NRC NEWS

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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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PREPARING FOR A NUCLEAR FUTURE

Remarks of
Dr. Richard A. Meserve
Chairman
United States Nuclear Regulatory Commission

before the
Sociedad Nuclear Mexicana
and the
Sociedad Mexicana de Seguridad Radiológica
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I. Introduction

It is an honor to be invited to present the keynote address at this joint conference of your two distinguished societies, which have contributed so much to the safe use of nuclear energy in the Americas.

It is also a great pleasure for me personally to be here. As some of you may know, I took a doctorate in physics before studying law. At the Nuclear Regulatory Commission (NRC), I have had the good fortune to be able to combine both interests. Mexico, of course, is the cradle of both science and government in this hemisphere. To those who are interested in the history of science and of government, what was being accomplished in the central Mexican plateau almost two millennia ago -- at Teotihuacán, for example -- is staggering, and worthy of a pilgrimage.

If one looks at the achievements of ancient Mexico -- not only in architecture, astronomy, and sculpture, but also in the creation of governmental structures -- one is continually struck by the sense that these were people who were building not just for the present, but also for the future. Perhaps this perspective is one of the qualities that defines a civilization: that it possesses a sense of time; that it takes long views; that it values what it has received from the past and feels a corresponding

responsibility to the future to preserve those achievements, to build on them, and pass them on.

The last several decades have not been kind to long views. Perhaps the speed of modern communications and the opportunity for instant access to the latest information subtly pushes individuals and societies to the quick fix, the current fad, the placement of the ephemeral above the enduring.

Is this trend permanent and irreversible? I, for one, do not believe so. On the contrary, I view the current emphasis on the moment as no more than a swing of the pendulum that ultimately will prove to be self-correcting.

The relevance of these observations is that all of us here are involved with a technology that in every respect is based on taking long views. Choosing the nuclear option entails a willingness to contemplate investments of time, money, and human capital, including education, on the promise of returns that are collected over decades. It requires self-confidence to make such a decision, as well as confidence in the capacity of one's society to deal with the economic, political, and other challenges that will inevitably arise during any span of time of such length.

It is in this context that I would like to respond to some of the fundamental questions about the future of nuclear power: Where does the nuclear option stand today? What can we reasonably expect for it in the foreseeable future? And to the extent that there is uncertainty as to what lies ahead, what should be the posture of the nuclear industry, and of the schools that train nuclear engineers, in the meantime?

I would briefly answer those questions by stating that the nuclear option is in sound condition today from the standpoint of safety, economics, and environmental effects. The signs for its resurgence are highly positive, even if there is uncertainty as to precisely what we can expect and when. And, as a result, it would be imprudent for societies to neglect the educational and other human infrastructure that will be needed when that renewed demand for nuclear energy presents itself.

Before I go further, I should interject that I am a regulator of nuclear power, not a promoter. It is not my role or that of the NRC to encourage electric utilities to build and operate nuclear power plants, and nothing that I say today should be understood otherwise. However, in stressing the NRC's role, I do not mean to leave you with the impression that the government of the United States is neutral as to the desirability of nuclear power as part of our country's energy mix. On the contrary, our Congress has made abundantly clear, in one statute after another, that it regards the existence of a sound and well-regulated nuclear industry as vitally important to the national interest. And similarly, our President has emphasized the importance of nuclear power as part of our energy portfolio. So it is within the context of that national policy judgment that the NRC operates as an independent and impartial regulator.

II. Nuclear Power Today

With that introduction, let me begin by talking about the state of nuclear power in the United States today, including the issues of performance, economics, operational safety, physical security, risk-informed regulation, and waste disposal. To a great extent, of course, these issues are intertwined and inseparable -- a high level of safety translates into improved performance, which in turn means greater economic attractiveness.

PERFORMANCE, ECONOMICS, AND SAFETY.

At present, the United States has 103 operating nuclear plants, representing almost 20 percent of the Nation's electrical generation. Those figures have stayed more or less unchanged for many years. What has changed, however, is the performance of the plants.

A dozen years ago, the overall performance of the U.S. nuclear industry was, to be quite frank, mediocre. The average plant had a capacity factor under 70 percent, and the average number of unplanned reactor scrams was nearly two per unit every year. That high number of scrams meant greater challenges to safety systems. In 1990, we saw on the average about one safety system actuation per plant, and there were four safety system failures. Again using averages, nearly half of our nuclear plants experienced a "significant event" in that year -- not an impressive record.

