

# Commercial Codes & Standards for Structural Design



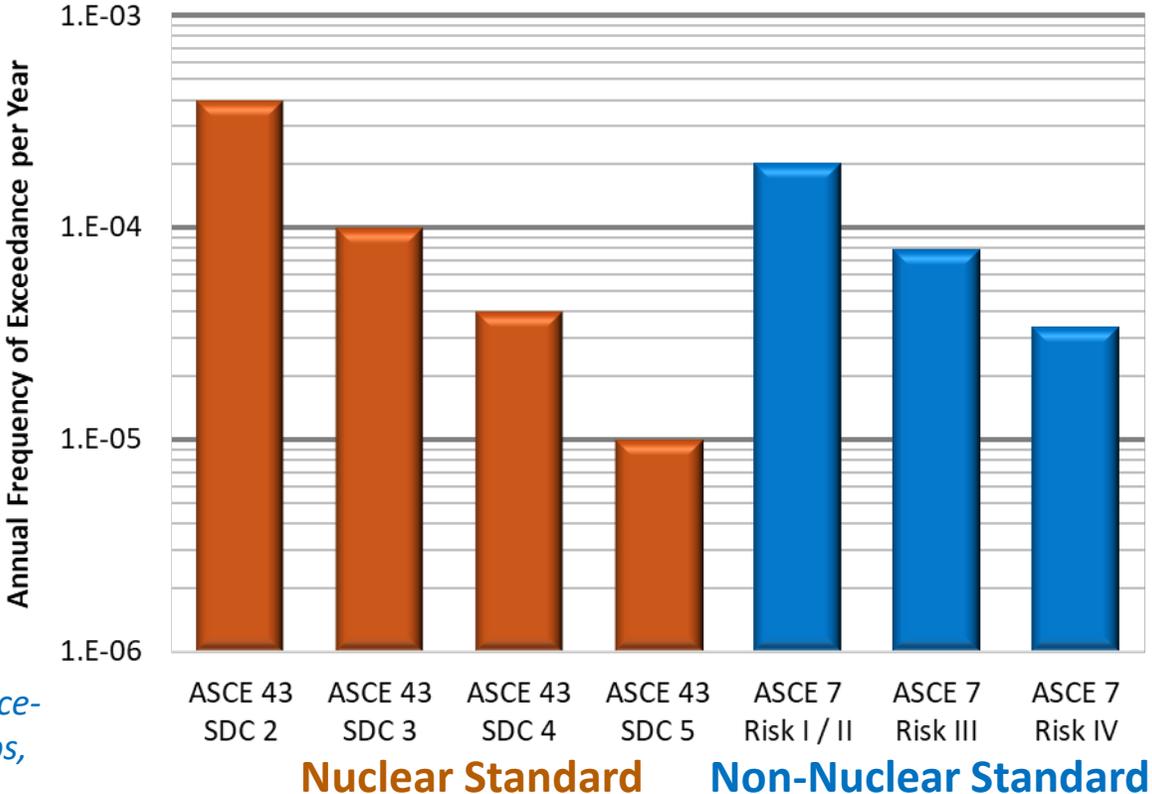
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# Risk-Informed Codes & Standards for Structures

- The research into LMP Risk-Informed Design for External Hazards (EPRI 3002029295\*) showed that LMP offers an opportunity to optimize structure costs while maintaining robust plant safety
- Non-Nuclear codes and standards (C&S) can achieve the necessary performance goals, enhanced with special treatments such as stress limitations or displacement limits, as necessary



\* *“Implementation of Licensing Modernization Project Risk-Informed Performance-Based Design Framework for External Hazards: Assessment of Challenges, Gaps, and Research Needs”*; September 2024

