[7590-01-P]

United States Nuclear Regulatory Commission

NRC-2008-0237

Policy Statement on the Regulation of Advanced Reactors

AGENCY: Nuclear Regulatory Commission.

ACTION: Final policy statement.

SUMMARY: On May 9, 2008 (73 FR 26349), the Nuclear Regulatory Commission (NRC; Commission) issued, for public comment, a draft policy statement on the regulation of advanced reactors. This final policy statement reinforces the Commission's current policy regarding advanced reactors and includes new items to be considered during the design of these reactors, including security, emergency preparedness, threat of theft, and international safeguards.

DATE: The effective date is **(Insert date 30 days after the date of publication)**

FOR FURTHER INFORMATION CONTACT: Mr. Wesley W. Held, Rulemaking, Guidance, and Advanced Reactor Branch, Division of New Reactor Licensing, Office of New Reactors, U.S. Nuclear Regulatory Commission, Mail Stop: T-6 C34, Washington, DC 20555-0001; Telephone: (301) 415-1583; fax number: (301) 415-5399; e-mail: *Wesley.Held@nrc.gov*.

SUPPLEMENTARY INFORMATION:

I. Background

On July 8, 1986 (51 FR 24643), the Commission published a policy statement on the regulation of advanced reactors. The Commission had the following three primary objectives in issuing the advanced reactor policy statement (ARPS):

- To maintain the earliest possible interaction of applicants, vendors, and government agencies with the NRC.
- To provide all interested parties, including the public, with the Commission's views concerning the desired characteristics of advanced reactor designs.
- To express the Commission's intent to issue timely comment on the implications of such designs for safety and the regulatory process.

On July 12, 1994 (59 FR 35461), the Commission revised the 1986 ARPS by addressing the Commission's policy on metrication (57 FR 46202; October 7, 1992; as revised June 19, 1996 (61 FR 31169)).

Since the events of September 11, 2001, the NRC has assessed potential threats and their possible impacts on the Nation's fleet of operating nuclear power reactors and has required upgrades of physical security measures and mitigative strategies through the issuance of a series of security orders and license conditions. For new nuclear power reactors, the Commission considers it prudent to provide expectations and guidance on security matters to prospective applicants so that they can use this information early in the design stage of new reactors to identify potential mitigative measures and/or design features that provide a more robust and effective security posture. Therefore, the Commission decided to revise the ARPS

to integrate these expectations for security and emergency preparedness with the current expectations for safety.

The Commission's expectation for advanced reactor designers to consider the effects of a large, commercial airplane impact is currently being addressed through rulemaking (Consideration of Aircraft Impacts for New Nuclear Power Reactor Designs—RIN AI19—Docket ID NRC-2007-0009). The Commission believes that reactors designed with potential aircraft impact considerations resulting from this rule would be more robust than if they were designed in the absence of this rule.

The proposed policy statement, "Policy Statement on the Regulation of Advanced Reactors," was published in the *Federal Register* on May 9, 2008 (73 FR 26349). The public comment period expired on July 8, 2008. This final policy statement reflects the pertinent comments received on the published draft policy statement.

II. Summary of Public Comments and Responses to Comments

Eight organizations and individuals submitted written comments on the draft policy statement. The commenters represented a variety of interests addressing a wide range of issues, and included individuals; reactor vendors; and citizen, environmental, and industry groups. Most commenters agreed with the general principle of the policy statement, but no commenter supported the policy statement exactly as proposed. Several commenters wanted changes made to the list of design attributes to be considered. Others suggested linking the design attributes to the general design criteria (GDC). Another commented on the security of nuclear power plants, and one commenter described a thorium reactor design.

