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THE STAFF IS PRIMARILY SEEKING INSIGHTS REGARDING THE CONCEPTS IN THIS PRELIMINARY LANGUAGE AND SECONDARILY SEEKING INSIGHTS RELATED TO DETAILS SUCH AS NUMERICAL VALUES FOR VARIOUS CRITERIA.

STAFF DISCUSSION OF SUBPART B – PRELIMINARY RULE LANGUAGE, NOVEMBER 2020

Preliminary Language	Discussion
Subpart B - Technology-Inclusive Safety Requirements	Subpart B is part of the Part 53 structure and format described in previous public meetings. In sum, Subpart B defines the safety criteria that other areas of Part 53 (e.g., design & analysis (Subpart C), operations (Subpart F)) will use as performance metrics.
§ 53.20 Safety Objectives. Each advanced nuclear plant must be designed, constructed, operated, and decommissioned such that there is reasonable assurance of adequate protection of the public health and safety and the common defense and security. In addition, each advanced nuclear plant must take such additional measures to protect public health and minimize danger to life or property as may be reasonable when considering technology changes, economic costs, operating experience, or other factors identified in the assessments performed under the facility safety program required by § 53.80.	This section provides the overall qualitative safety goals based on both § 182 (adequate protection) and § 161 (“protect health or minimize danger”) of the Atomic Energy Act, as amended (AEA). This two-tier structure of the AEA is articulated in a decision of the U.S. Court of Appeals for the D.C. Circuit (<i>Union of Concerned Scientists v. NRC</i> , 824 F.2d 108, (D.C. Cir. 1987)). The justification of NRC requirements since the 1980s has not always been described in the context of this two-tiered approach. However, the NRC has clearly explained the bases for more recent agency actions as being needed either for adequate protection (e.g., NRC post-Fukushima order on mitigation strategies (EA-12-049)) or to protect health or minimize danger (e.g., post-Fukushima order on severe accident capabilities for BWR hardened vents (EA-13-109)). This preliminary rule language proposes to use the two-tiered concept to support the development of a technology-inclusive, risk-informed, and performance-based regulatory framework for advanced nuclear plants.

A topic for discussion in developing this Subpart and the remainder of Part 53 is the proposed relationship between the first and second tier safety criteria and the two-tiered structure related to § 182 (adequate protection) and § 161 (“protect health or minimize danger”).

§ 53.21 Safety Functions.

- (a) The primary safety function is limiting the release of radioactive materials from the facility and must be maintained during routine operation and for licensing basis events over the life of the plant.
- (b) Additional safety functions supporting the retention of radioactive materials during routine operation and licensing basis events—such as controlling heat generation, heat removal, and chemical interactions—must be defined.
- (c) Design features and programmatic controls serve to fulfill the primary safety function and additional safety functions and must be maintained over the life of the plant.

(a) Limiting potential offsite consequences (i.e., dose to an individual) will be used as the primary performance metric throughout Part 53.

(b) Requires the applicant’s identification of supporting safety functions such as controlling heat generation, heat removal, and chemical interactions that will be essential for a particular design to ensuring retention of radionuclides within a facility; and (c) requires development and maintenance of design features and programmatic controls to fulfill the identified primary and additional safety functions over the life of the facility. Note that the safety functions and the design features and programmatic controls used to fulfill them will be the means to satisfy the first and second tier safety criteria.

These requirements are similar in concept to current requirements for LWRs to address the general design criteria and non-LWRs to provide principal design criteria; however, these safety functions are broad in order to support any technology. Subsequent Part 53 Subparts on design, analyses, and operations will require measures (i.e., design features and programmatic controls) to support the primary and additional safety functions.

§ 53.22 First Tier Safety Criteria.

