POLICY ISSUE
(Information)

August 30, 2004 SECY-04-0157

FOR: The Commission

FROM: Luis A. Reyes
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SUBJECT: STATUS OF STAFF'S PROPOSED REGULATORY STRUCTURE FOR NEW PLANT LICENSING AND POTENTIALLY NEW POLICY ISSUES

PURPOSE:

To provide a status report to the Commission on the staff's effort regarding a "Regulatory Structure for New Plant Licensing" and to alert the Commission on potentially new policy issues.

BACKGROUND:

In SECY-03-0047, "Policy Issues Related to Licensing Non-Light-Water Reactor Designs," dated March 28, 2003 (ML030160002), the staff discussed options and provided recommendations for Commission consideration on seven policy issues fundamental to licensing non-light-water reactor designs. The staff stated in that paper that four of the issues would be included in the development of the framework for future plant licensing. These four issues pertained to the definition for defense-in-depth, the use of a probabilistic approach to establish the licensing basis, the use of scenario-specific source terms for licensing decisions, and the advisability of revision of the emergency planning zone. The other three issues pertained to how requirements for non-light-water reactors (non-LWRs) relate to international codes and standards, the implementation of the Commission's expectations for enhanced safety in future non-LWRs, and the possibility of plant licensing without a pressure-retaining containment building.

In SECY-03-0059, "NRC Advanced Reactor Research Program," dated April 18, 2003 (ML023310534), the staff discussed its plan to develop a technology-neutral risk-informed structure for new plant licensing.

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The June 26, 2003, staff requirements memorandum (SRM) in response to SECY-03-0047, provided direction on recommendations on the seven policy issues. The Commission approved the staff's recommendations for the four issues being addressed in the framework, but disapproved the staff's recommendation related to international codes and standards. On the remaining two issues, the Commission requested the staff (1) to provide further details on the options for, and associated impacts of, requiring that modular reactor designs account for the integrated risk posed by multiple reactors and (2) to develop functional containment performance standards and submit options and recommendations to the Commission.

In SECY-04-0103, "Status of Response to the June 26, 2003, Staff Requirements Memorandum on Policy Issues Related to Licensing Non-Light-Water Reactor Designs," dated June 23, 2004 (ML041140521), the staff provided a status report on the integrated risk of multiple reactors and containment performance standards. The staff also noted that the Commission's direction on the other four policy issues was being implemented through development of the framework. The staff further noted that it planned to provide (1) a status paper in late August 2004 on the framework and any new policy issues and (2) a draft framework with recommendations on the new policy issues in December 2004.

This paper provides a status report on the staff's effort to date on the framework and discussion of new policy issues identified by the staff.

DISCUSSION:

The objective of the regulatory structure for new plant licensing is to provide a technology-neutral risk-informed approach that would enhance the effectiveness and efficiency of new plant licensing in the longer term (beyond the advanced designs currently in the pre-application stage). The staff is developing a regulatory structure with four major parts:

(1) a technology-neutral risk-informed framework (to be documented in a NUREG report) that will provide guidance and criteria to the staff for the development of technology-neutral requirements

(2) the content for a set of technology-neutral risk-informed requirements that will be based on the guidance and criteria established in the technology-neutral framework NUREG

(3) a technology-specific framework (to be documented in a NUREG report) that will provide guidance and criteria for the staff on how to apply the technology-neutral framework and requirements on a technology-specific basis

(4) technology-specific regulatory guides that will be derived from the implementation of the technology-specific framework and will provide guidance to licensees on how to apply the technology-neutral regulations on a technology-specific basis

This paper focuses on the status of Part 1 of the Regulatory Structure for New Plant Licensing: the Technology-Neutral Framework. Work has not been initiated on the other three parts, and although the framework will be useful to the staff and designers in their activities on new reactors, the completion of each part will be needed to achieve effectiveness and efficiency in conducting new plant licensing.