Comments on this proposed rule are available electronically at http://www.regulations.gov. From this page, the public can find all the comments received by inputting NRC-2008-0237 into the search field. Comments are also available electronically at

the NRC's Electronic Reading Room at http://www.nrc.gov/reading-rm/adams.html. From this page, the public can gain access to the Agencywide Documents Access and Management System (ADAMS), which provides text and image files of NRC's public documents. The public can search for comments using the ADAMS accession numbers listed in the table below, which includes the commenters' names and affiliations.

Letter No.	ADAMS Accession No.	Commenter Affiliation	Commenter Name	Abbreviation
1	ML081420201	Private citizen	Paul Sund	Sund
2	ML081420208	University of California - Berkeley	Per Peterson	UCB
3	ML081770159	Toshiba	Koichiro Oshima	Toshiba
4	ML081900560	Thorium ElectroNuclear AB	Elling Disen	TEN AB
5	ML081900562	North Carolina Waste Awareness and Reduction Network	John D. Runkle	NC WARN
6	ML081910787	Nuclear Energy Institute	Adrian Heymer	NEI
7	ML081910796	Union of Concerned Scientists	Edwin Lyman	UCS
8	ML081970378	Private citizen	Ray Van De Walker	Walker

This document places each public comment into one of the following categories:

A. General Comments

B. Attributes to Be Considered During Design

C. Security of Advanced Reactors

D. Relationship to GDC

E. Other Comments

Within each category, the NRC has either repeated comments as written by the commenter or summarized the comments for conciseness and clarity. At the end of the comment or comment summary, the NRC references the specific public comments and the letters by which they were provided to the NRC using the NRC-assigned sequential comment numbers listed in Table 1. For example, specific comments are referenced as [XXX]-[YYY],

where [XXX] represents the commenter's abbreviation and [YYY] represents the NRC-assigned sequential comment number.

A. General Comments

Comment: The commenter believes that a fast fuel reactor can help reduce the volume of radioactive waste currently in storage at reactor sites in the United States and hopes that the NRC has considered or will consider those designs. (Sund-1)

NRC Response: The NRC neither develops nor promotes reactor designs, but rather reviews the safety and security aspects of designs proposed by reactor vendors and designers. The NRC has the ability to develop the capability to evaluate innovative and advanced designs that are presented for NRC review (e.g., Toshiba's 4S reactor design). No changes were made to the policy statement as a result of this comment.

Comment: The commenter suggests that the term "current generation" in the first paragraph of the policy statement could be misinterpreted because it was written in 1986 and does not take into consideration plants currently in the licensing process. The commenter suggests that the term "current generation light-water reactors" be replaced with "plants licensed before 1997." (NEI-2)

NRC Response: The NRC agrees that the term "current generation" may cause confusion because it is subjective and time-dependent. During previous interactions with the industry, the staff indicated that "current generation light-water reactors" refers to those reactors that were licensed before 1997. Accordingly, a footnote has been added to Section III, "Final Policy Statement," providing this definition.

Comment: The commenter suggests that the discussion of the pending rulemaking on Consideration of Aircraft Impacts for New Nuclear Plant Designs (Rulemaking Docket NRC-2007-0009) is more akin to background information than a lasting statement of

Commission policy and recommends deleting this paragraph or relocating it to the Background section. (NEI-3)

NRC Response: The NRC agrees with the comment and has moved the discussion to the Background section in order to alleviate the need to revise the statement again as that rulemaking progresses.

Comment: The commenter states that the NRC licensing review is a famously difficult hurdle for advanced reactors and wants the Commission to consider a pilot program where commercial bureaus would use NRC policies to review, license, and inspect new reactor designs. (Walker-1)

NRC Response: The Atomic Energy Act of 1974, as amended, describes the NRC's responsibilities. These responsibilities include the licensing of nuclear reactors; therefore, the NRC cannot transfer this responsibility to another entity. No changes were made to the policy statement as a result of this comment.

