the Department of Energy initiative to work in partnership with the NRC and industry to develop a requisite and innovative regulatory framework, serving safety and reliability. But it is time to be bold and ask what more can we do for our country ... what more can we do for our country; to allow technological and regulatory innovation to be inserted, as needed, at the beginning, the middle or the end of the process, whether designing, building or operating. The tools exist, they are not perfect but they are quite good.