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NUCLEAR TECHNOLOGY: GLOBAL  
ACCOMPLISHMENTS AND OPPORTUNITIES

FROM UNCERTAINTY TO ...

Remarks of Commissioner Nils J. Diaz  
United States Nuclear Regulatory Commission

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Good morning. It is a great pleasure to be here this morning to share views and facts with nuclear practitioners from all areas of endeavor and from many countries. The views I will be stating are my personal views as a Commissioner of the Nuclear Regulatory Commission unless I specifically quote from positions of the Commission as a whole. However, I should say that the positions I will state today are an expression of what I view as the Commission's statutory obligation, put into law by the Atomic Energy Act, to "promote the common defense and security and to protect the health and safety of the public."

The theme of today's session -- "Nuclear Technology: Global Accomplishments and Opportunities" -- has been appropriately chosen. I will focus my remarks on one technology: nuclear power. Nuclear power does indeed stand at a crossroads, certainly in this country. It has accomplished much, and it has the opportunity to accomplish much more, but there has been an "if" hanging around its neck for the last 25 years. This "if" represents the uncertainties that have hampered its progress and potential.

Is it the destiny of the nuclear option to continue its more than 20-year decline in the U.S., and play less and less of a role in electrical generation as the current plants reach the end of their license terms, while in some nations the nuclear option grows? Or will the nuclear option in this country experience a renewal, such that it takes its place as a major part of America's energy mix in the 21st century?

The answer to that question cannot come from any single interest group, because it is a multi-pronged answer. I titled this talk "From Uncertainty to..." because uncertainty has been the common denominator of the problems that have hampered nuclear power and also because there is more than one appropriate answer. Uncertainty or stability?

Several years ago, a book was published by Jack Welch, the President of General Electric, and its title was taken from a favorite line of Mr. Welch: "Control your destiny or someone else will." I think that says it all.

The question of where nuclear power is headed needs to be answered by an active system, not a passive system, that produces improvements in every essential component of its infrastructure. One question I would like to address today is this: if the nuclear practitioners' community does want to see nuclear energy as an option in the decades to come, what must it do to make that happen? Because it is time that the nuclear community focused on what needs doing, not who is to blame, not pursuing improbable dreams, but addressing the whole picture, in an integrated way, and taking responsibility to make it happen. The good times have long gone; new times need to be carved, they just will not happen. I will also address my responsibilities as a member of the U.S. Nuclear Regulatory Commission, because we are very much part of the picture.

I would therefore like to direct my remarks today primarily to the future, but clear-sightedly learning from the past and realistically facing the present. It is the past, after all, through which you figure out how you got where you are today. That is not always a comfortable process -- we are all human, and we find ways of blaming others for failures that affect us -- but it can be a healthy process. So in the course of my talk, I will also try to clear the air a little about how nuclear power got to where it is.

If I had given this talk 25 years ago, I would have focused on five dominant issues. 20, 15, 10 years ago, they would have been the same five issues. And today, they remain the same dominant issues, for this technology, this business, this industry, and its regulatory agency.

The number one issue, then and now, is economics. Economics is a true

reflection of all issues. And the uncertainty in the economics of nuclear power plants has played a major role in determining its fate.

The second main factor is the closing of the fuel cycle. This was an issue at the beginning of the development of the nuclear industry, it is an issue today, and it might be an issue tomorrow. In a sense, the nuclear industry's problems in this regard are the opposite of the problems of many other industries. It had and has no difficulty with the beginning of the fuel cycle, it has good raw materials, good supplies, and good manufactured fuels -- and they are economical. But it may be the only industry in the world that has no assured means of discharging the byproducts of their processes. The industry, and then the government, have not known for sure what it will do with its wastes, and that is a major source of uncertainty, with unprecedented impact on how the viability of the industry is perceived.