Comment: The commenter encourages "type-licensing" of reactor designs and "fast-track combined operating licenses." (Walker-2)

NRC Response: The NRC generally agrees with the comment. As the commenter noted, the NRC has regulations in place that allow these regulatory approval processes. In 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," the NRC uses the term "design certification" to describe the process of approving by rulemaking a reactor design that may be referenced by combined license (COL) applicants. A COL is a licensing process that results in the granting of a combined construction permit and operating license with conditions. This process is different from the two-step process in 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," which provides for construction permits and operating licenses. In addition to the benefits gained by using the COL process, the NRC has

also developed a design-centered approach for COL reviews that implements a “one issue, one review, and one decision philosophy.” No changes were made to the policy statement as a result of this comment.

Comment: The commenter believes that the overall effectiveness of the policy will be strengthened if the fourth listed attribute (and perhaps to a lesser degree, the eighth), emphasizes or prioritizes the potential for minimizing severe accidents over minimizing the consequences of such an accident. This may be a small distinction, but the commenter believes there is a benefit to initially focusing on features to prevent an accident although reactor designers should not overlook mitigation features. (Toshiba-1)

NRC Response: The NRC agrees that accident prevention is preferable to accident mitigation and believes that the fourth attribute expresses this emphasis because the attribute lists design features that enhance prevention specifically. However, the attribute has been modified to place additional emphasis on accident prevention.

Comment: The commenter notes that the policy statement makes no mention of the use of probabilistic risk assessment (PRA) in assessing the design of advanced reactors and feels that it would be helpful to describe how PRA might be used to confirm the favorable design attributes suggested. The commenter feels that it may be helpful to provide advanced reactor designers with interim guidance regarding NRC efforts for a risk informed, technology neutral licensing framework to permit designers to approach licensing with less uncertainty regarding if and/or how PRA should be utilized. (Toshiba-3)

NRC Response: The NRC has established specific requirements related to the use of PRA in licensing new nuclear power plants, which would be applicable to advanced reactors. For example, in accordance with 10 CFR 52.47, “Contents of Applications—Technical Information,” applicants for a design certification must include in their application a description of

the design-specific PRA and its results. In addition, 10 CFR 50.71(h) requires each holder of a COL to develop and maintain a PRA for their facility and to periodically update the PRA to reflect plant changes and any NRC-endorsed consensus standards on PRA. In addition to adopting these regulatory requirements, the Commission has also issued policy statements on the use of PRA in regulatory activities (60 FR 42622; August 16, 1995), and severe accidents regarding future designs and existing plants (50 FR 32138; August 8, 1985). The use of PRA as a design tool is implied by the policy statement on the use of PRA and the NRC believes that the current regulations and policy statements provide sufficient guidance to designers. No changes were made to the policy statement as a result of this comment.

B. Attributes to Be Considered During Design

Comment: The commenter recommends that the policy statement explicitly discuss the threat of theft, in addition to the current focus on threat of sabotage of facilities, and encourage designers to consider requirements for implementing international safeguards monitoring early in the design process, particularly for reactors that will be co-located with reprocessing facilities. The commenter suggested a possible addition to the list of design attributes included in the policy statement that relates to theft and international safeguards. (UCB-1)

NRC Response**:** The NRC agrees with the comment and has added expectations that reactor designers consider the threat of theft and requirements for implementing international safeguards monitoring early in the design phase. An attribute has been added to the list of design attributes to be considered during the design of advanced reactors to address these topics.

Comment: The commenter suggests that the following attributes in the current ARPS are not statements of design philosophy and are solely a restatement of existing regulations and should be deleted.

- Designs with features to prevent a simultaneous loss of containment integrity (including situations where the containment is bypassed), and the ability to maintain core cooling as a result of an aircraft impact, or identification of system designs that would provide inherent delay in radiological releases (if prevention of release is not possible).
- Designs with features to prevent loss of spent fuel pool integrity as a result of an aircraft impact. (NEI-1)

NRC Response: The NRC agrees that these attributes are restatements of current requirements, but it believes that these aspects should be highlighted in the policy statement to ensure that they are considered early in the design phase in order to identify design features that could be included to prevent or mitigate problems rather than relying on operational programs. No changes were made to the policy statement as a result of this comment.

