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NUCLEAR POWER AND AMERICAN COMPETITIVENESS

COMMISSIONER FORREST J. REMICK
U.S. NUCLEAR REGULATORY COMMISSION

ANS EXECUTIVE WORKSHOP ON PRODUCTIVITY AND
QUALITY IMPROVEMENTS THROUGH PARTICIPATIVE MANAGEMENT
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Good morning, ladies and gentlemen. I want to thank Harold Keiser for those kind words of introduction, and I want to say how pleased and honored I am to have been invited to join my distinguished fellow speakers and all of you attending this conference.

I applaud the American Nuclear Society and Jack Ohanian, and the program co-Chairmen, Harold Keiser and Laurence Hecht, for putting this conference together.

When I was Chairman of the ACRS Subcommittee on Quality Assurance in Design and Construction, the ACRS held an international workshop on quality in the design and construction of nuclear power plants. The Committee believed that the present hiatus in licensing actions and the near completion of construction of the present generation of nuclear power plants provided an excellent opportunity for the NRC to reexamine the question of how best to achieve quality in design, manufacture, and construction.

I continue to believe that the time is ripe for reexamining the question of how best to achieve quality in the nuclear industry. And your presence here today is an encouraging sign that the industry will seize the opportunities before it, and that the improvements we have seen in the industry in recent years will continue, to the great benefit of the country.

The organizers of this Conference have asked me to say something about the potential contribution of nuclear power to making America more competitive. I hope I will be within this "specification limit" -- to use quality control vernacular -- if I briefly discuss the following two broad themes: first, the potential contribution to American competitiveness, and to American economic and social well-being in general, of having safe, economical, and reliable nuclear power; and second, the potential contribution to American economic and social well-being of having a nuclear industry in which improvement in quality continues.

Let me turn now to the potential contribution to American economic and social well-being of safe, economical, and reliable nuclear power. In sketching the outlines of that potential contribution, I could hardly do better than put before you the chief findings on nuclear power in the Administration's National Energy Strategy, issued this past February, thoughtfully just in time for this Executive Conference!

The text of the Strategy reminds us that abundant, relatively inexpensive energy is at the heart of our economic, and much of our social and political, life. The entire infrastructure of our cities, highways, and industries was developed with abundant and relatively inexpensive energy sources, and on the assumption that we would continue to have those sources. We need energy to sustain our productivity and innovation. Moreover, the link between GNP and the demand for energy suggests that, over the long term, we need more energy if we are to increase our productivity. Of course, we must increase our productivity if we are to become more competitive.

But we need this energy in a form which is reliable and which minimizes the impact on the environment of generating and using this energy. Among the most striking charts in the text of the National Energy Strategy are a dozen or so which show the increasingly detrimental impact of our pre-National Energy Strategy policies on the environment. Another striking chart in the text is the chart which shows the potential loss to GNP from the volatility of the price of oil on the world market.

As the National Energy Strategy makes clear, nuclear power can help make America more competitive. Right now, nuclear power contributes roughly 20% of electrical generation in the U.S., and nuclear power is a very attractive option for providing the new base-load generating capacity the Strategy says the U.S. will need in order to sustain its economic growth and hence its ability to compete. We do not need to worry about potentially unreliable suppliers of uranium the way we do about potentially unreliable suppliers of oil. And nuclear power generates no sulfur dioxide, nitrogen oxides, or greenhouse gases.

As you know, it is not up to the NRC to choose to meet the new energy needs with nuclear power. If chosen, our responsibility is to ensure public health and safety. Indeed, it is not even up to the Administration to make that choice. The National Energy Strategy will leave that choice to the market, where it belongs.

Nonetheless, there is much the government can do to make sure that the nuclear option is available to the market. The National Energy Strategy proposes to maintain exacting safety and design standards, reduce the economic and regulatory risks of building nuclear powerplants, and establish an effective high-level nuclear waste program.

As the agency which will license the new plants, and the permanent high-level radioactive waste repository and the monitored retrievable storage facility, the NRC has a major rol to play in assuring that the nuclear option is available. And much that the agency has done in the past few years has been directed to making sure that, if the market chooses the nuclear option, the NRC will have the appropriate standards, review capabilities, and licensing procedures in place.