The third factor is, how good is this technology and how good is its safety? The light water reactor technology was good and may be an excellent technology today, but uncertainty has always been there: how safe is it? The question and the answer play over and over again, and will continue to play. And there has to be only one answer: Yesterday, it was prudently safe; today, it is safer than yesterday; tomorrow, it should be safer than today. It is the industry, and yes the NRC, that have caused the safety of the technology to increase, and it is right to increase its safety even further as long as costs are prudently considered.

The fourth issue is public information and public and government support -- or the lack thereof. That includes communications with the public, the media, and the Congress, and what support is elicited from the government as public policy.

Fifth and last is the regulation of the industry. How are regulatory bodies in the USA, the NRC developing and implementing the regulatory processes, what is the impact on safety and what are the cost/benefit ratios, and how do the regulators interact with the regulated industry to achieve adequate protection of health and safety? And again, this has always been a source of uncertainty.

All these issues are part of a well-known but not well defined system with multiple feedback loops. [SLIDE 2] They all affect one another: a change or variation in any one changes others and changes the way they interact. Is the system stable?

And changes and events the industry has seen. In fact, this is an

event-driven industry. As one looks at the past, one sees how a single event -- TMI -- drove every one of these issues far beyond its previous boundaries. This was a major reactor accident with no radiological consequences to the public and workers; adequate protection was provided. Yet it cost a lot of money and drove public opinion against nuclear power, it drove Congressional opinion, and it changed the way in which society looked at the technology in this land and most others. It also changed the regulatory requirements, which in turn changed the technology, and of course, it changed the economics of nuclear power.

Thus all these issues are interdependent, so it is therefore appropriate to address nuclear technology holistically, taking all these factors into account. I'd like to take a few minutes on each of these issues, beginning with economics and winding up with the regulatory aspects, which is what I would like to concentrate on, as befits a regulator.

In the economics of nuclear power, there are three components of the cost of a kw-hr, each behaving differently although not independently. First, capital costs. Capital costs for nuclear power plants have always been high and were considered to be the dominant factor. Uncertainty has weighed heavily on construction costs and made capital costs too expensive. Looking at the 1970's, there are two major global events -- two "energy crises" -- that elevated capital cost way beyond expectation. [SLIDE 3] They drove up interest rates, and drove up inflation, thereby increasing the cost of power plant construction and lead to construction delays, which compounded all these problems. The impact is clearly visible on the next slide. [SLIDE 4]

In fact, the 1973-74 and 1978-1979 crises were more a financial crisis than energy crisis. Some people imagined that the oil crisis was going to make nuclear power more attractive; in reality, financial factors make the opposite true. As you know, the broader economic effects of the financial crisis had a devastating effect on the capital cost of nuclear plants and on their deployment. New nuclear plants, yesterday and today, are economical when inflation and interest rates are low, and when the uncertainty of the lead time is essentially eliminated. The events of the 1970's disrupted these factors, and their compound effect was financially disastrous.

In the years when the then new and booming nuclear power industry needed most to borrow money, and was most sensitive to changes in inflation, in the discount rate, and in the time of construction, these factors broke all historical boundaries and skyrocketed. Nuclear power plants in the U.S. were built in the worst ever financial scenario for

large, difficult, costly projects, at a time when electrical demand was low and unpredictable. Plant construction has not recovered.

From a parochial point of view, I believe it can be demonstrated that the NRC, contrary to the opinion of many, had only a small impact on capital cost. And I am obviously defending the NRC. The culprit for the crushing blow to plant construction times was financial conditions and lack of electricity demand, not regulatory requirements. The cost of increased regulatory requirements was small compared to the financial factors.

