KEYNOTE ADDRESS

FACTORS AFFECTING THE NEXT GENERATION OF NUCLEAR POWER

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INTRODUCTION

I am pleased to be given the opportunity to address you, the distinguished participants in the First MIT International Conference on the Next Generation of Nuclear Power Technology. Both the timing and the aim of this Conference are right.

Given the pressures on the environment and projections of increased need for energy, the present moment is none too soon to give the most serious consideration to whether there will be a next generation of nuclear power plants, and, if so, what the technology should be like. And this conference's aim of assisting in the process of building a consensus will help bring about a full public discussion of questions concerning the next generation of nuclear power.

Over the years, I have had to achieve something of a consensus with myself in my changing roles as regulated and regulator, and advisor to both. I hope that my personal experience with consensus-building will contribute to the discussions you are having at this conference.

I will speak first about some environmental and economic factors affecting whether there will be a next generation of nuclear power at all. Then I will discuss some issues concerning the designs of the next generation. Finally, I will say a few things about the respective roles of industry management, the Nuclear Regulatory Commission, and the public.

I turn now to some factors affecting whether there will be a next generation of nuclear power.

I. THE FUTURE OF NUCLEAR POWER

For both financial, environmental and health reasons, and because of external and internal factors affecting this nation's energy supply, nuclear power will likely play a part in supplying this nation's energy in the coming decades. I believe this to be true for some other parts of the world as well.

Even some severe critics of the nuclear power industry and the NRC might agree with me on this point. Increasing concern with the environmental consequences of the burning of fossil fuels has led some former opponents of the use of nuclear power to balance anew the risks and benefits of nuclear power and to modify to some degree their former opposition.

A related concern with the adequacy of the energy supply is leading others to modify their positions. According to analyses done by the U.S. Department of Energy, after 1994 the United States will no longer be able to assure all its citizens a reliable supply of electricity. Already, many areas of the country are in need of additional electric capacity.

In both Sweden and Switzerland, similar concerns have led to the adoption by many of more compromising positions.

Some critics of nuclear power may in the end still reject it as an alternative, but, with the increased pressures on the environment and on our energy supply, nuclear power is an alternative which cannot be rejected without the most serious consideration. This should be, I believe, a point of consensus among us. In sum, there is a future for nuclear power in the sense that there is a use for it.

It is appropriate to ask now whether there are environmental and economic factors which are decisive against nuclear power despite its usefulness. Let me discuss briefly two factors which are sometimes said to be prohibitive – namely, nuclear waste and the costs of building nuclear power plants. In discussing both of these factors, I will focus on major actions the NRC has recently taken which have a bearing on these factors.

Let me begin by saying that I am not blind to the significant technical and institutional challenges to the enterprise of licensing and constructing a high-level waste repository. But let me also hasten to add that the Commission is confident that in neither the high-level nor the low-level waste program does the need for disposal or interim storage capacity present an intractable health or safety problem, either long- or short-term.

As you may know, the Commission in 1984 completed a major adjudicatory rulemaking on the generic questions of whether high-level waste can be safely disposed of, when such disposal or off-site storage will be available, and whether spent fuel and high-level waste can safely be stored on-site past the expiration of existing facility licenses until off-site storage or disposal is available.

As head of the Commission's Office of Policy Evaluation in the early 1980s, I oversaw much of the initial writing for that first Waste Confidence Decision. I am pleased to say that most of our original findings of confidence have stood the test of time. On September 18, 1990, the Commission issued revised waste confidence findings which largely confirmed the 1984 findings.

I should emphasize that the Commission conservatively assumed that the Yucca Mountain site, to which DOE site characterization efforts are now confined by law, would be found unsuitable for repository development around the turn of the century, but still arrived at favorable findings of confidence.

The commercialization of safe dry cask spent fuel storage, and more experience with storage in pools, contributed to the Commission's enhanced confidence that spent fuel can safely be stored until sufficient repository space is available.

