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FUTURE REACTOR LICENSING
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ABSTRACT

The Nuclear Regulatory Commission has several activities underway directed toward future reactor licensing. These involve the issuance of regulations on standardization, the development of guidance on the treatment of severe accidents, and the review of advanced light water reactor, gas-cooled reactor and sodium-cooled reactor designs.

INTRODUCTION

The subject of this paper is the Nuclear Regulatory Commission's (NRC) plans and activities associated with future reactor licensing. Briefly, these plans and activities can be broken into six main areas:

- 1) Standardization
- 2) Development of rules and guidelines for the treatment of severe accidents,
- 3) Review of a utility sponsored Advanced Light Water Reactor (ALWR) Requirements Documents,
- 4) Review of three, large size, Advanced Light Water Reactor standard designs,
- 5) Review of mid-size ALWRs and
- 6) Review of advanced non-LWR designs.

Each of these will be discussed in turn, but first, some general comments about the relationship of these activities follow. First, the order in which the reactor types are discussed generally represents the order in which they would be available for electric power generation. Second, each group of reactor designs represent a change from reactor designs currently licensed and operating and the Commission expects future reactor designs to represent an improvement over the existing designs. Third, the Commission expects that each new reactor design presented for review in the future will have as its goal standardization of the design, preferably through the Design Certification process.

1) Standardization

Since the mid -1970s, the Commission has had a policy and regulations addressing standardization. These initiatives were embodied in Appendices M, N and O of 10CFR50, and put forth several options for

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achieving standardization (replicate plant, duplicate plant, reference plants manufacturing license and Design Certification). In varying degrees, all of these options, except Design Certification, have been used in the past. Recently, however, the Commission has been emphasizing standardization through the Design Certification process. This emphasis was most recently stated in a revised Commission Policy Statement on Nuclear Power Plant Standardization (published in the Federal Register on September 15, 1987). As stated in this policy statement, Design Certification is a process whereby a reactor design, after review and approval by the NRC staff, is certified for future use via a rulemaking. Applicants who then reference a certified design only have to have reviewed and litigated those portions of their application not covered by the certified design. Such a process is intended to promote standardization, minimize duplication of review by applicants and NRC staff and ultimately streamline the licensing process. As stated in the Commission's September 1987 Standardization Policy Statement, it is our intent to issue a new rule to provide the regulatory framework for the Design Certification process. This rule is currently in preparation and is to become 10CFR52. It is expected that the proposed rule will be issued for public comment sometime this summer and made final in about one year.

2) Treatment of Severe Accidents

In 1985 the Commission issued its Policy Statement on Severe Reactor Accidents. A portion of that Policy Statement was directed toward future reactor designs. Specifically, the Policy Statement called for future reactor designs to:

- ° complete a Probabilistic Risk Assessment (PRA) and consider the severe accident vulnerabilities it exposes,
- ° comply with the Commission's regulations, including the requirements for new plants resulting from the accident at TMI,
- ° demonstrate technical resolution of all applicable Unresolved Safety Issues (USIs) and medium and high priority Generic Safety Issues (GSIs) with a special focus on the reliability of decay heat removal and electrical supply systems.
- ° completion of a staff review that stress deterministic engineering judgement complemented by PRA.

As a result of this Policy Statement, the Commission has initiated an effort to develop more detailed guidance regarding how severe accidents should be treated in future reactor designs. It is expected that this more detailed guidance will be in the form of rules and Reg. Guides and will be developed over the next two years to support the Design Certification of the large size standard plant designs currently under review at NRC (the review of these designs is discussed in item 2 below). Current staff thinking regarding the the form and content of the rules and Reg. Guides is as follows:

- ° Two general rules - one requiring a PRA be submitted as part of any future application for a design approval and Design Certification and the other requiring that the design be evaluated against a range of severe accidents.
- ° Two Reg. Guides - one providing the standard format and content for the PRA and the other specifying those accidents, phenomena, acceptance criteria and other items which should be considered as part of evaluating a design for severe accidents.

Since these rules and Reg. Guides are intended to support the NRC staff's review of ALWRs, beginning with the large size ALWRs currently under review, it is essential that their development be a timely, well coordinated and open process. Accordingly, as an integral part of the development of these rules and Reg. Guides, we are planning periodic public meetings to brief interested parties on their content as they develop and on our future plans, to collect information and to solicit feedback on these and other selected topics. The first of these public meetings should take place in the next one to two months. Of course, the normal public comment process for rules, through publication in the Federal Register, will follow. It is our expectation that through such an open process the ALWR designers will have sufficient time to address staff concerns without impacting their schedule for Design Certification.

Regarding technical content, our current approach is to specify in the Reg. Guides items such as:

- ° Acceptable ways to select severe accidents and phenomena which a design must consider (internal and external events),
- ° guidelines for the evaluation of a design with respect to severe accidents (i.e., when is a design change warranted, treatment of USIs/GSIs, etc.),
- ° guidelines for severe accident procedures and training,
- ° acceptance criteria

The NRC is also aware of the industry initiatives to address severe accidents, as part of the programs described in the remaining parts of this paper, and plans to consider these in its development of the severe accident rules and Reg. Guides.