- (a) Design features and programmatic controls must be provided for each advanced nuclear plant to ensure the contribution to total effective dose equivalent to individual members of the public from normal plant operation does not exceed 0.1 rem (1 mSv) in a year and the contribution to dose in any

The first-tier safety criteria are metrics that establish a level of safety or backstop based on current requirements in (a) Part 20 limits on doses to members of the public and (b) the Sections 50.34, 52.79, 100.11 reference values related to the safety assessment of a site and radiological consequences from a “major accident” in terms of possible dose to an individual at defined distance and duration of exposure

unrestricted area does not exceed 0.002 rem (0.02 millisievert) in any one hour.

(b) Design features and programmatic controls must be provided for each advanced nuclear plant such that analyses of licensing basis events in accordance with § 53.24 demonstrate with high confidence that events with an upper bound frequency greater than approximately once per 10,000 years meet the following:

(1) An individual located at any point on the boundary of the exclusion area for any 2-hour period following the onset of the postulated fission product release would not receive a radiation dose in excess of 25 rem (250 mSv) total effective dose equivalent; and
(2) An individual located at any point on the outer boundary of the low population zone who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a radiation dose in excess of 25 rem (250 mSv) total effective dose equivalent.

(c) Design features and programmatic controls beyond those needed for paragraphs (a) and (b) of this section must be provided for each advanced nuclear plant to satisfy additional requirements established by the NRC for ensuring reasonable assurance of adequate protection of the public health and safety and maintaining common defense and security.

A topic for future discussion will be the degree to which the first-tier safety criteria for an important subset of licensing basis events (i.e., design basis accidents) will be fulfilled through design requirements such as classification of safety-related SSCs or operational requirements such as technical specifications; the expected level of detail in safety analysis reports; and staffing requirements. Related discussions will also address an applicant's analyses related to the first-tier safety criteria – for example, will the analyses more resemble the traditional, deterministic approach in Chapter 15 and the design basis accident category within NEI 18-04?

Section (c) was added to address longstanding desire to maintain some flexibility for the NRC to determine that an action is needed to provide reasonable assurance of adequate protection.

§ 53.23 Second Tier Safety Criteria.

(a) Design features and programmatic controls must be provided for each advanced nuclear plant to

The second-tier safety criteria establish a process – similar to current requirements on maintaining doses as low as reasonably achievable for normal operations/routine effluents. The preliminary language for

ensure the estimated total effective dose equivalent to individual members of the public from effluents resulting from normal plant operation are as low as is reasonably achievable taking into account the state of technology, the economics of improvements in relation to the state of technology, operating experience, the economics of improvements in relation to benefits to the public health and safety and other factors included in the assessments performed under the facility safety program required by § 53.80. Performance objectives for design features and programmatic controls must be established such that:

- (1) The calculated annual total quantity of all radioactive material above background to be released from each advanced nuclear plant to unrestricted areas will not result in an estimated annual dose or dose commitment from liquid effluents for any individual in an unrestricted area from all pathways of exposure in excess of 3 millirems to the total body or 10 millirems to any organ.
- (2) The calculated annual total quantity of all radioactive material above background to be released from each advanced nuclear plant to the atmosphere will not result in an estimated annual air dose from gaseous effluents at any location near ground level which could be occupied by individuals in unrestricted areas in excess of 10 millirads for gamma radiation or 20 millirads for beta radiation.

(b) Design features and programmatic controls must be provided to:

- (1) Ensure plant SSCs, personnel, and programs provide the necessary capabilities and maintain the necessary reliability to address licensing basis events

normal operations is taken from Part 20 and the higher level (dose values) from Appendix I to Part 50. One topic for discussion is the appropriateness of the Appendix I performance goals for a technology-inclusive regulation.