In the light of these findings, I believe that we could afford to move away from the present largely schedule-driven approach to the high-level waste repository program.

In effect, we could trade off the cost of more extended spent fuel storage for the benefit of having more time for the earth science and materials engineering likely to be required for the technical soundness of this first-of-a-kind facility. Ironically, the national commitment to avert the expected risks of a long-term spent-fuel storage has helped to enhance the risks of a short-term approach to the repository program.

As to the costs of nuclear power, the Commission has made a valiant effort this past year, an effort not widely enough recognized, to assure that the NRC's licensing process does not unnecessarily add to the costs of constructing a nuclear power plant.

The industry's desire to reduce the costs of construction and the agency's obligations to the public health and safety are not always consistent with each other. The industry wants a predictable licensing process, and the agency must assure adequate protection for the public, if possible without introducing uncertainties unrelated to our regulatory mission.

Yet, frankly, it is not the Commission's job to provide guarantees. I believe that the NRC's new regulations, on early site permits, design certifications, and combined licenses (10 CFR 52), balances these opposing interests and obligations so that the licensing process can provide not only adequate predictability for utilities to decide whether to apply for a license to construct and operate, but also adequate protection of the public health and safety, and a more than adequate opportunity for the public to participate in that process.

The new regulations provides for many things, but among them the most pertinent to my purposes this evening is the requirement that all design issues be resolved before construction and that those resolutions not be subject to further litigation before operation.

Under this new regime, the licensee would achieve at least one important measure of predictability: If the plant is built according to the requirements stipulated in the combined license, the plant will be allowed to operate.

To sum up, neither the difficulties with the high-level waste repository program, nor past bitter experiences with the licensing process should prevent a next generation of nuclear power from coming into being.

Before turning to some issues connected with the new designs on the horizon, let me mention one market factor which is too little recognized as having a potential for slowing the development of a next generation of nuclear power plants.

That factor is the size and quality of the technical work force required to design, license, construct, operate, and regulate this and the next generation of nuclear power plants and waste facilities.

The Department of Energy has predicted a close balance between supply and demand of qualified personnel in the nuclear industry for the next several years. However, this prediction does not take into account the recent emergence of new designs, replacement of an aging work force, and state and federal government environmental programs.

Further, the needs of the country's weapons programs and waste disposal program; the political shifts in Eastern Europe, which have already led to increased transfer of technology and knowledge to that part of the world; and pending and future legislation to increase protection of the environment, all require a large and competent technical work force.

But let me give you some roughly current figures which should raise some concerns about whether we are going to have that work force. Within the past six years, there has been a decrease in this country of about 200,000 in the number of scientists and engineers employed in energy-related activities.

I am told that the number of undergraduate degrees granted in nuclear engineering each year amounts to about three for every faculty member in nuclear engineering. With such a ratio, it is not surprising that the number of institutions granting degrees in nuclear engineering has declined from 70 to 57.

Finally, the number of research reactors in the U.S. has declined from 70 to only 35, and many of the remaining 35 require major upgrades.

I have elsewhere stressed the importance of industry and government finding ways to attract young people into technical fields, and into the nuclear fields in particular.

I would mention in this regard that the NRC recently established a scholarship program which supports qualifying students in Health Physics and Engineering in return for a certain number of years of service with the agency. Other such incentives are needed.

II. LESSONS LEARNED

Having discussed some of the factors which affect, or might affect, whether there is a next generation of nuclear power, I will now turn to some issues connected with what that new generation might be like. I will focus here on some lessons learned from the past, and on some aspects of the NRC's role in these new designs.

Simplicity, significant safety margins, capability to ride out anticipated transients at power without shutting down, maintainability--these are but a few of the capabilities the potential purchasers are saying they expect in an advanced reactor. And those purchasers are playing a role in the design of the next generation through their participation in EPRI's "Requirements Document" effort. The NRC is reviewing this work with the closest attention.

