NUCLEAR REGULATORY COMMISSION

10 CFR PART 50

Proposed Policy for Regulation
of Advanced Nuclear Power Plants

AGENCY: Nuclear Regulatory Commission

ACTION: Proposed Policy Statement

SUMMARY: The Commission intends to improve the licensing environment for advanced nuclear power reactors to minimize complexity and uncertainty in the regulatory process. Advanced reactors are defined as reactor designs which are significantly different from the present generation light water reactors. It is anticipated that these designs will reflect the benefits of significant research and development work, and include the experience gained in operating the many power and developmental reactors both in the United States and throughout the world. Since the wealth of analyses, research, development and operating experience provide useful insights to designers, it is also expected these reactor plants will have an enhanced margin of safety. To provide regulatory guidance during the development of advanced reactor design, the Commission wishes to encourage the earliest possible interaction between other government agencies, designers, potential licensees and the NRC. The proposed policy statement sets forth the general characteristics of advanced reactor design which the Commission believes will contribute to increased assurance of safety, to better public understanding, and to more

effective regulation. As the agency responsible for protecting the public from the potential hazards of nuclear power plants, the Commission will keep the public informed of its judgment on the known and unknown safety aspects of advanced reactor designs as they come before the Commission.

DATES: The comment period expires APR 25 [illegible]

ADDRESSES: Send written comments or suggestions to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Docketing and Service Branch. Copies of comments received by the Commission may be examined at the NRC Public Document Room, 1717 H Street, NW, Washington, DC 20555.

FOR FURTHER INFORMATION CONTACT: Dennis K. Rathbun or James G. Beckerley, Office of Policy Evaluation, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Telephone (202) 634-3295.

SUPPLEMENTARY INFORMATION: This statement gives the Commission's policy for considering advanced reactors which are those reactor designs that are significantly different from the light water reactors now under construction or in operation.

Legislative Background

The Commission's policy with respect to regulation of advanced reactors is guided by the legislative background. The Energy Reorganization Act of 1974, which established the Nuclear Regulatory Commission, specifically delegated to NRC "licensing and related regulatory authority" for demonstration nuclear reactors other than those already in existence "...when operated as part of the power generation facilities of an electric utility system, or when operating in any other manner for the purpose of demonstrating the suitability for commercial application of such a reactor...". The Energy Research and Development Administration (now the Department of Energy) was charged with "...encouraging and conducting research and development, including demonstration of commercial feasibility and practical applications of the extraction, conversion, storage, transmission, and utilization phases related to the development and use of energy from...nuclear...sources."

Under Section 205 of the Energy Reorganization Act, NRC must provide a "long-term plan for projects for the development of new or improved safety systems for nuclear power plants." The Commission is generally limited by language in Congressional Committee reports to research on safety systems to be incorporated into reactors of current design and on conceptual designs for both new systems and new reactors. NRC is precluded from designing or doing

research on complete new designs for the purpose of establishing or developing their commercial potential.[1]

Previous Experience

The Commission has had experience in the regulation of advanced reactors. In the early 1970's NRC reviewed several applications for high-temperature, gas-cooled reactors (HTGRs) and a conceptual design for a gas-cooled breeder reactor, and granted an operating license to Fort St. Vrain, the only operating HTGR. The NRC also expended substantial effort from 1975 to 1979 in reviewing General Atomic's standard high-temperature, gas-cooled nuclear reactor steam supply system (GASSAR). In addition, the NRC has supported a modest program of safety research on gas-cooled reactors every year since the agency's inception.

The NRC and its predecessor, the Atomic Energy Commission (AEC), have also been involved in the review and licensing of liquid metal fast breeder reactors (LMFBRs). The Fermi-1 and SEFOR reactors were reviewed and licensed, DOE's Fast Flux Test Facility (FFTF) was reviewed but not licensed,

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[1]The general principle defining the scope of NRC's research can be described as avoiding a conflict of interest--"[NRC] should never be placed in position to generate, and then have to defend, basic design data of its own" as expressed in the Conference Report to the Energy Reorganization Act of 1974.

and a formal licensing proceeding was conducted for the Clinch River Breeder Reactor (CRBR). The CRBR was subject to the same regulatory process as any current commerical nuclear power project. The NRC conducted an extensive safety research program in support of the LMFBR program and the CRBR licensing effort. When the CRBR project was cancelled, NRC's research program was revised to eliminate CRBR-specific work.