C. Security of Advanced Reactors

Comment: The commenter agrees that advanced reactor designers should consider potential mitigative measures and/or design features that provide a more robust and effective security posture, which should include the possible threat of terrorist attacks and aviation attacks at any reactor. (NCWARN-1)

NRC Response: As stated in the background section, the Commission's expectation for advanced reactor designers to consider the effects of a large, commercial airplane impact is currently being addressed through rulemaking (Consideration of Aircraft Impacts for New Nuclear Power Reactor Designs—RIN AI19—ID Docket NRC-2007-0009). The Commission believes that reactors designed with potential aircraft impact considerations resulting from this proposed rule would be more robust than currently-licensed reactors. However, if the NRC adopts the aircraft impact rule in final form, it will be applicable to future reactor designs and

need not be addressed in this policy statement. Regarding terrorist attacks, as with operating and proposed reactors, all licensees – including those using advanced reactor designs must be able to defend against the design basis threat (DBT), which considers terrorist attacks. No changes were made to the policy statement as a result of this comment.

Comment: The commenter states that it can be concluded from the wording of the ARPS that existing reactors and reactors currently being proposed (AP1000, ESBWR, etc.) do not address possible threats of terrorist attacks and aviation attacks in any meaningful way. (NCWARN-2)

NRC Response: The NRC disagrees with the comment. All operating reactors must be able to defend against the DBT, which considers terrorist attacks. The NRC conducts both routine security inspections and force-on-force exercises to ensure that the security plans at each plant are sufficient enough to successfully defend against the DBT. In addition, the NRC issued orders in 2002 to all operating reactors requiring them to implement measures to mitigate the effects of the loss of large areas of a plant caused by large fires and explosions. Those orders are currently being codified and once finalized will be requirements for new reactors as well. No changes were made to the policy statement as a result of this comment.

Comment: The commenter states that it seems an untenable position by the Commission to recognize that "advance reactors" need to be made safer, more robust and effective, yet ignore the clear message it is sending the public on the lack of safety at the current reactors and proposed reactors. The commenter provided a list of attributes that he feels should be required for current reactors and proposed reactors that includes many of the items listed in the policy statement as appropriate for consideration for advanced reactors. (NCWARN-3)

NRC Response: The NRC disagrees with the comment. The policy statement does not state that advanced reactor designs must be safer than the current generation of reactors, but rather that they must provide the same degree of protection of the environment and public health and safety and the common defense and security that is required for current-generation light-water reactors. The goal of the policy statement update is to encourage advanced reactor designers to consider safety and security in the early stages of design in order to identify potential design features and/or mitigative measures that provide a more robust and effective security posture with less reliance on operational programs. No changes were made to the policy statement as a result of this comment.

Comment: The commenter believes that current reactors and proposed reactors need to have attributes similar to those noted in the policy statement for advanced reactors. In addition, the commenter believes that the Commission needs to guarantee that all current reactors meet these minimal safety requirements as a top priority, and then ensure that the designs for the proposed reactors meet these requirements prior to the issuance of any new reactor license. (NCWARN-4)

NRC Response: The attributes listed in the policy statement are ones that the NRC believes should be considered during the design stage of advanced reactors. Although some of the attributes reflect those found in current requirements, not all of them are requirements. The NRC believes that it would be impractical to force existing reactors to modify their designs to include all of the design attributes in the Advanced Reactor Policy Statement. Such changes would essentially result in those plants being completely redesigned. There is no need for such a drastic step, given that the NRC continues to believe that all currently operating reactors provide reasonable assurance of adequate protection. No changes were made to the policy statement as a result of this comment.