The second-tier safety criteria for licensing basis events (b) establishes the connection to licensing basis events and defense in depth (1) and is taken from the NRC safety goals (2). These requirements will provide a basis for Subpart C which will be on design and analyses as well as Subpart F on operations (maintaining capabilities and reliabilities, facility safety program, etc.).

in accordance with § 53.24 and provide measures for defense-in-depth in accordance with § 53.25; and
(2) Maintain overall cumulative plant risk from licensing basis events such that the risk to an average individual within the vicinity of the plant receiving a radiation dose with the potential for immediate health effects remains below five in 10 million years and below two in one million years for a radiation dose with the potential to cause latent health effects.

§ 53.24 Licensing Basis Events.

Licensing basis events must be identified for each advanced nuclear plant and analyzed in accordance with § 53.[3x] to support assessments of the safety requirements of this Subpart B. The licensing basis events must address combinations of malfunctions of plant SSCs, human errors, and the effects of external hazards ranging from anticipated operational occurrences to highly unlikely event sequences that are not expected to occur in the life of the advanced nuclear plant. The evaluation of licensing basis events must be used to confirm the adequacy of design features and programmatic controls needed to satisfy first and second tier safety criteria of this Subpart and to establish related functional requirements for plant SSCs, personnel, and programs.

This section establishes the requirement to define and address unplanned events (both internal and external hazards) to ensure estimates of offsite consequences are below the safety criteria and that SSCs, personnel and programs address the safety functions. This section provides a starting point for subsequent requirements to be developed in design and analysis (Subpart C) and related operational requirements (Subpart F) for topics such as configuration control, reliability programs/metrics, etc.

§ 53.25 Defense in Depth.

Measures must be taken for each advanced nuclear plant to ensure appropriate defense in depth is provided to compensate for epistemic and aleatory

This section establishes requirements based on the longstanding nuclear philosophy to ensure defense in depth to address uncertainties. Additional requirements will be included in design and analysis (Subpart C) which will address requirements for both

uncertainties such that there is high confidence that the safety criteria in this Subpart B are met over the life of the plant. The epistemic and aleatory uncertainties to be considered include those related to the ability of barriers to limit the release of radioactive materials from the facility during routine operation and for licensing basis events and those related to the reliability and performance of plant SSCs and personnel, and programmatic controls. Measures to compensate for these uncertainties can include increased safety margins in the design of SSCs and providing alternate means to accomplish safety functions. No single design or operational feature, no matter how robust, should be exclusively relied upon to meet the safety criteria of 10 CFR part 53.

probabilistic risk assessment (PRA) and deterministic analyses and related operational controls. This is an expected topic for discussion in terms of both the concept and then subsequently the wording.

Definitions

Epistemic – relating to knowledge or to the degree of its validation

Aleatory – depending on chance; random

§ 53.26 Protection of Plant Workers.

(a) Design features and programmatic controls must exist for each advanced nuclear plant to ensure that radiological dose to plant workers does not exceed the occupational dose limits provided in Subpart C to 10 CFR part 20.

(b) The licensee must use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable.

This section incorporates Part 20 limits on occupational exposures as a way to ensure that protection of plant workers is included in the higher level safety criteria for Part 53.

Other Possible Topics for Discussion

- DOE orders and ANS 2.26, “Categorization of nuclear facility structures, systems, and components for seismic design,” include consideration of “unmitigated consequences” from event scenarios to determine equipment classification. This type of approach is also used in non-reactor consensus standards to determine appropriate design features and programmatic controls. Some recent discussions related to seismic design have indicated that such an approach can be aligned with the methodology described in NEI 18-04. Is there a role for such an approach within Part 53?
- An important feature of Part 53 will be embedded mechanisms to apply analytical safety margins to gain operational flexibilities in areas such as emergency planning, siting, and staffing. A question is whether provisions for doing the assessments and putting in place the needed design features and programmatic controls for alternative criteria should be in this Subpart or in subsequent Subparts. The initial plan is to provide these mechanisms in Subpart C (design and analysis) to lay out the basic process of establishing design goals more restrictive than the second-tier criteria – and using margins established by the defined threshold to justify alternatives in other sections/Subparts.