To date, the staff has made substantial progress in developing the framework. The staff is developing the framework in a hierarchal fashion using guidance in the Commission's policy statements (i.e., Commission's Policy Statement on Severe Accidents, 50 FR 32138, August 8, 1985, Commission's Policy Statement on the Regulation of Advanced Nuclear Power Plants, 51 FR 24643, July 8, 1986, and Commission's 1986 Reactor Safety Goal Policy, 51 FR 28044). Supporting criteria and guidance are being developed that will promote achievement of the top-level objectives in a risk-informed manner. This approach can then form the technical basis for developing a set of technology-neutral requirements for new plant licensing. In this regard, the framework is being used to implement the Commission's direction in the SRM of June 26, 2003, on the four approved non-LWR policy issues described in SECY-03-0047.

The staff conducted several public meetings from May 2003 to July 2004. The most recent public meeting was July 27 and 28, 2004. This meeting was well attended by approximately 50 people, including representatives from the nuclear industry, public citizen organizations, vendors, academia, the Department of Energy, national laboratories, consultants and members of the staff. The feedback on the framework was positive and indicated general agreement with the need for a framework and the conceptual bases of the framework. The attendees expressed their desire to comment on the draft framework when it is issued for public review and comment. In addition, the staff has had several discussions with the Advisory Committee on Reactor Safeguards (ACRS), both the full Committee and the Subcommittee on Future Plant Designs. The verbal feedback from the Committee has been very positive stating that the staff has made significant progress and is asking the right questions. The Committee also stated its interest in future staff briefings and its desire to support the staff. The staff plans to interact with both ACRS and external stakeholders on a regular basis.

The key features of the framework are:

- a hierarchal approach based on a safety philosophy that is consistent with the Commission's expectations for new reactors as expressed in the Commission's Policy Statement on the Regulation of Advanced Nuclear Power Plants;

- protective strategies that provide the basis for the technical requirements needed to ensure that the safety philosophy has been met;

- a defense-in-depth approach to address uncertainties that is based on previous Commission guidance, on recommendations from the ACRS and on cornerstones of safety developed as part of the Reactor Oversight Process;

- a probabilistic (risk-informed) approach that identifies and selects design basis accidents and that assigns safety classification;

- a performance-based approach that will establish performance standards and acceptance criteria for results in development of the requirements; and

- incorporation of Commission direction on security related matters for new plants.

To determine that the overall objectives of the regulatory structure have been met (e.g., enhanced effectiveness and efficiency), the staff identified key characteristics for the regulatory structure. Examples include:

- Flexible—The technology-neutral and technology-specific frameworks are developed in such a manner that they allow for changes and modifications to occur, in an efficient and effective manner, that are based on new information, knowledge, etc., and can be adapted to any technology-specific reactor design;

- Risk-informed—Risk information and risk insights are integrated into the decision-making process such that there is a blended approach using both probabilistic and deterministic information;

- Performance-based—The guidance and criteria, when implemented, will produce a set of safety requirements that will minimize prescriptive means for achieving its goals, and therefore, will be performance oriented to the extent practical;

- Uncertainty—The guidance and criteria will include treatment of the different types of uncertainties; and

- Defense-in-depth—Defense-in-depth is maintained and is an integral part of the framework.

In developing the framework, the staff identified three additional policy issues which the Commission may need to decide in the future:

- Should the objective of the requirements be to achieve the level of safety expressed in the Commission's Safety Goal Policy? As expressed by the Commission in a June 15, 1990, SRM, this level of safety represents that associated with "how safe is safe enough." The use of the level of safety expressed in the Safety Goal Policy as a target for the safety of future plants is also considered consistent with (1) the Commission's expectations for enhanced safety, as expressed in the Commission's Policy Statement on Severe Accidents and the Commission's Policy Statement on the Regulation of Advanced Nuclear Power Plants and (2) the approach being taken in risk-informing 10 CFR Part 50, with the reactor Safety Goal Policy subsidiary objectives being used as screening criteria for identifying potential areas for modification and in the decision making process for licensing changes.

