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