

Development of Risk-Informed Design and Regulatory Processes

February 24-25, 2000

Stanley E. Ritterbusch
Project Engineering Manager



Rev. 3-2000 NRC Training ABB-ppt-01

ABB

Outline

- