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THE CHANGING SHAPE OF U.S. LICENSING PHILOSOPHY - GHOSTS AND GOBLINS NOT ALLOWED

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INTRODUCTION

Good afternoon, ladies and gentlemen. I am very pleased to be participating in the Atomic Energy Society of Japan's International Conference on Design and Safety of Advanced Nuclear Power Plants.

The title of my presentation, which includes, "Ghosts and Goblins Not Allowed" is, in part, presented in recognition of a U.S. tradition celebrated on October 31st. This tradition is Halloween. Halloween is an event which began many years ago following the harvesting of crops by the farmers to express their appreciation to the saints for their help in providing a good growing season. This religious observance later turned into a celebration to reward children for helping their parents during the growing and harvesting of crops. Today, this celebration is marked with children dressed in scary costumes, such as ghosts and goblins, going from house to house yelling "trick or treat," implying, give me a treat, such as a piece of fruit or candy, or I will play a trick on you.

I will be speaking to you today about the changing shape of U.S. licensing philosophy, and it is my hope that after my talk you will see why I envision ghosts and goblins not allowed.

Nuclear power plant licensing philosophy is indeed undergoing a change in the United States. In order to deal with lessons learned from our earlier licensing experience, we have changed the process for reviewing and approving new plant designs. And in order to deal with lessons learned from our own operating experience, we have begun to change the way we focus our resources for regulating the operating plants. Using this philosophy, I see an opportunity to enhance other areas of regulation as well, and I will tell you how this could work.

THE NEW LICENSING PROCESS

In order to receive their operating licenses, the nuclear power plants currently operating in the United States were subject to a two step licensing process. An application for a construction permit for a facility was submitted to the NRC by the prospective utility licensee before construction began, well before the expected date of operation, and even well before the plant was fully designed. The application contained preliminary design and operating information, and a detailed environmental impact report. As part of the NRC's review of this information, a public hearing was held and oftentimes resulted in additional requirements being placed on the prospective licensee.

Approximately three years prior to the expected time of operation, the facility applicant was required to submit final design and operating information and a detailed environmental impact report. A second hearing was often held and frequently resulted in additional requirements being placed on the applicant. Design changes made in response to requirements developed during the final stages of construction, together with the licensee's continuing finalization of the design, added up to delayed construction completion schedules, and rising construction costs. The effects were devastating for some applicants.

Under the Commission's three year old regulations in 10 CFR Part 52, "Early Site Permits; Standard Design Certification; and Combined Licenses for Nuclear Power Plants," the Commission will finalize its approval of a vendor's plant design first, before a prospective utility licensee makes its decision to build the plant, and well before construction of the plant begins. The Commission will review a vendor's standard plant design in great detail, and then certify it in a public rulemaking. Once the design is certified, it cannot easily be changed. Then, when a prospective licensee decides to build a new plant, it will select a vendor's certified design, knowing that the design has a high degree of finality. The prospective licensee will only need to apply for one NRC license, the combined construction and operating license (COL), and not two.

Both the staff and the vendors recognized however, that there would be some limited portions of the plant design that would not be fully developed at the time of design certification. So the industry proposed Design Acceptance Criteria (DAC) to be used in a limited number of circumstances by the combined license applicant during plant construction. The DAC are a substitute for design details. Therefore, when we certify a design that includes control room

DAC, for example, we won't be certifying control room design details which are likely to become outdated rapidly.

Inspections, Tests, Analyses and their associated Acceptance Criteria (ITAAC) are also being developed by the vendors and approved by the NRC for use in confirming design implementation during plant construction. Our regulations in Part 52 require that applicants propose this set of verification activities that will demonstrate that the facility has been properly constructed in accordance with the design and will operate in conformity with applicable requirements.

These verification activities and their associated acceptance criteria will be specified in the design certification rule, and later the combined license.

The NRC will publish notices of successful completion of the licensee's inspections, tests, analyses, and acceptance criteria in the Federal Register at appropriate intervals during construction. This will thus be a "sign as you go" process.

The change in the NRC's licensing process from a two-step process toward something closer to a one-step process was recently codified in the Energy Policy Act of 1992, passed by the U.S. Congress. The President signed the legislation last week. His signature turns the legislation into binding law. In addition to codifying the essential elements of the agency's new licensing process, the Energy Policy Act also gives the NRC greater discretion in determining the timing and the format of any hearing which might be held after construction under a combined license is complete. The NRC's new process, enhanced by the new law, provides more than adequate assurance that the operation of any nuclear power plant built under the new process will not be unnecessarily delayed.