For example, two years ago the Commission promulgated new regulations governing the early approval of power plant sites, the certification of standard designs, and the issuance of combined construction permits and operating licenses. In affirming the bulk of these new regulations, a Federal Court of Appeals said that, "In responding to the industry's changing knowledge and the public's changing needs, the NRC has promulgated bold and creative new regulations." As you probably, know, the Court thought the agency had been a bit too bold and creative in imposing limitations on any hearing held between construction and operation under a combined license, but I'm pleased to report that the NRC and the Justice Department have since persuaded the full Court to reconsider. We have also let the Congress know that we would not object to increased flexibility with respect to the format and timing of any hearings held between construction and operation, though we continue to believe that legislation is unnecessary at this time.

We have good reason to hope that the new regulations will,_one >\ way or another, emerge largely intact and will give the utilities) the necessary assurance that matters resolved in an early site ¢~ permit proceeding or a certification proceeding will stay resolved in a later proceeding on an application for a combined license to build and operate the certified design.

But new procedures for certifying and licensing accomplish nothing if the agency doesn't have the technical know-how to do thorough reviews of the new designs. Analytical capability has been one of the agency's traditional strengths, and my discussions with regulators from other countries has convinced me

that the agency's capability commands considerable respect throughout the world.
However, we run the risk of becoming rusty. In recent years, during the present hiatus in licensing, the agency has become increasingly focussed on operating plants. Staff members experienced in site and design reviews have scattered to different offices, and regulations, regulatory guidance, computer codes, and the like, are in need of updating.

My colleagues and I, and senior NRC management, are working hard to gather the experienced reviewers together again, to see what needs to be updated, and to make sure that the agency has the necessary in-house analytical capability to do thorough and definitive reviews of new sites and designs. If the NRC doesn't do a first rate job, neither the public nor the utilities are likely to have the confidence in the new designs which is necessary if there is to be a nuclear option.

One more effort the agency is making to assure that the market has a nuclear option is the effort to develop regulations governing the renewal of existing licenses for nuclear power plants. The National Energy Strategy recognizes the importance of license renewal, or "life extension" as we hopeful mortals have come to call it. Utilities considering renewing their licenses will have to decide soon whether to renew them, and the NRC must be prepared to respond promptly to an application for renewal.

The agency issued proposed regulations on life extension last year, and the staff is now considering the public comments. As we told Congress in the recent congressional hearings on the NRC's proposed budget, the Commission assigns the highest priority to issuing final regulations on life extension.

The pursuit of quality by an organization is not self-sustaining. The quality must promise something beyond itself -- in the case of a profit-making enterprise, increased market share, or more jobs, or other economic benefits. There is all this and more in the promise of safe, economical, and reliable nuclear power: There is a role to play in making America more competitive, and there is a role to play in reducing the impact on the environment of generating abundant, low-cost, energy.

Let me turn now to my second theme, which, in a way, is to my first theme as the stick is to the carrot. The potential role which nuclear power has to play in the American, indeed the world, economy should inspire you to improve quality. But fear has a place here too. There is no future for the nuclear option unless designers, builders, operators, and regulators turn in sterling performances. Be it fair or not (and it's not), the public seems to hold the nuclear industry to a higher standard than some industries which pose comparable, or even greater, risks. Critics may not any longer demand zero risk from the nuclear industry, but at least one well-known critic of the

industry has assumed a backup position which is just as absurd. He says that the performance of the industry will have to be "technically flawless" in the years to come. That's not possible in this world.

Nevertheless, the industry's performance will have to be qood, very good. Give credit where credit is due: the utilities, for example, are already doing very

well indeed. The NRC's Office for the Analysis and Evaluation of Operational Data just released it's annual report on performance indicators (again thoughtfully published just in time for this conference!), and the indicators continue to show improvement in the performance of the nation's nuclear power plants. The indicators tracked by the Institute for Nuclear Power Operations tell the same story. This improvement helps keep the nuclear option alive.