I would note in passing that I am pleased that there are now a number of new designs before the NRC and otherwise under development. I would hope that the next generation will not have the same variety of custom designs that exist among operating plants. The NRC has long pushed for standardization of design. However, some variety is necessary for a number of reasons, not the least of them being that having readily available alternatives to a new kind of facility, be it a reactor or a repository, makes it possible to avoid identifying the success of any program with the success of a specific project or facility.

To designers, let me propose that it would be wise for them to stay alert to the possibilities for further reducing risks and radiation exposures, and to resist the temptation to forget some lessons learned. I have in mind in particular the lesson on containment.

Years ago, the NRC's Advisory Committee on Reactor Safeguard urged the building of substantial containment structures for our nuclear plants, even though some argued that these were expensive and unnecessary appendages that did little more than cause additional public concern.

However, right now the conceptual designs submitted to the NRC for review of the DOE-supported modular high temperature gas reactor and the modular liquid metal reactor do not include containment structures. The innovative designs show considerable promise for passive safety improvements.

But without containment or other mitigating features, I believe they will face considerable public opposition and will introduce major and important policy decisions for the Commission.

We must not forget that the containment at TMI worked. Although, in my opinion, the new designs generally speaking display a rising standard of professional excellence, I am concerned that efforts to reduce cost may be causing designers to forget the lessons learned.

Cost control is a legitimate engineering effort, but it must not be at the expense of prudent and adequate protection of public health and safety and the environment.

Let me mention two important aspects of the NRC's role in these new designs. First, I do not believe that regulatory standards should be elevated to meet the improving industry standards of excellence, unless it is found necessary to assure adequate protection of the public. For example, a designer may wish to aim for a highly desirable core damage frequency much lower than that sought by implementation of the Commission's Safety Goals. The Commission should not then adopt that lower frequency as a new, more stringent standard.

We have learned that we must not indiscriminately require changes to plants and designs, but instead must consider the overall risk significance, the practical effects on operations, and the cost once a level of safety is reached sufficient for adequate protection of the public.

I, for one, would not object to being criticized for not being as tough on a designer as the designer was on itself, if the NRC's Safety Goals objectives were met.

Second, it will be a challenge for the NRC to accomplish reviews of multiple designs without undue delays in this era of increasing fiscal constraints, but a thorough, technically sound NRC review will be essential to ensure that the United States will continue to have safe nuclear options available to meet the growing demand for electricity and the increased need to protect the environment.

With few new applications for licenses, the agency has focused its attention on inspecting operating plants. But I would be less than frank if I did not tell you that I wonder if we have gone about as far as we should in this direction.

I am concerned that emphasis on inspection may be at the expense of our ability to analyze and review nuclear safety in design. Such analysis and review have been our historical strengths.

In my travels abroad, I am impressed by the extent to which many countries closely follow NRC activities. A number of countries with smaller regulatory bodies basically adopt many of our regulations and the results of our analyses, reviews, and findings. I hope that our activities will continue to warrant respect in the years ahead, and it is my goal to assure that such is the case.

III. COMMUNICATION AND PUBLIC ACCEPTANCE

I have already touched on aspects of the industry's and the NRC's respective roles in the next generation of nuclear power. Let me expand now a bit on those roles and also say a few things about the topics which have occupied you this afternoon and will again tomorrow, namely risk communication and public acceptance.

First, as to the industry, I agree entirely with DOE Secretary Watkins when he says, "Nuclear safety is not something that can be installed through regulation or legislation." And I would add what I have often said, namely, that professionalism in plant operation crews is essential to the future of nuclear power.

One of the lessons of Three Mile Island was that the nuclear industry had to dramatically change its attitudes toward safety and regulations and police its own standards of excellence to ensure the effective management and safe operation of nuclear power plants.

If excellence is to be achieved and maintained, and the operation of current plants not be a block to another generation of plants, it will not happen by the NRC's dictating the details of management. No person or organization whose every movement is choreographed from without can ever achieve the independent judgment which is a necessary condition of excellence.

However, having stated what I would hope is another point of consensus among us, let me hasten to add that I do not believe that the industry should, or could, self-regulate itself. There must be, in the nature of things, an NRC, or some agency whose perspective is not the industry's.

For example, as I said fifteen years ago, there is no question in my mind that without the licensing requirements that make training necessary, the general standards and qualifications of reactor operating personnel could not be as good as they are today. This in no way reduces my pleasure in, and great respect for, recent industry initiatives in enhanced training activities.

And in carrying out its responsibilities, I believe that the NRC should seek an excellence of its own. That seeking requires trying to view our actions and the agency direction from the perspective of the outside world. Conferences such as this help us all to see ourselves from different perspectives.

As I have already stated, I believe that historically the NRC has been recognized internationally as a leader in nuclear safety analyses and reviews. But we have much work to do to maintain what we have done, and to do better.

For example in the NRC, too often we appear to generate actions and positions Office by Office and Region by Region with little apparent relation to overall agency coherence and philosophy. Much can be done to make our regulations more coherent, consistent and understandable.

Aiming at coherence and a sound regulatory philosophy, the agency has, for instance, established safety goals for use in judging the overall safety level of nuclear power plants, and whether or not further regulatory actions are warranted. However, even here, it appears that the agency sometimes forgets to incorporate those goals in its activities and, at times, proposes actions inconsistent with their guidance.

To bring us full circle to the question of whether there will be a next generation of nuclear power, I shall end my presentation by discussing briefly a matter I have touched on a few times already this evening, namely, public acceptance of nuclear power. And here I am going to tell you some bad news and some good news.

The bad news is that, so far, the public has not been very accepting of a mighty effort the NRC made recently to achieve some more regulatory coherence and to help assure that public resources are devoted to the most significant safety issues. That effort culminated in the NRC's recently published policy statement on "below regulatory concern," or BRC policy, as it is commonly called now.

If some of the newspaper accounts of the policy were to be believed, the NRC had decided to cause thousands of cancer deaths each year by permitting highly radioactive wastes to be disposed of in ordinary landfills.

Of course, as you all know, minimally radioactive wastes are being disposed of in municipal landfills every day - discarded smoke detectors, for example, or luminescent road signs, clocks, watches, and thermostat dials.

Because of the extremely low levels of radiation in consumer products such as these, many of them have been exempted from regulatory control for some time. But those exemptions have been decided upon too much on a case-by-case basis.

The BRC policy is an effort to articulate a consistent approach to such exemptions and to assure that, neither individually nor together, would exempted practices pose a significant risk to anyone.

Moreover, the agency has needed a BRC standard to apply in other areas of regulation, for instance, in the decommissioning of power plants, to determine when a site can be released for unrestricted use as well as in the recycling of materials which are slightly radioactive.

The policy aims at a level of risk to the most exposed individuals which is so low that further expenditure of resources by either licensee or regulator to reduce this risk would be unreasonable.

That level is a fraction of the exposures we receive from background radiation, and even a fraction of the differences in average background levels prevailing in different parts of the United States.

In all of this the NRC aimed only at the best: Coherence in the regulatory approach, levels of risk well below radiation risks the public accepts every day, and a full explanation of its policy in terms which could be understood by members of the public who were not technically trained.

The response, to put it mildly, has not been gratifying. In fact, there is widely supported legislation pending in the U.S. House of Representatives which would "revoke" the BRC policy statement. The false image of highly radioactive wastes in landfills appears to have crowded everything else out of some people's minds.

I hope that, if the policy survives the Congress, the public proceedings on individual requests for exemptions under the policy will serve as fora in which the public will come to see more clearly what the agency was trying to accomplish.

The growing use of nuclear medicine suggests that people can and do make distinctions about the sources of radiological risk; that they understand that there are tradeoffs between radiological and non-radiological risks; and that they are capable of weighing one kind of risk against another.

Now the good news, which should go some way toward alleviating public concerns over the safety of nuclear power. The National Cancer Institute recently completed a two-year study of cancer rates around U.S. nuclear facilities.