When the energy and financial crisis of the Seventies and early Eighties was over, even operating the industry found itself with spiraling costs. It was not the fuel; industry had always counted on low fuel cycle costs, and in fact those costs are still relatively low, probably aided by low demand. [SLIDE 5] The industry was, however, also counting on low costs for operation and maintenance, but O&M costs instead kept increasing, with regulatory requirements increasing due to the event at TMI, and later a few reactor events and backlash from Chernobyl. [SLIDE 6] In response to TMI, the NRC established regulatory requirements that demanded performance of the industry beyond what could be accommodated at that time. The cost was very high. It is in O&M that the cost impact of the regulatory demands were felt over many years; in fact, this was a dominant contributor to the rise in O&M cost after 1980. The correlation between NRC regulatory actions and O&M costs is quite striking: according to a 1995 report of DOE's Energy Information Administration, a 1% increase in NRC regulatory actions was associated with a 0.5% increase in real O&M costs. Finally, the industry has had to face the mounting cost of decommissioning.

Thus the industry faced a double whammy: first soaring construction capital costs and then higher O&M, just when it thought it would be reaping the economic benefits of nuclear power. O&M continued to increase until about 1987, when nuclear production cost became more expensive than coal. [SLIDE 7] Without a clear edge over coal, and with complicated operational and regulatory requirements, growth stopped.

What has happened to the economics picture today? There is no question that these financial factors are more favorable today than ever in the history of this industry. In fact, the financial picture is the opposite of the 1970's. Reactor fuel cost is still low, O&M is stable and coming down, and for new plants the combination of low inflation, low interest rates, and predictable lead time with certified standardized designs appear to indicate that competitive costs are reachable. The financial uncertainty has been significantly reduced today; but now comes

de-regulation, and here we go again. But economics are only one factor out of five, and as I have said, you have to look at the whole picture.

The second issue: closing the fuel cycle, an issue of classical uncertainty, global in scope and political in nature. In the beginning, the industry was counting on reprocessing and recycling to make the nuclear fuel waste problem one of hundreds of years. Instead, the situation today is one in which waste disposal is a problem of thousands of years, with the waste of higher radiotoxicity and more costly to deal with than originally planned.

The Nuclear Regulatory Commission has addressed the issue of a permanent repository. I'd like to quote what Chairman Jackson, speaking for the Commission, said recently in a letter of October 9, 1997, to Governor Tony Knowles of Alaska, the Chairman of the Western Governors' Association:

[It is] the Commission's view that an integrated high-level waste management system is needed for protection of public health and safety and the environment. The elements of this system include interim on-site storage, centralized interim off-site storage and deep geologic disposal, together with a transportation mechanism to tie the elements together.

This view has been expressed to the U.S. Congress and the Administration. This unresolved health and safety issue now appears again closer to resolution, as the reality of its importance weighs on the national scene. While the fundamental responsibility for resolving this issue lies with the Congress and the Executive Branch, the NRC is continuing technical reviews and inspections of all phases of high level waste management within its responsibility.

Let me interject at this point that I would like to recognize Senator Domenici for taking the initiative in discussing this and other issues related to nuclear power in his recent speech at Harvard and today. As a matter of public policy, the issue of whether and how this nation uses nuclear power in the coming century is of vital importance to every American. 20% of the electrical supply of the United States is an issue of common defense and security. It should not be decided by default, through a failure to confront the questions involved. So all Americans, whatever their views on the nuclear power issue, can be grateful to Senator Domenici for his willingness to make nuclear power the subject of public debate.

The third issue: nuclear technology and its safety. As nuclear technology developed, we dealt with safety issues in parallel, in an evolving way, reflecting our growing experience and knowledge. Today, with a mature industry, it can be said with assurance that the present industry and the regulatory body have resolved the majority of the significant operational safety issues. There are still issues being worked out, to be sure, but when the NRC allows a plant to operate today, the Commission is expressing its position that it meets adequate protection of health and safety. Period. No worker or member of the public has received a radiation dose exceeding federal limits and the overall safety performance of nuclear plants keeps improving, as shown on the next slide. [SLIDE 8]

What can you look for in the future in this area? Continued improvements in present reactors from information technology and I&C to maintenance and configuration control. Also, the NRC has certified two advanced reactor designs that provide two orders of magnitude additional safety margins on top of the already high degree of safety. This enhanced safety of present and future reactors goes a long way, in my view, toward resolving the impact of safety as an issue affecting the viability of nuclear power plants. In this area also, then, uncertainty has been reduced.