However, the NRC's AEOD reports that the rate of improvement in the indicators it tracks slowed down again in 1990. Does the continued slow-down in the rate of improvement mean that there is nothing to be gained by trying to find ways to increase the quality of performance? There is always room to improve. The problem, when improvement is tapering off, is, how? Exhortation and trying harder don't always work.

Here we can get some help from the man who is one of the reasons why we are here today, W. Edwards Deming, who, along with people from Bell labs and other American companies, took American ideas about quality control and persuaded many Japanese companies to adopt them. Now Deming is trying to persuade more American companies to adopt these same American ideas. The schedule for this morning calls for some discussion of the applicability of the criteria of the Deming and Baldridge Awards. The Deming Prize was established by the Union of Japanese Scientists and Engineers to honor a company which makes great advances in quality. As many of you knowr Florida Power and Light was the first American firm to win the Deming Prize.

Several other countries, including the United States, have now established similar prizes. In 1987, Congress established the Baldridge Award, named after Malcolm Baldridge, who was Secretary of Commerce from 1981 until his untimely death in 1987. The award goes to organizations which have ~benefited the economic or social well-being of the United States through improvements in the quality of their goods or services." Again, as many of you know, Westinghouse's Commercial Nuclear Fuel Division was one of the first three winners of the Baldridge Award.

In the preamble to the legislation establishing the Baldridge Award, Congress sounded my second main theme this morning, namely, that a "commitment to quality and quality improvement" is "essential to our ability to compete effectively in the global marketplace." Congress also listed in the preamble some things it thought were needed to restore the U.S.'s former leadership in quality. Among these were two that I want to say something about this morning: improved management understanding of its employees' jobs, and greater emphasis on statistical process control.

Now I am not about to give you a sales pitch on statistical process control. Some of you may think speakers rely on statistics the way a drunk leans on a lamppost: for support, but not for illumination. Besides, though I studied a great deal of statistics when I was a graduate student, my working knowledge of statistics has, for the most part, proved to have a short half-life.

Nonetheless, I believe that the leading idea in Deming's writing will give us some idea how to face the decline in the rate of improvement in performance indicators.

Deming reports the following case: A large company suffered a lot of fires over a long period of time. The management kept track of the number of fires each month for five years. The record showed that there were on average, 1.2 fires a month, but never more than five. The number of fires per month otherwise varied randomly. 1.2 fires a month, sometimes 5, year after year, are of course too many fires. Deming says that, like it or not, this steady production of fires was as much a part of the company's output as the products it sold.

What to do? Well, the president of the company wrote a letter to each of the 10,000 employees of the company, urging them to stop setting fires!

Now it's pretty obvious that such letters would do no good. The employees weren't deliberately setting fires, year after year. If the number of fires was going to be reduced, <u>management</u> was going to have to make some systematic changes.

But it isn't always so obvious that systematic changes are required. Deming's leading idea is that organizations are often in the situation of the company that had an average of 1.2 fires a month, but they don't know it and, not knowing it, are under the illusion that the difficulties are the fault of the employees. Of course, employees often are at fault to some degree for the poor performance of an organization, and much improvement can be got simply by making sure people do their job the best way they know how. But once all the employees are doing the job they're supposed to, there will still be defects and

ther difficulties, the rate of improvement will taper off, and frustration and bad feeling will set in, because, Deming says, management will, in effect, be telling the employees to stop setting fires.

Consider now the declining rate of improvement in the performance indicators. Take, for example, the number of so-called "significant events" quarter-by-quarter over the last six quarters, or the number of accident sequence precursor events year by year over the past five years. The numbers are small and diverge from the averages over those periods of time by less than two standard deviations. If the numbers continue this way, we might be justified in concluding that the system was, as a whole, "in statistical control", as the statisticians put it. The utilities may be on the verge of becoming like the company that had an average of 1.2 fires a month but never more than five. They may be about to slip into a routine of producing, along with so many gigawatt-hours of electricity, a certain number of reactor trips, significant events, forced outages, accident sequence precursors, and the like, year after year.

If so, should we settle for this routine output? If we shouldn't, will it do any good for the utilities to tell their employees, or for the NRC to tell the utilities to stop tripping reactors or starting accidents?

