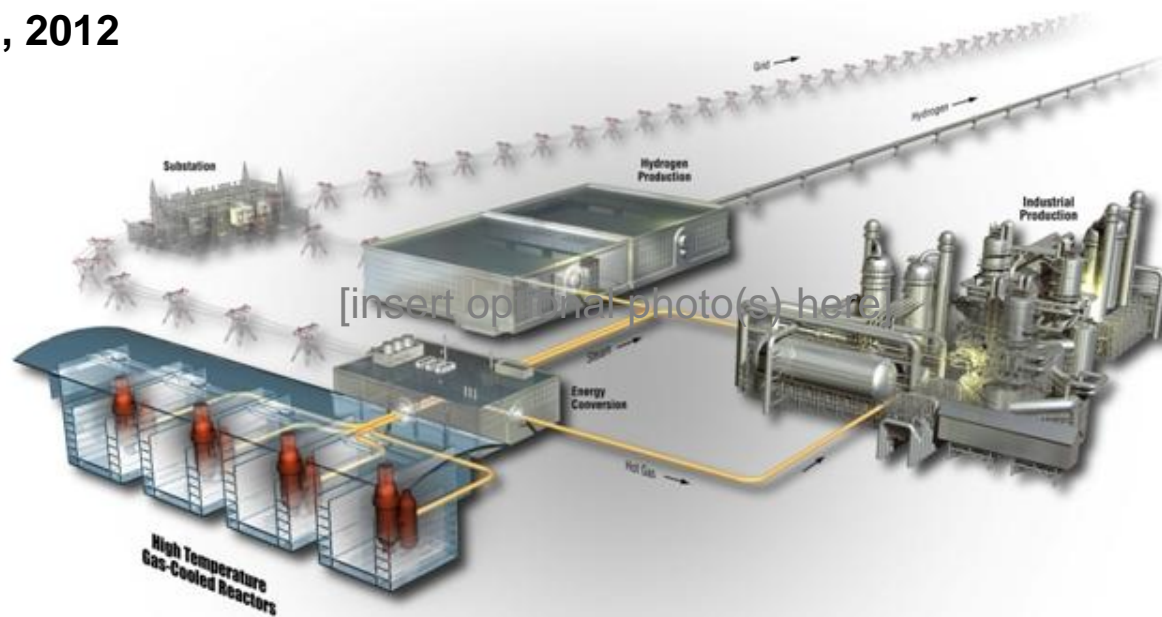


Next Generation Nuclear Plant

Risk-Informed Performance-Based Licensing Approach Discussions

May 16, 2012

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Meeting Outline

- Background
 - Project status
 - Meeting purpose
- Summary From Last Meeting
- Discussion of Assessment Report Issues
 - Event sequence frequency vs. initiating event frequency
 - Plant-year vs. reactor-year
 - Treatment of Anticipated Operational Occurrences (AOOs)
 - Frequency ranges and treatment for LBEs
- Meeting Summary
 - Closed Issues
 - Additional information Needed
 - Containment discussion
 - Future topics and meetings

NRC-DOE “Next Steps” for NGNP Licensing

Agreed upon areas of focus are summarized in a recent (February 15, 2012) letter from NRC. The focus areas are:

- Licensing basis event (LBE) selection
- Source term
- Containment functional performance
- Emergency planning

The risk-informed performance-based licensing approach being covered today affects all of these areas, and LBE selection most directly

RIPB Licensing Framework White Papers

White Paper	Submittal Date	Public Meeting
1. Defense-In-Depth (INL/EXT-09-17139)	December 9, 2009	March 8, 2010
2. Licensing Basis Event Selection (INL/EXT-10-19521)	September 16, 2010	November 2, 2010
3. Structures, Systems, and Components Safety Classification (INL/EXT-10-19509)	September 21, 2010	November 2, 2010
4. Probabilistic Risk Assessment (INL/EXT-11-21270)	September 20, 2011	None
5. Modular HTGR Safety Basis and Approach (INL/EXT-11-22708)	September 6, 2011	None