Finally, the Commission notes that the precedent for the broad policy approach to advanced reactor regulation, as proposed here, is firmly established in the 1979 Non-proliferation Alternative Systems Assessment Program (NASAP), wherein the NRC considered the safety and licensability of a variety of advanced reactor concepts within the context of non-proliferation objectives. The concepts considered and reported on by the NRC in the 1979 study ranged from preliminary conceptual designs to variations of existing (LWR) power plant designs.

Current Commission Policy

The Commission's policy with respect to regulating nuclear power reactors is to assure adequate protection of the public health and safety and the environment, consistent with its legislative requirements.

As discussed in the 1985 Policy and Planning Guidance, while the NRC itself does not develop new designs, the Commission will maintain the capability to respond to innovative and advanced designs that might be presented for Commission review. The Commission intends to make known the factors it considers important for advanced reactor concepts in order to minimize complexity and uncertainty in the regulatory process.

On standardization of the current generation of nuclear power reactors, the Commission's 1985 Policy and Planning Guidance states:

> The NRC recognizes that there are advantages to the development and use of standardized nuclear power plant and balance of plant designs. Such designs can benefit public health and safety by concentrating the resources of designers, engineers and vendors on particular approaches, by stimulating standardized programs of construction practice and quality assurance, by improving the training of personnel and by fostering more effective maintenance and improved operation. The use of such designs can also permit more effective and efficient licensing and inspection processes. Therefore, the Commission strongly encourages industry to pursue standardization in future reactor designs.

The Commission is preparing a policy statement on standardization which will be applicable to future reactors.

Proposed Policy

The Commission's proposed policy is to encourage the earliest possible interaction of applicants, vendors, other government agencies and the NRC to provide the most effective regulation for advanced reactors, and to provide all interested parties, including the public, with a timely, independent assessment of the safety characteristics of advanced reactor designs. The NRC would undertake, within its statutory responsibilities, to minimize complexity and add stability and predictability in the licensing and regulation of advanced reactors.

The Commission believes that reactor designs with some or all of the following general characteristics would be desirable. Combinations of some or all of them may help obtain early licensing or standardized design approval with minimum regulatory burden and should be more readily understood by the NRC, the utilities and the general public.

1. Designs that require few supplemental safety features to ensure safety, and/or designs that provide longer time constants to allow for more diagnosis and management prior to reaching safety systems challenge.

2. Simplified safety systems which require the fewest operator actions, the least equipment (especially equipment subjected to

severe environmental conditions), and the minimum number of components needed for maintaining safe shutdown conditions, thereby facilitating operator comprehension and reliable system function. Such simplification can also reduce the uncertainties associated with deterministic engineering judgment and probabilistic risk analyses.

3. Designs that (a) minimize the potential for severe accidents and their consequences by providing sufficient inherent safety, reliability, redundancy, diversity and independence in safety systems; (b) provide reliable equipment in the rest of the plant, thereby reducing the number of challenges to the safety systems; (c) provide easily maintainable equipment and components; and (d) reduce potential radiation exposures to plant personnel.

4. Increased standardization and shop fabrication to minimize the potential for field construction errors without creating new difficulties in factory-to-field transport, installation and maintenance.

5. Design features that can be proven by citation of existing technology or which can be satisfactorily established by commitment to a suitable technology development program.

If specific advanced reactor designs with characteristics such as the foregoing were brought to the NRC for comment and/or evaluation, the Commission could develop preliminary general design and licensing criteria for their safety-related aspects. However, until such time as detailed conceptual designs are submitted, the Commission believes that regulatory guidance must be sufficiently general to avoid placing unnecessary constraints on the development of new design concepts. The number and nature of regulatory requirements will be based on the extent to which an individual advanced reactor design incorporates the general characteristics above.