If in fact the curve of improvement is leveling out, it may be hard to improve quality. Once upon a time, a company decided to make a grand piano as good as Steinway's best. So the company bought one of Steinway's best, took it apart, and duplicated each part: same materials, same shapes, same everything. Then the workers assembled the new parts into what looked like a piano. But when they tried to play it, it went clunk. They decided all they could do was reassemble the Steinway and sell it to recoup some of their losses. But when they put the Steinway back together, all it did was go clunk!

The moral: Efforts to improve quality can also make things worse. Consider a little experiment of Deming's:

Imagine that a funnel is held upright above a flat surface, and that marbles are dropped through the funnel. The marbles will come to rest at various distances from the point directly below the tip of the funnel. After, say, 50 such drops, there will be 50 marbles on the flat surface, arrayed roughly in a circle. After enough drops, it is easy to predict the limits within which all future drops are likely to come to rest. We have here a model of the company which produces an average of 1.2 fires a month.

Suppose now, however, that the managers want to make systematic changes to reduce the number of fires. In the case of the funnel model, imagine that we try to make the marbles come to rest more nearly directly under the tip of the funnel, say by moving the funnel after each drop until it is directly over the spot where the last marble came to rest. After 50 such drops, the marbles will be arrayed in no recognizable shape. The circle will have decayed into a random walk, and the system will have lost all predictability.

I'd like to be able to say that any resemblance between this little experiment and the NRC's adventures with backfitting in the early 1980's is purely coincidental. But I must admit that the random walk reminds me of the staff finding in the early 1980's that the flood of backfitting then had brought about a safety impact of "unknown dimensions."

In sum, years of hard work by the utilities, INPO, the NRC, and other organizations and persons has paid off handsomely in greatly improved performance, but we may now be reaching a point of stasis and high predictability, where efforts to improve performance may do more harm than good. But no one is suggesting that the utilities stop trying to improve. Certainly this conference is based on the assumption that it's worth it to try to do better. Before I end my talk, let me comment briefly on what, in my experience, you can hope for from your employees and from changes in your organization as you pursue improved quality.

Richard Feynman, the great American physicist and Nobel Laureate, tells the following tale about working at Los Alamos on the Manhattan Project. At one point, he supervised a group of high school students who had to do the involved calculations necessary to predict the energy that would be released by the implosion bomb. For security reasons, the students were given just the numbers and told what calculations to do. But they were not told what the numbers measured, nor what Los Alamos was up to. Despite Feynman's supervision, the work went slowly. Problems got solved at the rate of about one every three months, Feynman says.

Then Feynman got the bright idea of letting the students know what they were doing! With Oppenheimer's help, Feynman persuaded the military authorities to let the students in on the secret. The effect was explosive. Once they knew what the numbers meant, and why anyone was interested in them, the students ceased to need much supervision and on their own began finding better ways to calculate. Soon problems were getting solved at the rate of about three every month, instead of the other way around.

I can't promise you that telling people what they're doing will always unleash their productivity. Once two friends went golfing. The one was experienced. The other had never played. On the course, the beginner asked the old hand, "what do I do?" The old hand said, "hit that little ball down that big green stretch, and then go find it." So he did. Then he asked, "what do I do now?" And the old hand said again, "hit it again in the same direction and go find it again." This conversation was repeated a few more times until they were on the green, and then the beginner again asked, "what do I do now?" This time the old hand said, "try to hit the ball into that little cup there." At that point the beginner got mad and said, "Well, why didn't you tell me that before?"

But, my experience as an operator and trainer of operators taught me long ago that a well-informed employee can do a lot for you. For example, a trainee should not just memorize facts. He should be encouraged and trained to ask why certain techniques or procedures are followed. If he understands the how and the why, he'll know more of the what. Then he'll be better equipped to personally contribute to the continual improvement of procedures and operating techniques. It's true a utility can't inspire him by telling him that he's working on a bomb to end a war, but I have met both young and old trainees who had transferred from fossil-fueled plants who were extremely enthusiastic about the challenge of learning a new technology, and who later were very pleased by what they had learned during their training. You're not managing well if you can't capitalize on this enthusiasm and potential pleasure, and you're missing out on the safer and more reliable operation these employees can help you achieve.