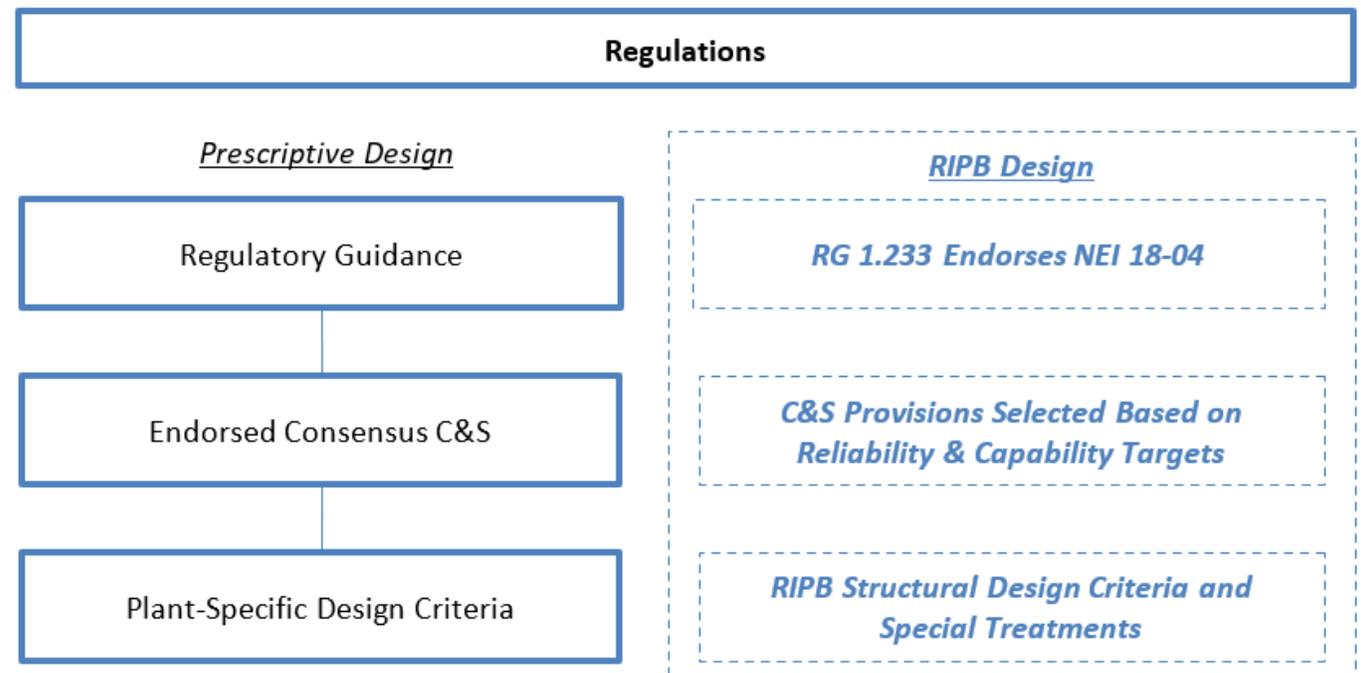
# Regulations, Guidance, C&S, & Design Criteria

## Prescriptive Design

- Regulations -> regulatory guidance -> C&S -> plant-specific design criteria

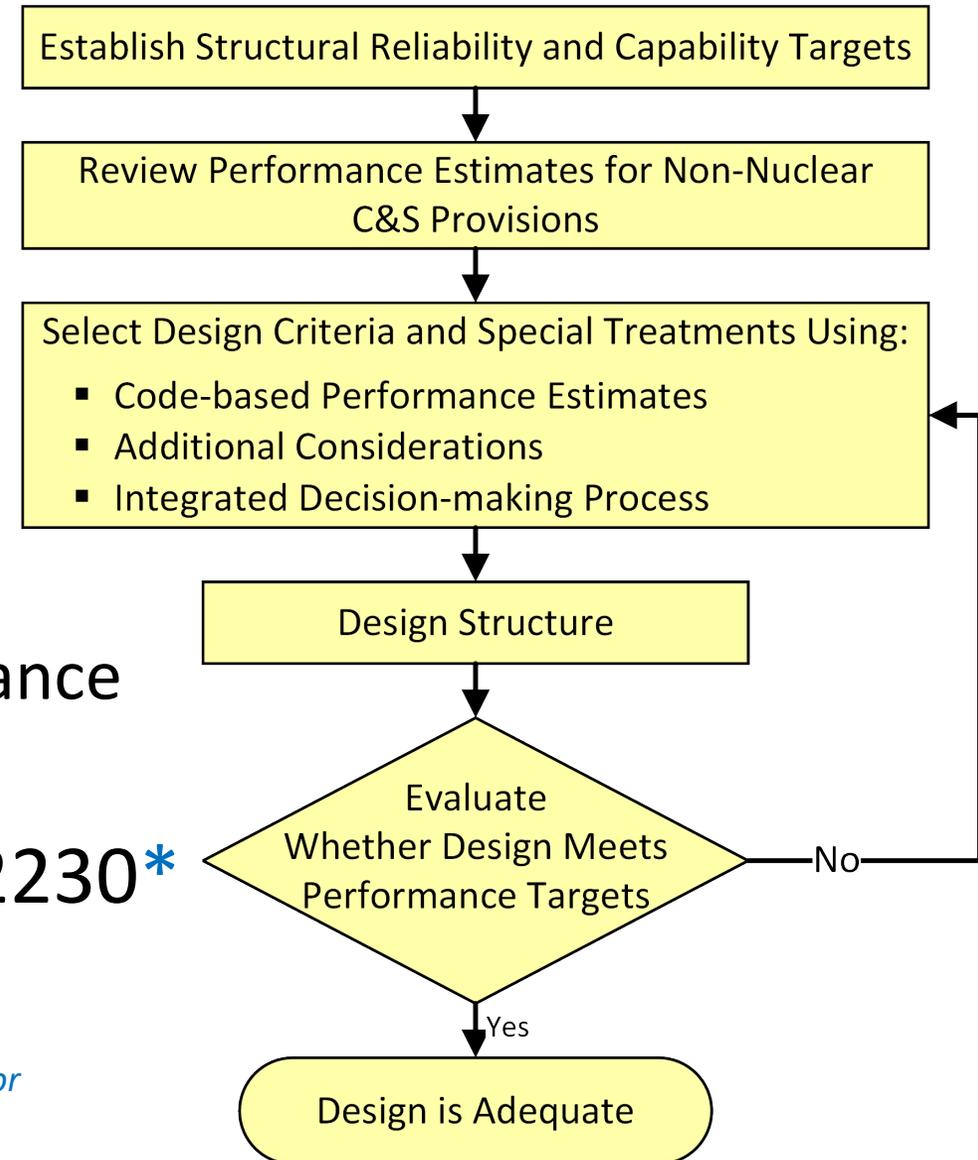
## Risk-Informed Performance-Based Design