RIPB Licensing Framework – RAI Responses

<u>RAI Topic(s)</u>	<u>NGNP Response Date</u>	<u>Accession No.</u>
1. Defense-In-Depth	September 15, 2010	ML102590481
2. Licensing Basis Event Selection SSC Classification Defense in Depth	October 14, 2011	ML11290A188

Today's Meeting

- Achieve consensus on key issues related to the NGNP's proposed risk-informed performance-based licensing process
 - Process is described in a series of NGNP white papers

- Material to be discussed draws on:
 - Previous NGNP-NRC public meeting interactions
 - NRC HTGR familiarization sessions (May, 2010)
 - Insights based on NGNP review of the NRC assessment reports

- At the end of today's meeting, we'll identify areas of consensus and establish next steps for resolution of remaining open issues and the topics to cover in the next meeting

SECY-03-047

“Policy Issues Related to Licensing Non-Light-Water Reactor Designs”

- The Commission approved the staff’s recommendations as outlined in SECY-03-047 for issues 2, 4, 5, and 7
- Issue 4 (Probabilistic Event Selection, Safety Classification and Reliability Criteria):
 - Modify the Commission’s guidance, as described in the SRM of July 30, 1993, to put greater emphasis on the use of risk information by allowing the use of a probabilistic approach in the identification of events to be considered in the design, provided there is sufficient understanding of plant and fuel performance and deterministic engineering judgment is used to bound uncertainties
 - Allow a probabilistic approach for the safety classification of structures, systems, and components
 - Replace the single-failure criterion with a probabilistic (reliability) criterion

NUREG-2150

“A Proposed Risk Management Regulatory Framework”

- Recommendation GIV-R-1:

“For Generation IV reactors, the RMTF recommends that the concept of design-basis accidents be maintained, but the NRC should be amenable to and promote, where practical, the adoption of more risk-informed approaches for the selection of relevant scenarios (e.g., alternatives to the single failure criterion) for design-basis accidents.”

- We believe our event selection approach is consistent with the vision presented in NUREG-2150

LBE White Paper Outcome Objectives

2. LBEs cover a comprehensive spectrum of events from normal operation to rare, off-normal events. There are three categories of LBEs:
- AOOs, which encompass planned and anticipated events. The doses from AOOs are required to meet normal operation public dose requirements. AOOs are utilized to set operating limits for normal operation modes and states
 - DBEs encompass unplanned off-normal events not expected in the plant's lifetime, but which might occur in the lifetimes of a fleet of plants. The doses from DBEs are required to meet accident public dose requirements. DBEs are the basis for the design, construction, and operation of the structures, systems, and components (SSCs) during accidents
 - BDBEs, which are rare off-normal events of lower frequency than DBEs. BDBEs are evaluated to ensure that they do not pose an unacceptable risk to the public
 - The LBEs in all three categories will be evaluated individually to support the tasks of assessing the performance of SSCs with respect to safety functions in response to initiating events and collectively to demonstrate that the integrated risk of a multimodule plant design meets the NRC Safety Goals

LBE White Paper Outcome Objectives, cont.

3. The frequencies of LBEs are expressed in units of events per plant-year where a plant is defined as a collection of reactor modules having certain shared systems. The limits on the frequency ranges for the LBE categories are as follows:
 - AOOs – event sequences with mean frequencies greater than 10^{-2} per plant-year
 - DBEs – event sequences with mean frequencies less than 10^{-2} per plant-year and greater than 10^{-4} per plant-year
 - BDBEs – event sequences with mean frequencies less than 10^{-4} per plant-year and greater than 5×10^{-7} per plant-year
4. Acceptable limits on the event sequence consequences and the analysis basis for the LBE categories are as follows:
 - AOOs – 10CFR20: 100 mrem total effective dose equivalent (TEDE) mechanistically modeled and realistically calculated at the exclusion area boundary (EAB). For the NGNP facility, the EAB is expected to be the same area as the controlled area boundary
 - DBEs – 10CFR50.34 [10CFR52.79]: 25 rem TEDE mechanistically modeled and conservatively calculated at the EAB
 - BDBEs – NRC Safety Goal quantitative health objectives (QHOs) mechanistically and realistically calculated at 1 mile (1.6 km) and 10 miles (16 km) from the plant

LBE White Paper Outcome Objectives, cont.