NEW DESIGNS UNDERGOING THE NEW LICENSING PROCESS

As some of you may know, the lead nuclear plant design being reviewed for certification in accordance with our new 10 CFR Part 52 is General Electric's Advanced Boiling Water Reactor (ABWR), two of which are under construction by TEPCo as Kashiwasaki-Kariwa Units 6 and 7. The review is nearing completion and final design approval (FDA) is expected in the next few months. A significant portion of this design was developed in concert with the Japanese industry. The process for certifying the design through rulemaking should begin in 1993.

Another plant under review for final design approval is ABB-Combustion Engineering's System 80+. The final design approval for the System 80+ design is anticipated by the end of 1993.

Both the ABWR and the System 80+ plants are based on evolutionary designs employing active components to prevent and mitigate accidents. They are large-sized plants of approximately 1300 Mwe.

However, these are not the only new designs under review. The NRC has recently received an application from the Westinghouse Corporation for its AP600 plant design. This design employs extensive use of passive systems, such as gravity and stored energy driven accident prevention systems, and optimizes simplicity in its design.

Another recent submittal for certification of an advanced plant employing gravity and stored energy driven safety systems is General Electric's Simplified Boiling Water Reactor (SBWR). This plant is also being developed in cooperation with the Japanese industry. General Electric has submitted experimental data from the GIRAFFE experimental facility, which is a full height Toshiba facility designed to evaluate and validate the performance of a gravity driven containment cooling system.

Both the AP-600 and the SBWR are smaller plants of 600 Mwe. The United States is pursuing in parallel the development of both large and mid-sized new designs.

These gravity and stored energy driven safety systems, while simpler in design, will provide new and unique technical challenges which have prompted the NRC to reexamine how we interpret the regulations in the United States. Not only has the process changed in preparation for licensing advanced designs but the licensing philosophy will change as well.

CHANGING LICENSING PHILOSOPHY - NEW DESIGNS

In the past the final safety determinations upon which the Commission's licensing decisions were made were based on the results of deterministic reviews of plant design and planned operation. Final safety determinations were based in part on how 64 General Design Criteria were met. For the new plant designs, the scope of the technical information required of applicants in support of their applications has been broadened. For example, information now required for design certification includes:

design specific probabilistic risk assessments,

design specific resolution of severe accident issues,

resolution of all medium and high priority generic safety issues which are technically relevant to the design,

identification of site parameters to which each plant was designed and an analysis and evaluation of the design in terms of such parameters, and

ITAAC which are necessary and sufficient to provide reasonable assurance that if the tests, inspections and analyses are performed and the acceptance criteria met, a plant which references the design is built and will operate in accordance with the design certification.

The broadened scope is a result of the Commission's expectation that the new designs will be better than the designs of twenty years ago in that they will achieve a higher standard of severe accident safety performance. The challenges to systems which could lead to a severe accident are expected to be significantly reduced from those in the present generation reactors, and the defense in depth philosophy will extend beyond the traditional scope. Areas where improvements are appropriate, both for reducing the core damage frequency, and for assuring the capability of containment to withstand some of the severe accident challenges, particularly during the early stages of an accident, are being considered.

For example, the Commission approved the staff's proposal that

> evolutionary light water reactors be designed with sufficient reactor cavity floor space to enhance debris spreading and provide for quenching of the debris in the reactor cavity,
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> that evolutionary light water reactors include a depressurization system, and
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> that evolutionary light water reactors be designed with a containment failure probability of 0.1 or a deterministic containment performance goal that offers comparable protection.

The staff is planning to develop severe accident requirements which establish containment performance criteria for severe accidents, addressing both early failure and leak rate, and prescribe hardware modifications for dealing with containment integrity.

The Commission's philosophy on the capability of the new designs to withstand severe accidents is being guided by its safety goals. We continue to recognize that there are uncertainties in our methods of quantitatively estimating the level of safety achieved by each design, so we will continue to require defense in depth and prevention and mitigation features in the designs, particularly containment.

Also, for this same reason, the NRC is evaluating the reliability of the non-safety shutdown systems and what effect their reliability will have on overall plant safety. The staff is reconsidering the need for traditional system redundancy requirements, equipment qualification requirements, seismic criteria, and the need for additional technical specifications for some systems.

Most importantly, the NRC believes that certain separate effects tests and high pressure integral system test programs will be useful for developing the necessary data for improvement and validation of the computer programs relied upon for assessment of the new designs.