Not surprisingly, when the electric utility industry began to be deregulated in the mid-1990s, there were many who were ready not only to dismiss the possibility of new nuclear construction, but also even to predict that existing plants would be shut down before the end of their useful lives. Those who had never approved of nuclear power were probably the quickest to pronounce it doomed. But even those who took a more favorable view of the technology were concerned.

Instead, we saw a marked turnaround in industry performance -- a trend that has continued. Average capacity figures have risen to about 90 percent, and the average number of scrams per plant is a quarter of what it was in 1990. In tandem we see a marked improvement in safety, with rates of safety system challenges and failures less than half of the 1990 figures, and a remarkable reduction in the number of significant events -- down by more than a factor of 10 from the levels of 1990. Other performance indicators, including collective radiation exposure to plant personnel, have also shown improvement.

In economic terms these statistics mean that the production cost of nuclear-generated electricity is now less than that of either coal or natural gas, its major competitors. And contrary to the mass extinction of the nuclear plants that some people were foreseeing, one utility after another has been applying, or signaling its intention to apply, for renewal of its license. It now seems likely that all or almost all nuclear power plant licensees will seek life extension.

This does not mean that all challenges are behind us. We have recently seen at the Davis-Besse plant in Ohio a reminder of the need for constant vigilance on issues of plant safety. In that case, the plant shut down for an outage in February of this year, and, in accordance with an NRC bulletin, began to inspect reactor pressure vessel head penetration nozzles for cracking. Cracks were found, and as the licensee began to repair them, it discovered that boric acid corrosion of the pressure vessel head had created a cavity that extended all the way through the carbon steel head to the stainless steel interior cladding. Plainly there was a serious degradation of safety. On further investigation, the NRC found that there were numerous indications of the problem that the licensee had overlooked. The event reminds us that if licensees -- or regulators, for that matter -- begin to take safety for granted, we invite trouble. The fact that nuclear power has had a good safety record in recent years is not a justification for complacency. Without a probing, questioning attitude, problems are not going to be detected as quickly as they should be.

PHYSICAL SECURITY.

I would next like to discuss the physical security of nuclear power plants -- an issue that has been on the minds of many. As all of you know, the events of September 11, 2001, have added a new urgency and new dimensions to this problem.

On that day in September, I and my colleagues looked out from the windows of the NRC headquarters building and, on the horizon to the South, saw the plume of smoke rising from the Pentagon. It is an image that none of us will ever forget. The attacks of September 11 brought home to us, to the American people, and to our elected leaders just how vulnerable a modern society is to the actions of malevolent enemies. Since then, we have seen other evidences of this vulnerability, including the use of anthrax spores sent through the mails. We have learned to live with additional security measures in various aspects of our lives: delays in receiving mail as letters are irradiated against biohazards, delays in boarding planes as travelers' shoes are inspected, and many other similar examples.

In the first surge of public anxiety after September 11, there were some -- a relative few -- who called for the shutdown of all nuclear power plants on the grounds that the consequences of a successful terrorist attack on a reactor would be catastrophic. With the passage of time that kind of sentiment has largely subsided. There is widespread public appreciation of the fact that nuclear power plants have been built to a robust standard unlike other civilian structures. While we are not yet in a position to say definitively what the current generation of nuclear facilities can withstand, we do know this: that of the countless possible targets for a terrorist to attack, few, if any, have the inherent defenses of a nuclear power plant.

Nuclear plants are built to be formidable; they are constructed to withstand hurricanes, tornadoes, and earthquakes. They are protected by multiple fences with surveillance and detection systems in place at all times. They are guarded by well trained and well armed security forces. And none of this, I would emphasize, is some hurried response to a danger we became aware of only in the past 14 months. On the contrary, the need for defense to a possible terrorist attack is something that we have included in our regulations for a quarter century.

Nonetheless, the NRC has also taken a number of steps to make the plants even more resistant to attack. The Commission has issued over 30 safeguards and threat advisories to the major licensed facilities, placing them on the highest security level. Many of these strengthened security measures have now been elevated into requirements. These include increased security patrols, augmented security forces, and enhanced coordination with the law enforcement and intelligence communities.

The plant owners have also improved access control at nuclear power plants, recognizing that a knowledgeable insider might be able to provide valuable assistance to would-be attackers. Among other changes, the regulations governing individuals with unescorted access to facilities have been tightened significantly.

The Commission has also intensified its inspections of nuclear power plant security. In the past, each plant was inspected every eight years; we are moving inspections involving force-on-force exercises every three years. This effort has already commenced with table-top exercises that include Federal, State, and local law enforcement and emergency planning officials.