The fourth issue: public information. Here I have to say that nuclear practitioners, the industry, the NRC, and the AEC before it, have done a very poor job. And my main concern is that in the rhetoric, and in the frequently poor or imprecise information given, often speculative and alarmist, the people of the U.S. have been shortchanged or directly harmed. Because, I ask, who pays when the health and safety impacts of a reactor site undergoing decommissioning are grossly exaggerated? Who pays when minor events, devoid of safety significance, are described in such a way that members of the public are made to believe that they have narrowly escaped a catastrophe, or there is an impending one?

The answer is that everyone does: the industry pays, the regulator loses credibility, the ratepayers pay more, and most of all the public, one way or another pays. To give people inaccurate or distorted information is to cheat them of the means of making sensible decisions on issues that affect the quality of their lives, their homesteads, the very ground they walk on.

We, all of us, must be candid and up front about events that have an impact on safety. Nothing could be more counter-productive than to try to hide adverse information. And today, with instant information, it is even

worse than counter-productive, it is wantonly self-destructive. By the same token, however, I think we do the public, the media and government agencies no service when we inundate them with news about non-events. For example, every time we begin startup of a nuclear power plant, we bombard FEMA, the Governor, and local media with notifications that are devoid of any safety significance. Thus we have: "Event Notification: Plant X is warming the reactor coolant prior to startup." And in small letters: "this is not an event."

How this country began this inflated, continuous news barrage about nuclear power plants I'm not sure anyone knows. Perhaps it was thought that the public would be reassured by news of non-events. But the corollary of the old proverb that "no news is good news" is that most people probably assume that when they do read news about an occurrence at a nuclear plant, it is really bad news, with some safety significance. Imagine being a well qualified and responsible Governor, but with no training in nuclear reactors, who is handed a piece of paper reading, "Event Notification: the reactor is going to Mode 3." What is that Governor supposed to think of such a notification? News are made from "radioactive coolant leak" with zero dose to the public while everyday thousands of Americans receive radiation doses from medical uses important to the preservation of their health with zero news.

Not long ago, the New York Times ran an intelligent and thought-provoking article comparing how two agencies -- the NRC and the Federal Aeronautics Administration -- approached the news. In a nutshell, it suggested that the FAA sometimes gives out too little news, whereas the U.S. NRC puts out a notification every time someone at a nuclear plant falls off a ladder.

So I think that industry, technologists, and regulators alike have contributed to creating a situation in which media coverage of nuclear issues tips in the direction of overstating risks. (The New York Times article I cited is an exception to that generalization.) To me, this means that we need to do a better job of public communication, of saying what has to be said in terms that are readily understandable, and not easily misunderstood or distorted. And since balance is necessary, it should be well understood that wild, unsubstantiated, unrealistic claims about the goodness of nuclear power are not very helpful. A reality check is needed.

Another part of the remedy is for nuclear practitioners, the industry, and the NRC to stand up for the truth, and object, firmly and categorically, whenever misinformation on nuclear issues is placed in circulation. This is not a matter of being pro-nuclear, or anti-nuclear,



it is a matter of being pro-public and pro-truth.

Just so there is no misunderstanding of what I just said, let me emphasize that I am not here to bash the press. I used to live in a country with a controlled press and know how destructive it can be. That gives me all the more reason to appreciate U.S. news media -- with all their strengths and all their weaknesses. So should every American. To choose between a free press that often makes errors and a press that never made mistakes but takes exclusive direction from the Government is no contest for any one of us: the free press wins hands down. But the responsibility for ensuring balanced press coverage can not be placed on the press alone. It also depends on knowledgeable and informed people offering their views, pro and con, as our democratic institutions allow. I would go further and say that democracy does not merely permit exchange in the marketplace of ideas, it depends on it.