CHANGING LICENSING PHILOSOPHY - OPERATING REACTORS

Probabilistic risk assessment (PRA) will be relied upon to a greater extent in licensing decisions involving both new designs and operating reactors. But it will continue as a supplement to deterministic reviews for uncovering plant design vulnerabilities and specific equipment and systems reviews. Since PRA technology is not yet fully mature, and the Commission continues to discourage strict use of bottom line PRA numbers, the Commission views it primarily as a useful tool for understanding what is very important and what is less important, where the most safety return for the resources expended may be realized, and for determining where we may have gone too far with our requirements.
Even though I would not go so far as to say the Commission is relying more on PRA and less on deterministic reviews for our licensing decisions, I would say that the development of probabilistic risk techniques in the United States has contributed to our move toward a more performance based regulatory philosophy. I will explain why I think it became a good idea for us to head this way in the U.S., but first I would like to say a little more about performance based regulatory philosophy.

During the last several years, the Commission has determined that significant safety advantages may be derived from less prescriptive regulation. With less prescriptive regulation comes the opportunity to encourage industry to seek newer and better means of accomplishing its objectives. The kind of excellence we expect from the nuclear industry cannot be solely choreographed from the outside. Some of the most effective initiatives come from within, when the industry has established its own performance goals. Non-prescriptive and performance based regulation could provide the industry the latitude it needs to apply innovative solutions to improve maintenance, training, and operations.

However, developing performance based regulations is not easy. It requires solid bases on which to set quantitative standards for performance and a way to measure whether they have been met, and it sometimes requires that the NRC be willing to give full and fair consideration to new ways of meeting traditional standards.

The NRC has been attempting to shift its regulatory program, where practical, away from programmatic requirements, to requirements based on qualitative and quantitative goals and objectives. Perhaps the best example of where the Commission has chosen to shift the balance between regulation based on deterministic analyses and regulation based on quantitative risk analyses is its recent performance based maintenance rule. The final rule provides a framework for evaluating the effectiveness of licensees' maintenance programs by requiring licensees to monitor the performance or conditions of key structures, systems, and components against licensee established goals, in a manner sufficient to provide reasonable assurance that those structures, systems and components will be capable of performing their intended functions. Where monitoring proves to be unnecessary, licensees would be permitted the option of relying upon an appropriate preventive maintenance program such that the structure, system, or component remains capable of performing its intended function. Once a program is established, a licensee would be required to (1) evaluate its program on an annual basis, taking into account industry-wide operating experience, and (2) adjust its program where necessary to ensure that the

objective of preventing failures is appropriately balanced against the objective of minimizing unavailability of structures, systems and components.

Another example of where the Commission has chosen to regulate by objective and allow the industry more flexibility in meeting that objective is in the area of operator licensing and requalification training. In its recent training rule the Commission took action to ensure that the industry remains responsible for developing and implementing its operator training programs, and we expect to return administration of operator requalification exams to the licensees soon.

Other examples of performance based initiatives the Commission is considering include risk based technical specifications, and risk based inspection programs.

These activities, while more applicable to operating reactors, also need to be factored into the design and operation of future reactors.

ANNUAL INDIVIDUAL RISK GOAL

Not only does regulation by objective allow industry latitude to apply innovative solutions, it also provides a framework within which NRC can better focus its resources. I have been proposing recently that we in the United States apply the idea of performance based regulation with quantitative objectives toward achieving greater coherence in our overall regulatory program. Let me explain what I mean.

In the United States there generally continues to be only limited and piecemeal application of risk assessment in establishing both limits and priorities for regulatory and managerial activities. Further, there is no common national public health and safety risk goal that guides the regulator and the regulated in determining whether a given public risk is acceptable in light of the public benefit of the activity.

It has become my personal belief that regulatory activities which relate to the protection of public health and safety could be guided by a general public risk goal consisting simply of an annual individual risk goal. Such a national risk goal would guide regulators in establishing regulatory requirements for the protection of the public health and safety in their area of responsibility. In other words, the question of how much safety is enough safety for a variety of human activities involving public risk would have been answered on a common public risk basis. Industry then would be encouraged and well advised to set design and operation risk goals of their activities below the health and safety risk goals, in order to account for data and analytical uncertainties and for economic risk considerations.

Such a general risk goal would provide us with a criterion to judge when our efforts at prevention and mitigation have been taken to reasonable and rational limits. Without such a goal, I'm afraid that regulators will continue to strive to reduce frequency numbers without knowledge of or a feeling for the relative risk significance of these efforts. Viewing such efforts from a relative risk perspective, we would be better able to concentrate on those events, or human activities, which represent the more significant risks to society. Further, the combined use of a general public risk goal with risk assessment tools would enhance communication among the various disciplines and among the various regulatory bodies involved in protecting the public health and safety.
It is my personal hypothesis that a general public risk goal in the form of an annual individual risk of fatality on the order of 10E-5 to 10E-6 per year could be such a goal.