Comment: The commenter states that none of the existing reactors are safe and secure and that advanced reactors can wait until present deficiencies are fixed and proposed reactors are made safe and secure. (NCWARN-5)

NRC Response: The NRC believes that the existing fleet of nuclear power plants is safe and secure. The NRC also believes that advanced reactor designers should consider the expectations in the policy statement to ensure that security and emergency response are considered alongside safety during the early stages of plant design. The fact that such actions might reduce the need for operator actions or improve the overall risk profile for future plants does not mean that the existing operating plants are unsafe. No changes were made to the policy statement as a result of this comment.

D. Relationship to General Design Criteria (GDC)

Comment: The commenter wants the agency to incorporate the 'expectations' in the policy statement into the regulations as additional GDC. (UCS-1)

NRC Response: The GDC establish minimum requirements for the principal design criteria for nuclear power plants. The goal of the policy statement is not to raise these minimum requirements, but rather to encourage advanced reactor designers to consider safety and security matters during the development of future reactor designs. No changes were made to the policy statement as a result of this comment.

Comment: The commenter believes that the utility of the policy could be enhanced if the relationship of the attributes listed in the policy to the GDC of 10 CFR Part 50, Appendix A is provided. (Toshiba-2)

NRC Response: The NRC believes that the attributes identified in the policy statement should be used in conjunction with the GDC, other NRC regulations, and sound design practices to ensure that safety and security are appropriately considered in the design. The

attributes do not necessarily correspond to any particular GDC or set of GDCs, and it is not clear what benefit would be obtained if the NRC were to now identify "relationships" between the design attributes and the GDC. No changes were made to the policy statement as a result of this comment.

E. Other Comments

Comment: The commenter did not submit comments on the draft revision to the ARPS, but instead submitted information on a thorium reactor design. (TEN AB-1)

NRC Response: The commenter did not address any topic of the draft revision to the policy statement, nor did the comment explain why it should include design information on a specific design concept. No changes were made to the policy statement as a result of this comment.

III. Final Policy Statement

Consistent with its legislative mandate, the Commission's policy with respect to regulating nuclear power reactors is to ensure adequate protection of the environment and public health and safety and the common defense and security. Regarding advanced reactors, the Commission expects, as a minimum, at least the same degree of protection of the environment and public health and safety and the common defense and security that is required for current generation light-water reactors (LWRs).[1] Furthermore, the Commission expects that advanced reactors will provide enhanced margins of safety and/or use simplified, inherent, passive, or other innovative means to accomplish their safety and security functions.

Among the attributes that could assist in establishing the acceptability or licensability of a proposed advanced reactor design, and therefore should be considered in advanced designs, are:

[1] Current generation LWRs are those nuclear power plants licensed before 1997.

- Highly reliable and less complex shutdown and decay heat removal systems. The use of inherent or passive means to accomplish this objective is encouraged (negative temperature coefficient, natural circulation, etc.).
- Longer time constants and sufficient instrumentation to allow for more diagnosis and management before reaching safety systems challenge and/or exposure of vital equipment to adverse conditions.
- Simplified safety systems that, where possible, reduce required operator actions, equipment subjected to severe environmental conditions, and components needed for maintaining safe shutdown conditions. Such simplified systems should facilitate operator comprehension, reliable system function, and more straightforward engineering analysis.
- Designs that minimize the potential for severe accidents and their consequences by providing sufficient inherent safety, reliability, redundancy, diversity, and independence in safety systems, with an emphasis on minimizing the potential for accidents over minimizing the consequences of such accidents.
- Designs that provide reliable equipment in the balance of plant (BOP) (or safety-system independence from BOP) to reduce the number of challenges to safety systems.
- Designs that provide easily maintainable equipment and components.
- Designs that reduce potential radiation exposures to plant personnel.
- Designs that incorporate the defense-in-depth philosophy by maintaining multiple barriers against radiation release, and by reducing the potential for, and consequences of, severe accidents.
- Design features that can be proven by citation of existing technology, or that can

be satisfactorily established by commitment to a suitable technology development program.