5. The frequency below which events are not selected as LBEs is 5×10^{-7} per plant-year. The PRA examines events to 10^{-8} per plant-year to assure that there are none just below this de minimus frequency
8. Uncertainty distributions are evaluated for the mean frequency and the mean consequence for each LBE. The mean frequency is used to determine whether the event sequence family is an AOO, DBE, or BDBE
 - If the upper or lower bound on the LBE frequency straddles two or more regions, the LBE is compared against the consequence criteria for each region
 - The mean, lower, and upper bound consequences are explicitly compared to the consequence criteria in all applicable LBE regions
 - The upper bound for the DBE and DBA consequences must meet the 10CFR50.34 dose limit at the EAB

Bases for Top-Level Regulatory Criteria

- Generic, technology-neutral and independent of plant site
- Quantitative
- Direct statements of acceptable consequences or risks to the public
- Found in various sections of the regulations
- A different methodology is related to each TLRC
- Frequency is not explicitly quantified by the regulations

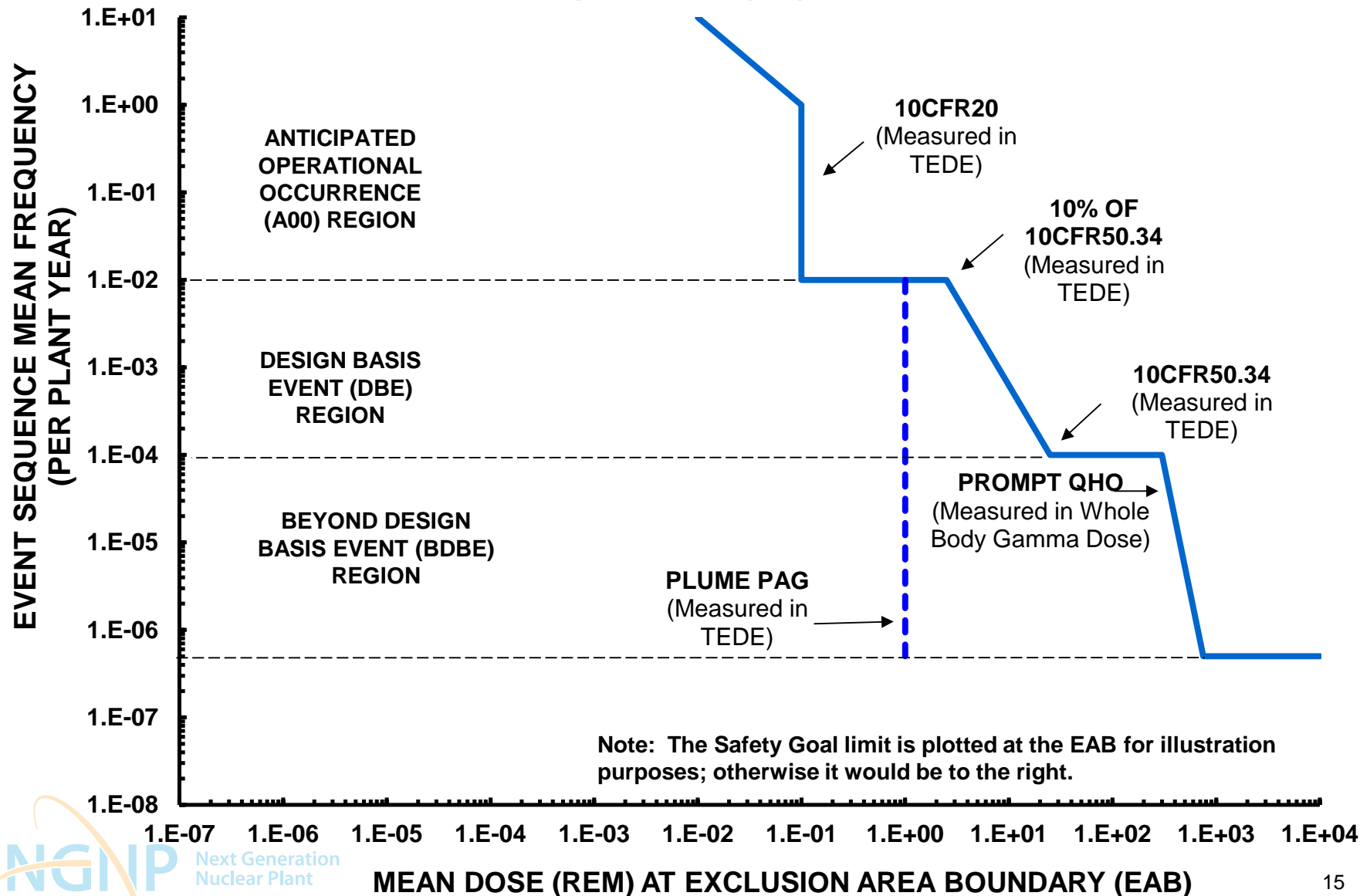
Top Level Regulatory Criteria for the Public