U.S. CIRCUMSTANCES LEADING TO APPLICATION OF RISK GOALS AND THE OPPORTUNITY TO APPLY THEM INTERNATIONALLY

Perhaps a similar regulatory philosophy could be applied in other countries as well. I do think, however, that it is the result of certain circumstances in the United States that has caused such a regulatory philosophy to seem to be particularly appropriate at this time.

First, in the U.S., risk analysis is now being used to some extent in virtually every significant government program. The U.S. Environmental Protection Agency (EPA), the U.S. Consumer Products Safety Commission, the Food and Drug Administration, the Department of Energy, the U.S. Department of Agriculture, the Department of Defense, and The Occupational Health and Safety Administration (OSHA), are but a few of the other agencies that utilize risk assessment. Additionally, the Congress has created a Commission on Risk Assessment as part of the Clean Air Act Amendments of 1990.

One of the reasons we have been able to incorporate risk assessment into our nuclear regulatory program to such a degree is because, with a very large commercial nuclear power plant program, we have access to a great amount of operating data. We have an enormous data base with which to judge and improve system and equipment performance. In addition we have had the benefit, through INPO and WANO, and Bilateral and Multilateral Agreements, of sharing some operating data on an international basis.

Also as a result of our extensive operating experience we have accumulated data regarding operator performance as well as system and equipment performance. This has enabled us to consider a regulatory program that is performance-based with quantitative objectives.

Whether such a regulatory philosophy is to take hold and prove successful in the United States remains to be seen. It is still in its very early stages of development. As I mentioned before, there continues in general to be only limited and piecemeal application of risk assessment in establishing both limits and priorities for regulatory and managerial activities.

The Bush Administration began an initiative to establish consistent risk assessment and management principles for all agencies, and set up a central review panel for agency risk decisions. One part of the proposal would be a set of general principles for all agencies to follow in conducting "risk analyses." Currently, agencies have their own policies for treating uncertainties in application of risk assessment, for example, leading to overly conservative results in some cases and consequent allocation of resources not necessarily focused on activities presenting the most public risk. Also, agencies would be required to explain risks in a way the public can understand, avoiding single-number characterization of risks.

I am pleased to see that the Energy Policy Act just signed requires us to shift from a release based standard to a risk based dose standard for high level waste.

The Energy Policy Act directs the Environmental Protection Agency (EPA) to set new health based standards applicable to the proposed high level waste site at Yucca Mountain that are based upon findings and recommendations of the National Academy of Science.

After the EPA finalizes its high level waste standards, the NRC will modify its technical requirements and criteria in Part 60 of our regulations to be consistent with the EPA standards. The EPA standards are to be finalized not later than December 31, 1994, and the NRC's conforming standards are to be finalized one year later.

The provisions of the Energy Policy Act that are related to commercial nuclear power and permanent high level waste disposal should lead to more efficient and effective regulation of nuclear activities.

A second major element of the Administration's proposal would be the establishment of a "central review mechanism" for agency risk analyses. Agencies would also ensure that when

they take action to reduce one risk they do not inadvertently create worse risks through the alternative offered. I hope the Administration will continue to pursue this initiative after the election.

Perhaps the need to more finely tune how we focus resources has also been the result of our changing economy in the United States during the past ten years. The industry has always encouraged the regulators to be sensitive to regulatory impacts in terms of cost, but in recent years such impacts have become an even more important topic. Earlier this year President Bush initiated a program to strongly encourage regulatory agencies to evaluate existing regulations and programs to reduce unnecessary regulations. Initially the NRC identified several regulations that fell into this category, and anticipates continued effort to identify other regulations which might be modified or eliminated because they are no longer necessary to assure public health and safety.

CONCLUSION

Now I hope it is clear why I envision ghosts and goblins not allowed. Yes, US regulatory philosophy is exchanging old shape for new, but the image I see is in no way scary or menacing. Many are involved in its metamorphosis.

While I am confident that the NRC will do a detailed quality job reviewing and evaluating the evolutionary and advanced reactor designs, all this effort could be wasted if public acceptance of the nuclear technology erodes. Public acceptance of the nuclear technology can be shaped and influenced through international events. The continued safe operation of existing plants will play a vital role in the public's acceptance of the nuclear technology. It is important that the NRC's process remain open to public scrutiny and that we utilize every opportunity to explain to the public our design, construction, operation, licensing, and regulatory philosophies and procedures.

Once again, it is my pleasure to participate in this international conference. It is ever more evident that nuclear is an international technology, where we all learn from each other.