Fifth and last, I want to talk about the NRC regulatory infrastructure, the need to decrease its impact as a source of uncertainty, and the continuing drive to make its products consistent with its health and safety mandate, within the prudent envelope of cost/benefit analysis.

As I have indicated, I believe that the enormous increase in the capital costs of nuclear plants resulted primarily from the increased cost of money and escalation during construction, not from regulatory changes by NRC. However, it is also true, as I mentioned, that the increases in O&M costs in the 1980's are closely correlated with NRC regulatory demands. These costs have been decreasing, however, independent of regulatory operational safety demands, because the industry is now better able to keep costs down, regulatory requirements are quite stable, and with some notable exceptions, e.g. Millstone, utilities have been able to deal with the additional design basis requirements at modest additional cost.

There are probably some who would like to ignore all other factors and say that the NRC and its changing regulatory requirements are to blame for the decline of nuclear power. Regulatory agencies are easy targets. I think this would be non-factual, however, and also a distraction from the real task at hand, which is to deal with the present and prepare for the future. We take part of the credit, but not all the credit. In fact, I would like for you to accept whatever position you are responsible and then get on with life. The Commission recognizes that it is essential for any safety and health regulatory agency to provide stable, yet improving requirements that keep pace with the technology it regulates and with societal needs. After all, we serve the people of this country, and it is

their quality of life that is central to our mission.

I have said that nuclear technology is multidimensional and evolving, becoming better with time. The regulatory infrastructure, which is also multidimensional and evolving, must likewise become better with time. Therefore, the key question for the NRC is how to determine where and how the regulatory requirements intersect with the technological issues, and to ensure that it evolves in synch with technological developments. How do we define better where the intersections are? How do these intersections make the nuclear plants safer? What are the state-of-the-art tools to maintain safety and accomplish it at minimum cost? For our mandate from the Congress, and also what the President and the American people expect, is that we do what is required for health and safety, but without imposing unnecessary costs. Necessary costs yes, unnecessary costs no.

The nuclear technology interaction with the regulatory structure begins with the filing of the Preliminary Safety Analysis Report (PSAR), and from there on, a proliferation of intersections takes place between the technology and the regulatory framework. The complexity of nuclear technology and the complexity of the regulatory framework are such that we have an extraordinary number of intersection points between the two: a multidimensional matrix so tight as to be represented by the knots of two woven fabrics: the regulatory fabric and the technology fabric. [SLIDE 9]

And it is essential for the technologists to learn the intricacies of the regulatory scheme; indeed, they need to become experts at regulation. For it is by understanding the requirements imposed by regulation at every intersection point that the industry can best address the issues and find safe, practical solutions for implementing those requirements. Likewise, it is essential that the regulatory body have the necessary technological expertise. Balance depends on the interaction of a technologically sophisticated regulatory agency with an industry sophisticated in its understanding of the regulatory process. As in so many other aspects of our precious democratic system, balance is the key to making the system function and prosper.

If a particular intersection is not at a safety-related point, and does not contribute to the better protection of health and safety, we, the regulators, need to hear that, and hear it loud and clear and delete the requirements that do not contribute to safety. Because it is the industry that manages radiation risks; the NRC establishes the requirements. Industry is the first line of defense and the second; the NRC serves as a

distant -- but, we trust, strong -- additional line of defense. Because the main role of the NRC is to enable the industry to do well its job of protecting health and safety, while maintaining a safety net capable of ensuring it.

The NRC's success needs to be measured by how strong, capable, efficient, and effective the nuclear industry is in discharging its responsibility under the requirements established for the benefit and protection of the American people. Because in democratic societies, regulation is not control. Chernobyl was the product of control without regulation, and we learned much from it. An effective regulatory infrastructure in a democratic system is driven by concern for safety, health, and quality of life.

I think we should not be satisfied with a nuclear regulatory structure or technology that is merely good. I think we should be striving for excellence, for two fabrics like those of fine carpets, that become stronger at their intersecting knots, improving with time. We need fabrics that are complete, not marred by holes and patches, and that can be used, at a cost proportionate to the benefits they provide, predictably.

And if there were just one thing I would ask you to consider and perhaps take to heart from this presentation it would be this: the only way today to provide predictable and balanced regulatory requirements, where safety is always dominant, is to make the regulatory fabric risk-informed. Only a nuclear regulatory infrastructure permeated by risk-information can improve effectiveness and efficiency; only a nuclear industry permeated by risk-information can manage power plants with clearer, more precise, safety-focused operational and regulatory requirements, forming an integrated and cohesive net.

So what is the NRC doing? For one thing, we have embarked on a revision of our regulatory structure, aimed at developing more consistent, integrated, more risk-informed regulation. Though we know that our ultimate objective of performance-based regulation is not around the corner, we have the capacity now to make our regulations more risk-informed, and we are moving in that direction, keeping in pace with the technology. The result of this will be, I believe, regulations that are more cost-effective, better integrated, more truly tied to safety, and less onerous on licensees.

As I indicated earlier, we have also approved advanced reactor designs. In tandem with that, we have adopted new and more efficient licensing procedures that will apply when pre-approved designs are

selected. This, if and when the regulatory fabric becomes fully risk-informed, will improve the timeliness and predictability of the NRC's adjudicatory proceedings.

[SLIDE 10]

However, even though nuclear technology and its safety, many economic factors, and maybe even waste disposal could be more favorable to nuclear power than in past years, and even though the NRC is taking steps as I have described to improve its regulatory structure, none of this guarantees that the nuclear option will be viable in the years ahead. The industry is facing competition and deregulation, issues of which the NRC maintains a continuous awareness, so unless financial institutions have the confidence that nuclear plants will continue to be viable, the financing to improve or maintain existing plants or to construct a nuclear plant might not be available. Second, the technological infrastructure must be there. If the companies that used to produce the pumps and valves, and the rest of nuclear plant's infrastructure no longer do so, because they have decided that nuclear energy has run its course, another new and large obstacle will have been created. Again and again, we see how central a role uncertainty has played over so many critical issues fundamental to nuclear power.

What I just described underscores just how important one issue, more important than others is: license renewal and plant life extension -- is for the future of the nuclear option. If the current generation of nuclear plants is allowed to shut down, without plant life extension, that cannot help but have deep implications across the board for the future of nuclear power in this country. It will be a clear signal to the public, the financial institutions, the technological infrastructure, and the Congress that the odds of nuclear energy being part of the energy mix in the 21st Century have lengthened.

Accordingly, I believe that the NRC must regard a vigorous, risk-informed license renewal program as an important priority, because it is so important to the energy security of the U.S. It is not within our authority to direct licensees to apply for license renewal, but we can certainly ensure that if and when they do so, the process, with all due safety and health considerations, is predictable and timely. And I have said predictable twice.

I realize that nuclear regulators must steer clear of being promotional. It is not promotional, in my view, to state my belief that it serves the American people well not to have their energy choices foreclosed unnecessarily. It also serves them well if their Government works efficiently, and if electricity is supplied without costs being increased by regulation beyond what is necessary to ensure their health

and safety.

I titled my talk, "From Uncertainty to..." I purposely left the ending blank. What will the end of the phrase be? It has yet to be written. I believe, however, that the NRC, this industry, and this country are mature enough to determine what the end of the phrase will be.

For the NRC, the ending has to be, "from uncertainty to predictability," as we carry out our mandate to act with regard for the common defense and security and for protecting the health and safety of the public.

I thank you for the opportunity to share my views with you.

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