- Designs that include considerations for safety and security requirements together in the design process such that security issues (e.g., newly identified threats of terrorist attacks) can be effectively resolved through facility design and engineered security features, and formulation of mitigation measures, with reduced reliance on human actions.
- Designs with features to prevent a simultaneous loss of containment integrity (including situations where the containment is by-passed), and the ability to maintain core cooling as a result of an aircraft impact, or identification of system designs that would provide inherent delay in radiological releases (if prevention of release is not possible).
- Designs with features to prevent loss of spent fuel pool integrity as a result of an aircraft impact.
- Designs with features to eliminate or reduce the potential theft of nuclear materials.
- Designs that emphasize passive barriers to potential theft of nuclear materials.

If specific advanced reactor designs with some or all of the previously mentioned attributes are brought to the NRC for comment and/or evaluation, the Commission can develop preliminary design safety evaluation and licensing criteria for their safety-related and security-related aspects. Incorporating the above attributes may promote more efficient and effective design reviews. However, the listing of a particular attribute does not necessarily mean that specific licensing criteria will attach to that attribute. Designs with some or all of these attributes are also likely to be more readily understood by the general public. Indeed, the

number and nature of the regulatory requirements may depend on the extent to which an individual advanced reactor design incorporates general attributes such as those listed previously.

In addition, the Commission expects that the safety features of these advanced reactor designs will be complemented by the operational program for Emergency Planning (EP). This EP operational program, in turn, must be demonstrated by inspections, tests, analyses, and acceptance criteria to ensure effective implementation of established measures. The Commission also expects that advanced reactor designs will comply with the Commission's safety goal policy statement (51 FR 28044; August 4, 1986, as corrected and republished at 51 FR 30028; August 21, 1986), and the policy statement on conversion to the metric measurement system (61 FR 31169; June 19, 1996).

To provide for more timely and effective regulation of advanced reactors, the Commission encourages the earliest possible interaction of applicants, vendors, other government agencies, and the NRC to provide for early identification of regulatory requirements for advanced reactors and to provide all interested parties, including the public, with a timely, independent assessment of the safety and security characteristics of advanced reactor designs. Such licensing interaction and guidance early in the design process will contribute towards minimizing complexity and adding stability and predictability in the licensing and regulation of advanced reactors.

While the NRC does not develop new reactor designs, the Commission intends to develop the capability, when appropriate, for timely assessment and response to innovative and advanced reactor 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 solved to ensure adequate protection of the public health and safety.

The earlier these design problems are identified, the earlier satisfactory resolution can be achieved. Prospective applicants are reminded that, while the NRC will undertake to review and comment on new design concepts, the applicants are responsible for documentation and research necessary to support a specific application. Research activities would include testing of new safety or security features that differ from existing designs for operating reactors, or that use simplified, inherent, passive means to accomplish their safety or security function. The testing shall ensure that these new features will perform as predicted, will provide for the collection of sufficient data to validate computer codes, and will show that the effects of system interactions are acceptable.

During the initial phase of advanced reactor development, the Commission particularly encourages design innovations that enhance safety, reliability, and security (such as those described previously) and that generally depend on technology that is either proven or can be demonstrated by a straightforward technology development program. In the absence of a significant history of operating experience on an advanced concept reactor, plans for the innovative use of proven technology and/or new technology development programs should be presented to the NRC for review as early as possible, so that the NRC can assess how the proposed program might influence regulatory requirements.

Finally, the NRC also believes that it will be in the interest of the public as well as the design vendors and the prospective license applicants to address security issues early in the design stage to achieve a more robust and effective security posture for future nuclear power reactors.

Dated at Rockville, Maryland, this 7th day of October 2008.

For the Nuclear Regulatory Commission.

/RA/

Annette L. Vietti-Cook,
Secretary of the Commission.