Finally, the NRC is working closely with the Office of Homeland Security and other agencies to improve our defenses against the possible use of radiological dispersal devices. This means greater controls over radioactive sources at every stage, including production, use, transportation, and disposal.

The question is often asked whether concern about terrorism will have a negative effect on public attitudes toward nuclear power? I myself doubt it. I think that there is a widespread consensus that, for the time being at least, the danger of terrorism is a fact of life, and that the way to deal with it is by combating the terrorists and preventing them from striking, rather than by engaging in a futile effort to identify and eliminate every possible target. If we were to shut down nuclear power plants for fear that they might be attacked, the same logic would dictate that we should also dismantle our skyscrapers and decommission our bridges, tunnels, and dams. Such an approach would hand terrorism victory on a platter.

In sum, I think the U.S. public appreciates that it is necessary to take a comprehensive and integrated approach to the defense against terrorism, rather than singling out just one of many possible targets. Nonetheless, important issues remain. In mandating higher levels of preparedness at nuclear facilities, we face the question of where the licensees' responsibility leaves off and the government's obligations begin. The Commission directed licensees to increase their capacity to deal with acts of terrorism, but at the same time, we recognize that some attacks might exceed the capability of a private guard force to repel. Government must fill the gap.

A related thorny issue with country-wide application is that of reconciling our commitment to openness -- the principle that the public has the right to know how the public's business is conducted -- with the need to keep sensitive information away from those who would use it for destructive purposes. This is a particularly difficult topic, because withholding information is too often perceived as covering up failure rather than securing a legitimate public interest.

Finally, we need to be sure that neither licensees nor regulators are devoting so much attention and so many resources to physical security issues that we allow our attention to the ever-present task of preventing nuclear accidents to diminish. Safety must be the abiding focus of the NRC and our licensees.

RISK-INFORMED REGULATION.

Before the events of September 11 elevated the NRC's attention to security, the Commission was engaged in reforming its regulatory philosophy. The evolution toward risk-informed regulation at the NRC has become a central theme in the agency's activities. Historically, the NRC employed a deterministic approach, with a philosophy of defense-in-depth. Nearly 40 years of operating experience, and some 25 years of progress in the development of probabilistic risk assessment (PRA), have given us new tools with which to refine our regulatory approach.

The Commission refers to this as risk-***informed*** regulation. There is a reason for using that term, rather than "risk-***based***" regulation. We have not jettisoned the existing structure of deterministic regulations, and we do not rely on risk analyses alone. Instead, we have moved in careful, deliberate steps to use the insights derived from PRAs to make our regulatory requirements correspond ever more closely to the safety significance of the subject matter.

This approach is doubly beneficial. It means that licensees and regulators can devote more resources to the areas of greatest risk, while allowing regulatory burdens to be reduced where this can

be accomplished without compromising safety.

The shift toward risk-informed regulation is a complex and challenging task, as the Commission has sought to mesh new and traditional approaches to ensuring safety. One example of the use of risk insights is our revised maintenance rule. It utilizes risk assessments throughout: to verify the adequacy of the risk assessments for the existing plant configuration, to perform additional assessments before conducting maintenance activities, to use risk assessment tools to ensure the availability of key safety functions, and to identify and implement appropriate risk management activities. What this means is that there may be circumstances in which it is actually safer to perform maintenance while the plant is on-line than during shutdown status.

Another area in which the Commission has incorporated a risk-informed philosophy is in the new reactor oversight process (or "ROP"), which was developed in an effort primarily to focus attention on the areas of greatest risk. Our purpose was also to increase the efficiency, objectivity, and predictability of the oversight process. The ROP seeks to direct greater regulatory attention to facilities with performance problems; to give all stakeholders timely and understandable assessments of plant performance; to minimize unnecessary regulatory burdens; and to ensure consistent and risk-appropriate responses to regulatory violations.

The effort to risk-inform our regulatory system will likely be a continuing activity of the Commission for years to come.

WASTE MANAGEMENT.

Let me spend a moment to discuss spent fuel.

If nuclear power is to have a future, the issue of waste management must be resolved. The matter presents not one issue, but many rolled together -- issues of technology, geology, politics, and economics. For many years, as the volume of spent nuclear fuel accumulated, interim measures were applied: reracking in spent fuel pools, for example, and later, the use of dry cask storage. But the absence of a facility for permanent storage hung over the nuclear option. To opponents of nuclear power, the lack of such a facility was proof that the waste problem was unsolved and therefore insoluble. In recent years, as the search for a suitable depository narrowed to Yucca Mountain, in Nevada, the debate became deeply political, with the state government of Nevada strongly opposing the Yucca Mountain facility and the Federal Government in Washington supporting it. Finally, this past summer, the Federal Government's endorsement of the Yucca Mountain site came to a vote in the U.S. Congress. By a wide margin, bipartisan majorities in both Houses of Congress voted not to disturb the President's finding, and thereby authorized the project to go forward.