- High-level regulatory requirements the same whether RIPB or conventional design
- RIPB design may be more flexible when defining criteria and requirements
- RIPB design principles are driven by performance targets (reliability and capability targets), informing design criteria, ensuring SSCs achieve the required performance



# Risk-Informed Codes & Standards for Structures

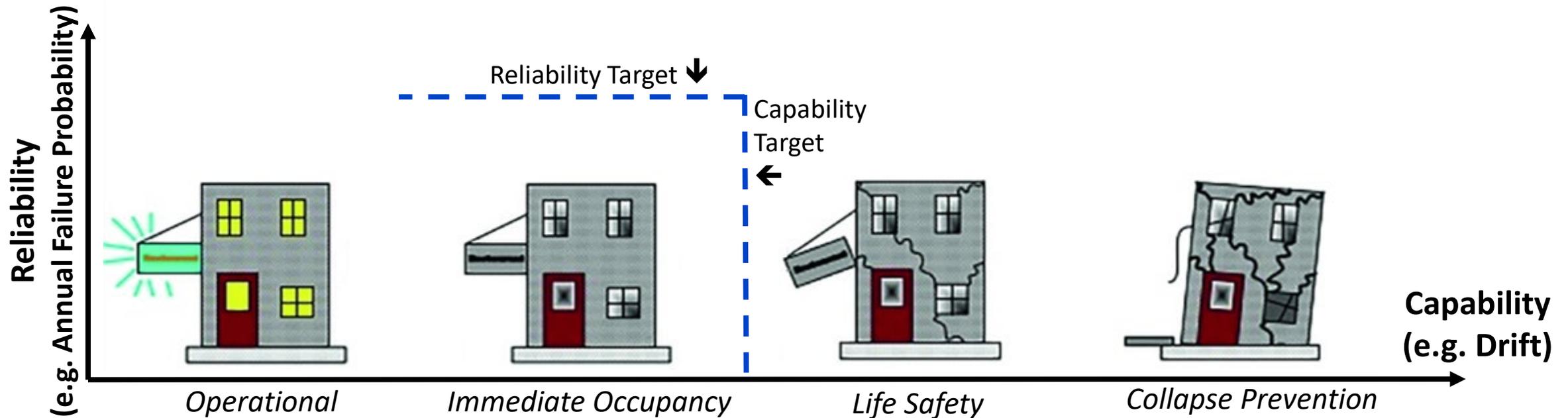
- Develop and justify structural design criteria using non-nuclear C&S, enhanced with special treatments as necessary
  - Use structure reliability and capability targets from the risk assessments
  - Define design criteria to meet the performance targets
- Framework established in EPRI 3002032230\*



\* *"Risk-Informed Performance-Based Application of Codes and Standards for Advanced Reactor Structural Design: Conceptual Approach"; November 2025*