- 10CFR20 annualized offsite dose guidelines
 - 100 mrem/yr total effective dose equivalent
 - Measured on a cumulative basis annually at the EAB of the site
 - For normal operation and anticipated operational occurrences
- 10CFR50.34 (10CFR52.79) accident offsite doses
 - 25 rem total effective dose equivalent
 - Evaluated at the site EAB at 2 hr and at the site LPZ at 30 day
 - Design basis for off-normal events
- EPA-400-R-92-001 Protective Action Guides (PAGs) offsite doses
 - 1 rem total effective dose equivalent for sheltering
 - Evaluated at the site EPZs (10 miles for plume exposure and 50 miles for ingestion)
 - Emergency planning and protection during off-normal events
- 51 Federal Register (FR) 130 individual fatality risks
 - Prompt and latent Quantitative Health Objectives (QHOs) of 5×10^{-7} /yr and 2×10^{-6} /yr
Evaluated at 1 mile for prompt and 10 miles for latent
 - Overall assurance of negligible cumulative risks during normal operation and off-normal events

Categories of Licensing Basis Events

- TLRC apply to the full spectrum of normal operation and off-normal events
- Some specific TLRC apply to normal operation and anticipated operational occurrences; others to design basis events; others to events less frequent than design basis events
- Design Basis Accidents (analyzed in Ch 15 of SARs deterministically assuming that only structures, systems, and components classified as safety-related are available)
- LBE categories selected:
 - Anticipated Operational Occurrences - AOOs
 - Design Basis Events - DBEs
 - Design Basis Accidents – DBAs
 - Beyond Design Basis Events – BDBEs

Placement of Plume PAG on F-C Curve



Issues for Initial Discussions with NRC Staff

- Event Sequence Frequency vs. Initiating Event Frequency
 - LBE-10: BDE and BDBE Frequency Ranges
 - LBE-11: Event Sequence Frequency vs. Initiating Event Frequency
 - LBE-18: Frequencies and Plant-Year vs. Reactor-Year
- Plant-year vs. Reactor-year
 - LBE-09: Plant-Year vs. Reactor-Year
- Treatment of Anticipated Operational Occurrences (AOOs)
 - LBE-12: Conservative Dose Calculation
 - LBE-14: Regulatory Practice for AOOs
 - LBE-15: F-C Curve & Uncertainty Treatment

Issues for Initial Discussions with NRC Staff (cont.)

- Frequency Ranges and Treatment for LBEs
 - LBE-10: BDE and BDBE Frequency Ranges
 - LBE-18: Frequencies and Plant-Year vs. Reactor-Year
 - LBE-22: Addressing BDBEs in a Conservative Manner
 - LBE-16: Evaluating Bounding Events as DBEs
 - LBE-07: LBE Frequencies
 - LBE-08: Frequencies for DBEs

Meeting Summary

- Summarize Closed Issues
- Discuss Need for Additional Information
- Containment Discussion
- Future Topics and Meetings