- Should security issues be included in the scope of plant risk assessments? Although the staff intends to incorporate Commission direction on security-related matters into the framework, security matters have not been traditionally included in the scope of plant risk assessments. Further, the Commission's Safety Goal Policy specifically excludes sabotage from the scope of risk addressed by the safety goals. However, with the development of a risk-informed process for new plant licensing, where risk information will be part of the licensing basis, and with the potential for security-related matters to affect plant risk, the Commission may wish to consider whether to include security matters within the scope of plant risk assessments and the associated acceptance criteria.

- Should selective implementation be prohibited? The staff is developing a technology-neutral risk-informed framework and requirements for new plant licensing on an integrated basis. The structure is hierarchal. The various elements build on and are integrally related to each other. The staff expects that there will be very few "stand alone" pieces in the framework of requirements. Accordingly, it will likely not be practical to pick and choose pieces of the framework or requirements to implement.

The staff plans to provide preliminary recommendations on the additional policy issues in December 2004 and final recommendations after the public review and comment period. Stakeholder input will, therefore, have been taken into consideration.

A more detailed description of the framework is attached.

RESOURCES:

The plans discussed in this paper do not require additional resources for implementation. Implementation is included in budgeted activities related to the development of a framework for new plant licensing and regulatory infrastructure development. Specifically, the current RES budget has 2 FTEs and $500K in FY 2004 for this activity. The proposed budget before the Commission for RES for this activity requests 1 FTE and $500K in FY 2005, and 1 FTE and $400K in FY 2006.

COORDINATION:

The Office of the General Counsel has no legal objection.

The Office of the Chief Financial Officer has reviewed this Commission paper for resource implications and has no objections.

CONCLUSION:

The staff will complete the draft framework which will be provided concurrently to the Commission and to the public for formal public review and comment by the end of December 2004. The staff will also provide recommendations on new policy issues for Commission consideration.

/RA/

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Attachment: Summary, Technology-Neutral
Framework for a Regulatory
Structure for New Plant Licensing

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SUMMARY

TECHNOLOGY-NEUTRAL FRAMEWORK FOR A REGULATORY STRUCTURE FOR NEW PLANT LICENSING

1. Objective

The objective of the framework is to provide the technical basis, scope, and approach for the development of a stand-alone set of technology-neutral licensing requirements for the licensing of new nuclear power plants.

2. Scope

The scope of the framework includes:

- Design, construction and operation
- Full power, low power, shutdown, spent fuel storage
- Internal and external events

Security will be addressed consistent with Commission direction.

3. Safety Philosophy:

The framework is based on establishing an overall safety philosophy. Under this safety philosophy, the regulations would be written to achieve the level of safety defined by the Commission's Safety Goal Policy. A frequency-consequence curve for risk to the public using the Commission's safety goals has been established as a measure of this objective.

- The frequency-consequence curve is based upon ensuring that the overall level of risk to the public meets the Commission's safety goal quantitative health objectives (QHOs).

- The frequency-consequence curve also ensures low consequences for the more likely events.

- Uncertainties are assessed and considered in implementation

- Risk to workers and the environment from accidents are considered and controlled:
  - to workers via requirements on the control room and on the accident management program for workers outside the control room
  - to the environment via a subsidiary risk objective for accident mitigation (e.g., large early release frequency)

4. Technical Approach

The technical approach is a risk-informed approach that blends probabilistic and deterministic criteria in development of the framework including consideration of uncertainties using a defense-in-depth philosophy. The framework establishes "protective strategies" which are fundamental to safe nuclear power plant design, construction and operation. Each of these elements are briefly described below.

Protective Strategies:

These strategies serve as the building blocks for development of technology-neutral requirements. Acceptable implementation of the strategies provides reasonable assurance that the overall mission of protecting the public health and safety is met. Four protective strategies have been defined.

- The objective of the *barrier integrity* strategy is to ensure that there are adequate barriers to protect the public from accidental radionuclide releases. Adequate functional barriers must be maintained to limit the effects of reactor accidents if incidents do occur. Barriers can include physical barriers as well as those based on physics and chemistry that can inhibit the transport of material when physical barriers are breeched.

- The objective of the *limit initiating event frequency* strategy is to limit the frequency of events that can upset plant stability and challenge critical safety functions during all plant operating states, (i.e., full-power, shutdown, and transitional states). Initiating events must be considered that can affect any source of radioactive material onsite in any chemical and physical form.