The essential lesson in Feynman's story and in my experience with training is that there must be communication and cooperation among different disciplines, different ranks of employees, and different offices of an organization. Not that everybody has to do everything, but people should have the big picture in mind and share with each other what they know. In this way, they will achieve a more panoramic view of shared problems, and develop more optimal solutions than could be developed by individuals, disciplines, or ranks working in isolation.
Turning now from employee "empowerment," if you like, to organizations, is it possible to organize for quality? Is it possible, for instance, to formalize increased cooperation and communication? Here, I believe, there are two fundamentally conflicting models, each necessary, but each subject to abuse.

One model, is the "Appendix B" model, or at least what we are likely to think of as the Appendix B model. In this model, quality is the job of persons who are free to operate independently of cost and schedule considerations, and who are not reviewing their own work. It is a legal model. The

inspector is a judge, free of conflicting interests. The most important attribute of the judge is his lack of bias, not his knowledge. Here quality is inspected into the product.

Now it's obvious this model goes too far. Imagine constructing a new, standard, plant design and waiting to worry about quality until the agreed-upon inspections, tests, and analyses required by Part 52 were performed. There's not much hope for the nuclear option if this is the way we're going to proceed.

Now in fact, Appendix B is not so extreme. In revising Appendix B to include the requirement for separationt the Commission recognized that, in its words, ~the greater the independence or separation ... the more difficult it may be in some instances to maintain lines of communication in identifying quality problems and initiating corrective action." But some organizational separation is necessary. We cannot let each employee be his own judge, or each team or office have the final authority to approve or disapprove its own work. Science and engineering are selfcorrecting enterprises, but not because each practitioner corrects himself.

Ultimately, you have to find forms of organization which balance the legal and the scientific models, which employ people with the necessary knowledge early in the process but enlist an independent view too.

To do this, you need flexibility. I think that Appendix B in fact gives you the necessary flexibility. I just hope that, as the agency implements Appendix B, it makes good on the promise of Appendix B.

Further improvement in quality requires that the NRC leave the industry flexibility in many areas, not just in the form of organization it adopts under Appendix B. The NRC has been giving the industry room in recent years to develop its own demanding standards -- for example, in operator training. More recently, during consideration of revisions to the charter of the NRC's Committee to Review Generic Requirements, the Commission decided that, where practicable, generic action by the agency should take a performance-based, non-prescriptive form.

The Commission has been roundly criticized for both these approaches. As you probably know, the Courts have now forced us to devise a training rule. We are hoping to come up with one soon which preserves the great improvements in operator training since TMI, and which permits further improvements to be made.

Also, Congress several years ago urged the Commission to consider whether a more prescriptive approach to design and construction would improve the quality of design and construction. In NUREG1055, a work which anyone interested in quality in design and

construction should consult, the agency rightly responded that the more prescriptive approach would unnecessarily limit designers' and builders' choices and would tend to make people think that only the NRC was responsible for the safety of plants.

Behind some of the opposition to industry standard-setting and non-prescriptive regulation seems to be a notion that excellence, which, I acknowledge, must often be promDted from without, must also ultimately be imDosed from without. This is a strange notion. Would anyone claim that Richard Feynman's achievements in physics were imposed on him, or that the inventiveness of American engineering, quality control, and management was achieved by outside edict? Why then should anyone think that the NRC will make you better by always telling you exactly what to do?

In the nature of things, there must be an NRC, or something like it, to provide outside impetus, as the agency did, for instance, in the area of operator training. And the agency must have independence and analytical capability which command public confidence. But the agency cannot assure safety or continual improvement by acting like a puppeteer. No person or organization whose every move is directed from without can ever achieve the independent judgment necessary for excellence. The NRC reaulates, for safety's sake. But it does not create: It does not design, it does not build, it does not operate. If safe, economical, and reliable nuclear power plays a role in making America more competitive, and increases our economic and social well-being, it will be because, under a watchful, demanding, but not too constricting, regulatory presence, you never lost your delight in the pursuit of excellence.