The Institute's epidemiological researchers looked at the frequency of mortality from sixteen types of cancer, including leukemia, around fifty-two nuclear power plants, nine DOE weapons facilities, and one commercial fuel reprocessing plant. The researchers concluded that their survey had produced "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities."

Another epidemiological study, this one of residents around the Three Mile Island nuclear power plant a the time of the 1979 accident, came to a similar conclusion. Dr. Beyea, who is participating in this conference, was a major contributor to that study.

Critics were quick to assert that the studies did not give nuclear power "a clean bill of health," and, strictly speaking, the critics are right. Studies of this kind cannot demonstrate conclusively that radioactivity from these plants did not cause cancer.

The authors of these studies have themselves suggested areas for further study. But this much seems clear: Well-qualified workers using sophisticated methods have been unable to find any significant evidence in the operating history of U.S. nuclear power plants to link them to increased levels of cancer. I believe that the burden of proof has now shifted to those who claim otherwise.

Leaving the risks of low-level radiation aside, I believe that we can all agree that, even if the NRC's BRC policy should be accepted ultimately, and even though the industry as a whole has improved greatly since TMI, poor performance at individual stations may lead the public to reject nuclear power.

Our good record does not matter if our neighbor's operation is shoddy. And we know too well that events that occur half way around the world can have immediate and substantial impacts on all of us. We are our brothers' keepers in these matters, each of us, albeit in different ways.

As to myself, ironically – considering that safety regulators are not promoters of nuclear power and indeed are often accused of impeding it – the future of nuclear power may well be most secure when the public can be confident that the regulators are tough enough to do whatever is needed to assure adequate performance at even the worst stations.

SESSION FIVE

AUDIENCES, RATIONALES AND QUANTITATIVE MEASURES FOR DEMONSTRATIONS OF NUCLEAR SAFETY AND LICENSING BY TESTS

AUDIENCES, RATIONALES AND QUANTITATIVE MEASURES FOR DEMONSTRATIONS OF NUCLEAR SAFETY AND LICENSING BY TESTS

Lawrence M. Lidsky

RESPONSE BY

John Taylor

INTRODUCTION

Session 5 – Audiences, Rationales and Quantitative Measures for Demonstrations of Nuclear Safety and Licensing by Tests

The purpose of this session was examination of the implications of a proposal which has been made by some proponents of advanced reactor concepts. It has been suggested that reactor concepts capable of achieving much higher levels of safety than current plants could demonstrate this via physical tests rather than by means of extensive analyses, has been typical to-date. It is argued that this approach to safety regulation could permit more efficient licensing while simultaneously allaying fears of nuclear technology among the public.

However, consensus does not exist that this is a feasible proposition. Among the questions which arise are the following:

- What data would be required from an adequate test?
- What set of tests would be adequately complete to span the range of potential safety concerns?
- Given the reality of having only limited resources available for a set of tests, how would residual uncertainties in expected system performance be treated?
- How can test results be communicated in a fashion such that an audience of laymen can use them for meaningful thought?

Ultimately the discussion of this proposal concerns the types of physical proofs, assuming that some would be possible, which would demonstrate adequate safety. It is argued that, if enough of the public were satisfied that a reactor concept were adequately safe, its employment could proceed without serious interruption and at predictable costs.

In this session the keynote paper was given by Prof. Lawrence Lidsky, Professor of Nuclear Engineering at MIT. Prof. Lidsky has long been a proponent of the 'license by test' idea, particularly in the context of the MHTGR concept. The respondant paper was presented by Mr. John Taylor, Vice President with responsibilities for all nuclear power matters at the Electric Power Research Institute (EPRI). EPRI is the research agency of the United States electric utility industry.

The following discussion was concerned with various means by which reactor safety can be evaluated and communicated. Ultimately, and repeatedly, the discussion continued to return to the question of 'how can a technology be determined to be safe and shown to be so to a suspicious public?'.