The NRC is responsible for licensing the project. Our role is to exercise our independent judgment as an expert technical agency and decide the issues as they are developed in an administrative hearing. I will not prejudge whether the Department of Energy's application for a license will satisfy the NRC's exacting regulatory standards for a permanent waste repository. I will say, however, that if we *do* approve DOE's application, I am confident that the public health and safety will be protected, now and in the future. Our regulatory standards require a demonstrated capability to comply with stringent environmental standards over a period of 10,000 years, which is longer than all of recorded human history.

Although I am not prejudging the suitability of the proposed Yucca Mountain facility, a successful DOE application will resolve one of the major impediments to increased reliance on nuclear power.

III. Nuclear Power Tomorrow

I have just described a nuclear power industry in the United States that today is enjoying excellent health, from the standpoint of safety, performance and economics. What should we expect for the future?

One indicator, certainly, is the strong interest in license renewal, to which I referred earlier. Even more significant, however, are the expressions of interest in constructing new plants. No application has yet been received, and I can understand the hesitation generating companies may feel about being the first to test the waters. But when the first application is filed, I think we can expect more applications to follow, and not in the United States alone.

The groundwork has been laid by the Commission for this future. In the late 1980s, the NRC decided that the dormancy of nuclear power offered an opportunity to bring about some major improvements in our licensing process. Under Part 52 of the NRC's regulations, reactor vendors can apply to have reactor designs approved generically, by rulemaking. To date, the agency has approved three such designs -- the General Electric Advanced Boiling Water Reactor, the Combustion Engineering System 80+, and the Westinghouse AP600. The NRC staff is currently reviewing the Westinghouse AP1000, and is undertaking pre-application discussions with vendors about five other designs.

A particular benefit of the generic approval of standardized designs is that a certified design can be coupled with the early review of a potential reactor site. If a utility decides to utilize a pre-approved design, and to construct the reactor on a pre-approved site, the NRC's regulations allow a greatly streamlined licensing process, culminating in the grant of a combined construction permit and operating license. This should allow utilities to plan with far greater confidence than in the past when our two-stage licensing process meant that significant issues were resolved only after construction.

You might ask whether the public will support the renewed construction of nuclear power plants. I believe there is growing appreciation on the part of the public that choices have to be made among energy sources. No choice is without its pluses and minuses. I think the public understands the progress that has been made in safety and performance over the past two decades of nuclear operations. I think it also understands the environmental and other costs associated with alternative sources of energy. In short, I think that the American public is prepared to judge among energy sources more pragmatically than ever before, which should constitute excellent news for those who favor the growth of nuclear power.

However, when the demand for new nuclear plants becomes reality, we will be confronted with a serious challenge: do we have the human capital to perform the duties that are required? This is an issue we see already at the NRC, where the workforce is aging, and a large percentage of our employees, including some of the agency's foremost experts, will be eligible to retire shortly. The long drought in orders for nuclear plants had the regrettable effect of discouraging many talented young men and women from entering the nuclear field, and led some educational institutions to curtail or even suspend their nuclear programs.

I cannot express strongly enough my hope that we will see this trend reversed. Physical infrastructure can be assembled more easily than human infrastructure. I personally believe that in coming years, we will see an increased need for expertise in nuclear engineering and related fields, and it would be a grievous loss, and not only in the United States, if a shortage of trained personnel were to become a factor inhibiting the exploration of the nuclear option.

IV. Conclusion: Building for the Future

At the outset of these remarks, I spoke briefly of the need for society to be able to take long views: to look beyond the immediate present and comprehend much greater spans of time. We know that man does not live by bread alone: universities, libraries, scientific institutes and the like help to create an intellectual inheritance to pass on to future generations. But neither can man live *without* bread. History suggests that economic well-being is often a prerequisite for many other kinds of well-being: political stability, education, health, personal security. And one prerequisite of economic well-being has always been access to reliable and ample supplies of energy.

For those here who have devoted their careers to the use and advancement of nuclear energy, my message is one of cautious optimism. I believe you have reason not just for hope, but also for confidence that nuclear technology will be contributing significantly to the betterment of people's lives in the Americas in the years and decades ahead.

Thank you.