During the evolutionary phase of advanced reactor development, the Commission particularly encourages design innovations which increase safety and reliability (such as those described above) and which generally depend on technology which is either proven or can be demonstrated by a satisfactory technology development program.

The Commission's ultimate goal is the approval of essentially complete standard plant designs. However, advanced reactor designers and prospective construction permit applicants are encouraged not to wait until detailed designs are complete, but to submit technical information on their proposed conceptual designs as far in advance of application as practicable, so that NRC staff may evaluate fundamental safety characteristics in a timely manner.

To enhance Commission participation and continuity in the review of advanced reactors, an advanced reactors group has been established in the Office of Nuclear Reactor Regulation. This group will be the focal point for NRC interaction with the Department of Energy, designers (domestic and foreign) and potential applicants and will prepare a plan for the development of regulatory criteria for licensing proposed advanced reactors. In addition, the group will provide guidance on an NRC-funded advanced reactor research program to ensure that it supports, and is consistent with, the Commission's advanced reactor policy. The Advisory Committee on Reactor Safeguards (ACRS) will play a significant role in reviewing proposed advanced reactor design concepts and supporting activities.

The Commission would also like to be informed as early as possible of new design concepts under consideration by the nuclear industry so that the staff can review and comment on their safety and, if necessary, support confirmatory research on them. While the NRC itself does not develop new designs, the Commission intends to develop the capability for timely, appropriate assessment and response to innovative and advanced designs that might be presented for NRC review. Prior experience has shown that new reactor designs--even variations of established designs--may involve technical problems that must be identified and solved in order to assure adequate protection of the public health and safety. The earlier such design problems are identified, the earlier satisfactory resolution can be achieved. When informing the NRC of new concepts under consideration, prospective

applicants should understand that they are responsible for all research necessary to support any specific license application. NRC research is conducted only to provide the technical bases for rulemaking and regulatory decisions; to support licensing and inspection activities; to assess the feasibility and effectiveness of safety improvements; and to increase our understanding of phenomena for which analytical methods are needed in regulatory activities.

Questions

A number of basic issues were identified in development of this policy statement. The Commission requests comments from all interested parties on the following questions, as well as on any other aspects of the policy statement:

1. Should NRC's regulatory approach be revised to reduce dependence on prescriptive regulations and, instead, establish less prescriptive design objectives, such as performance standards? If so, in what aspects of nuclear power plant design (for example, reactor core power density, reactor core heat removal, containment, and siting) might the performance standards approach be applied most effectively? How could implementation of these performance standards be verified?

2. Should the regulations for advanced reactors require more inherent safety margin in their design? If so, should the emphasis be on providing features that permit more time for operator response to off-normal conditions, or should the emphasis be on providing systems that are capable of functioning under conditions that exceed the design basis?

3. Should licensing regulations for advanced reactors mandate simplified designs which require the fewest operator actions, and the minimum number of components needed for achieving and maintaining safe shutdown conditions, thereby facilitating operator comprehension and reliable system function for off-normal conditions?

4. Should the NRC develop general design criteria for advanced reactors by modifying the existing regulations, which were developed for the current generation of light water reactors, or by developing a new set of general design criteria applicable to specific concepts which are brought before the Commission?

5. Should the NRC favor advanced reactor designs that concentrate the primary safety functions in very few large systems (rather than in multiple subsystems), thereby minimizing the need for complex benefit and cost balancing in the engineering of safe reactors?

6. What degree of proof would be sufficient for the NRC to find that a new design is based on technology which is either proven or can be demonstrated by a satisfactory technology development program? For example, is it necessary or advisable to require a prototypical demonstration of an advanced reactor concept prior to final licensing of a commercial facility?

Dated at Washington, D.C., this 21st day of March 1985.

For the Nuclear Regulatory Commission

John C. Hoyle
Acting Secretary of the Commission