- The objective of the *protective systems* strategy is to ensure that the systems that mitigate initiating events are adequately designed, constructed and operated such that their reliability and capability are consistent with the design assumptions regarding accident prevention and mitigation during all states of reactor operation.

- The objective of the *accident management* strategy is to ensure that measures to control accidents and protect the public health and safety in the event of a severe accident are provided, consistent with risk to the operating staff and the public.

Probabilistic Considerations:

The guidance and criteria developed in the framework are a blend of structuralist (deterministic) and rationalist (probabilistic) elements. Examples of the more significant considerations include the following:

- Probabilistic criteria are established for identifying events and event sequences to be considered in the design.

- Probabilistic criteria are established for selection of anticipated operational occurrences and design basis accidents (DBAs) for use in interfacing with other parts of 10 CFR Part 100 (e.g., siting criteria) and to maintain a risk-informed approach.

- Probabilistic criteria are established for identification of safety related structures, systems and components.

- Accident scenarios derived from the probabilistic risk assessment are used in lieu of single failure criteria.

- Technology-neutral accident prevention and accident mitigation risk metrics are used.

Examples of Deterministic Considerations:

As noted above, the guidance and criteria developed in the framework is a blend of structuralist (deterministic) and rationalist (probabilistic) elements. Examples of the more significant considerations include the following:

- DBAs acceptance criteria are established consistent with siting criteria for use of scenario-specific source terms in DBA analysis.

- Specifications for a containment (to be determined).

- Emergency preparedness.

- A performance-based approach will be used in formulating requirements.

Treatment of Uncertainties:

A defense-in-depth philosophy is defined and implemented to ensure uncertainties associated with design, construction, operation, and accident behavior are accounted for such that there is high confidence that the safety objectives will be met.

- Principles of defense-in-depth are established that are to be met by the designer and will be imbedded in the regulations. These principles include:
  - Safety should be accomplished using both accident prevention and accident mitigation measures.
  - The accomplishment of key safety functions should not be dependent upon a single element of design, construction, or operation.
  - Uncertainties in equipment and human performance should be accounted for such that there is high confidence that reliability and risk goals can be met.
  - Regulated activities should be conducted at locations that facilitate protection of public health and safety.

- Defense-in-depth model and implementation
  - NRC staff should ensure that the regulations identify specific requirements and goals and define a process by which defense-in-depth measures can be determined.
  - Applicants and licensees should apply process elements of defense-in-depth and propose appropriate measures.
  - Performance monitoring and feedback should be employed by licensees to ensure key assumptions in safety and risk analysis remain valid.

5. <u>Technology-Neutral Requirements Guidance</u>

Technology-neutral guidance will be provided to identify those topics which need to be addressed in the requirements to ensure design, construction, and operation meet the safety objective. These topics include both technical and administrative.

Technical: For each protective strategy, where each strategy represents an important element of safety, requirements are developed from a set of topics that, if accomplished, will ensure the design, construction and operation of the nuclear power plant achieves the overall safety objective.

For each protective strategy, examples of considerations that the staff will evaluate include:

- use of a realistic analysis for uncertainty
- definition of DBA
- use of realistically conservative acceptance criteria
- use of the maximum exposed individual for DBA analysis
- the level of confidence for meeting acceptance criteria
- use of Level 1 PRA with large release frequency analysis (minimum) for risk analysis, with the option to propose alternative (e.g., use of Level 3 PRA).

Administrative: Administrative requirements will need to be established to ensure that the implementation of the technical requirements by licensees is done in a consistent, controlled and documented fashion. Examples of considerations that the staff will evaluate include:

- Format and content of applications
- Quality assurance
- Quality of analysis
  - analytical code qualification
  - PRA quality
- Operating experience evaluation and feedback
- Reporting and record keeping
- Change control
- Document control
- Exemptions
- License amendments
- Environmental conditions
- Backfitting
- Enforcement

6. Structure

The framework will identify and organize the topics that need to be included in new plant licensing requirements in the following categories:

- design
- construction
- operation