3) Review of Utility Sponsored ALWR Requirements Document

In 1983, the Commission was approached by the Electric Power Research Institute regarding the review of a utility sponsored document which was to define the requirements utilities desired to see in future LWRs. In addition, this document was an attempt to stabilize the regulatory process (by proposing solutions to all identified generic safety issues and by proposing ways of treating severe accidents), to propose changes to some existing requirements and to promote standardization. The Commission agreed to review this document and to document its review in a Safety

Evaluation Report (scheduled for completion in 1991). The staff's review of the EPRI document is for the purpose of evaluating the licensing acceptability of the requirements therein. Designers then choosing to use the Requirements Document would have some degree of confidence that their design met utility as well as regulatory requirements. Current LWR licensing requirements are being used as the baseline for the review, with EPRI proposed changes to these licensing requirements being assessed on a case by case basis. The treatment of severe accidents, as proposed by EPRI in their submittals, is one key area the staff will focus on in this review.

4) Review of Large Size ALWR Standard Plant Designs

The Commission currently has underway review activities on three large size ALWR standard plant designs. These are:

- 3800 Mwt (1350 Mwe) Westinghouse 4-loop advanced PWR (RESAR SP/90)
- 3800 Mwt (1270 Mwe) Combustion Engineering 2-loop advanced PWR (CE's System 80 plus design)
- 3926 Mwt (1356 Mwe) General Electric advanced BWR.

These designs represent evolutionary changes from reactor designs currently operating and, as such, are being reviewed in accordance with existing requirements for LWRs. The design submitted by CE and GE are final designs whereas the Westinghouse design currently under review is a preliminary design. Each of these designs has as its goal Design Certification through a rulemaking process and will be the first designs to go through that process. Currently, schedules call for the initiation of Design Certification rulemakings by:

- 2/92 for the SP/90
- 4/91 for the CE-APWR
- 8/90 for the ABWR

Regarding the treatment of severe accidents, each of the designers is to prepare a PRA on their design and each has indicated they will assess their designs for severe accident vulnerabilities. It is expected that specific proposals regarding the treatment of severe accidents will be made by the designers during the NRC review process on these applications.

5) Review of Mid Size ALWRs

As part of a joint Department of Energy (DOE), EPRI and industry program, conceptual designs of mid-size (600 Mwe) ALWRs are being developed. These mid-size ALWRs are attempting to utilize passive safety features and simplified plant design and represent a smaller plant size option targeted for the mid-1990s. It is our understanding, that these designs may be submitted for NRC review as early as 1990 and desire Design Certification in the mid-1990s. We would expect such designs to represent an improvement over previous LWR designs and to adequately address severe accident and other design issues facing present generation LWRs.

Recently, we have been contacted regarding conducting a review at the conceptual design stage on one of the mid-size designs (the Westinghouse AP-600) similar to the conceptual design reviews we are currently conducting on three non-LWR designs, as described in Item 6 below.

6) Review of Advanced Non-LWR Designs

In July 1986, the Commission issued a Policy Statement on the Regulation of Advanced Nuclear Power Plants. It was directed toward designs that differ significantly from current generation LWRs and specifically encouraged the development of designs with enhanced safety characteristics and the early interaction between the NRC staff and advanced reactor designers.

In accordance with this policy DOE, in late 1986, submitted for NRC review three advanced reactor conceptual designs. These are:

- ° a 350 Mwt Modular High Temperature Gas-Cooled Reactor (MHTGR),
- ° a 425 Mwt sodium cooled modular reactor called the Power Reactor Inherently Safe Module (PRISM) and
- ° a 900 Mwt sodium cooled modular reactor called the Sodium Advanced Fast Reactor (SAFR).

These concepts are currently under review by NRC with the purpose of our review being to provide preliminary guidance on the licensing requirements for and acceptability of these designs. These designs are quite different than LWRs and make use of passive and simplified safety system to accomplish their safety functions. In addition, they have attempted to reduce dependence on operator action and reduce the potential for operator errors to affect the performance of safety functions. In this process, they have proposed that some of the traditional requirements applied to reactors should no longer apply to these advanced designs because of the ability of these designs to prevent core damage. Of most significance in this regard are their proposals regarding how to accomplish the containment function, to eliminate the need for offsite emergency evacuation and to utilize mechanistic source terms for siting purposes. In addition to these major items, a number of other licensing issues have been raised by these designs. Examples of these are provided in the following table:

TABLE

Advanced Reactor Licensing Issues

- ° non-safety grade control room
- ° role of the operator
- ° performance and reliability of passive shutdown and decay heat removal systems

- ° fuel performance
- ° treatment of balance of plant

Our review of these conceptual designs is nearly complete. The results of these reviews are to be documented in SERs to be published this fiscal year. Due to the policy implications of some of the issues raised by these designs (containment, emergency planning and use of a mechanistic source term), it has been necessary for us to seek guidance from the Commissioners on these. This guidance will be factored into our SERs.

The review process established for these conceptual advanced reactor designs (as documented in the Advanced Reactor Policy Statement and in NUREG-1226 "Development and Utilization of the NRC Policy Statement on the Regulation of Advanced Nuclear Power Plants") represents a new opportunity to have early interaction with NRC prior to submitting a formal application. It is our intent that if and when an actual application is received on one of these designs, the NRC review of that application would build upon and utilize the results of the reviews conducted at the conceptual design stage.

SUMMARY

The NRC has several activities underway directed toward future reactor licensing. These activities cover the span from future plants of evolutionary design to those significantly different than LWRs. Common objectives in all of these activities are the interest and emphasis on standardization of plant designs, establishment of requirements and guidance on consideration of severe accidents in plant design and operation and expected improvements in safety in each of the new designs.