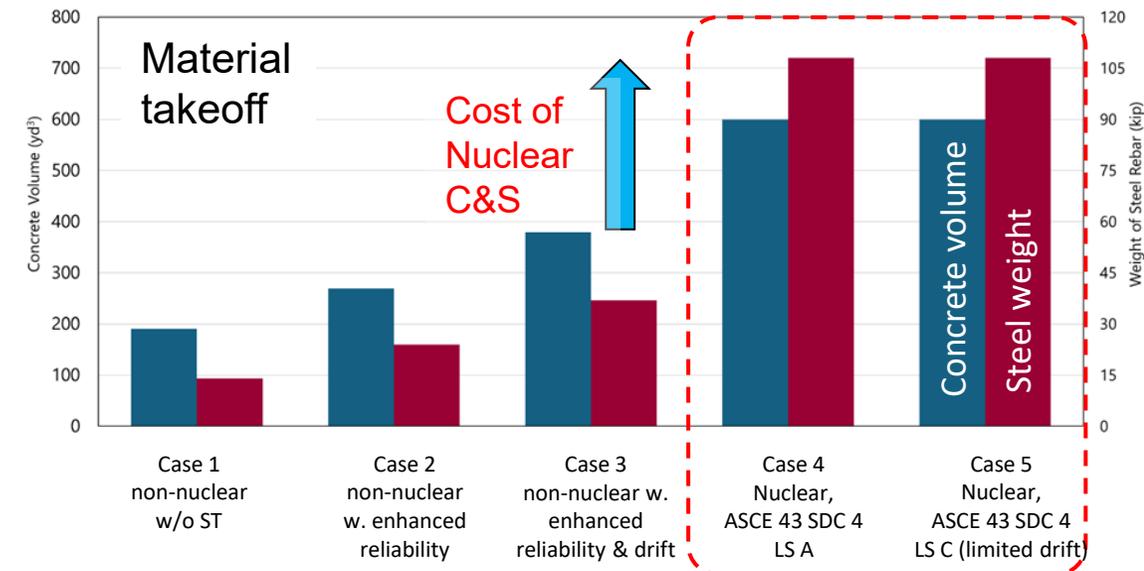
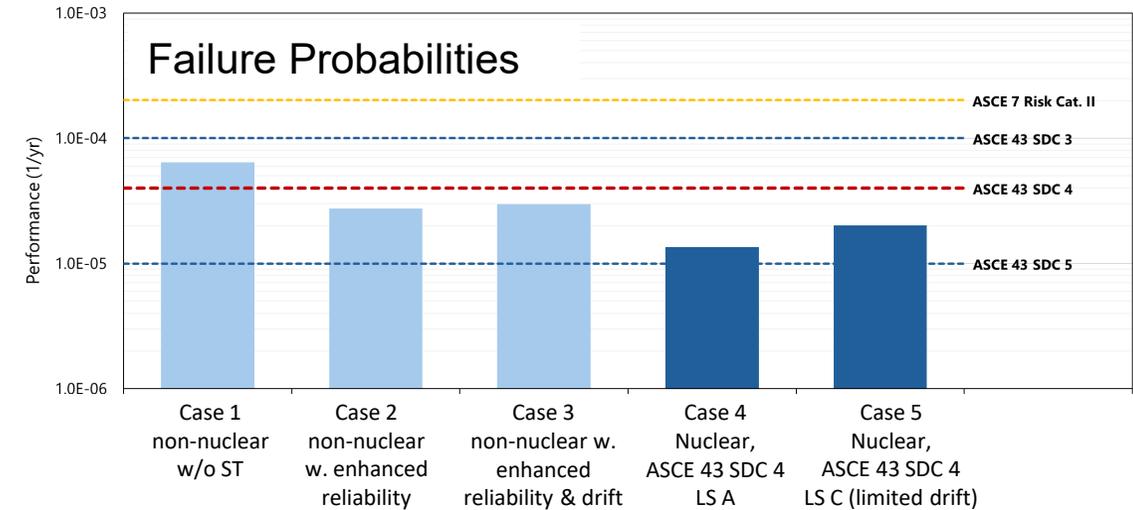
# Capability and Reliability Targets

- **Capability target** is a limit on structural behavior beyond which the structure will fail to perform its function(s).
- **Reliability target** is a limit on structural failure probability that, if achieved, ensures that the structure design is adequate



# Example Implementation of Conceptual Approach

- Design and evaluate a representative Reactor Building structure for five sets of reliability and capability targets using non-nuclear C&S with special treatments and nuclear C&S
  - Non-nuclear C&S achieve a specified level of performance, albeit lower reliability than may be expected for SR LWR structures
  - Special treatments can augment non-nuclear C&S provisions to improve reliability and/or capability performance
  - Nuclear C&S target the same performance as non-nuclear with special treatments, but over-perform because of seismic loading criteria, strength design provisions, and elastic behavior requirements
  - Nuclear C&S are constrained by implicit performance expectations for conventional LWR nuclear containment structures



# Considerations and Future Activities

- Considerations beyond achieving performance targets:
  - Ensure that design criteria & special treatments work within the context of other C&S provisions to achieve the required system performance
    - For example, consider analysis criteria for developing in-structure response spectra, load factors for nuclear-specific load effects, and seismic interaction requirements.
  - Review how combined hazards and nuclear-specific load effects in design influence performance—reliability and capability
- Future research:
  - Framework demonstrated for seismic loads; planning to extend the framework for other necessary loadings
- Quality assurance expectations should also be risk-informed



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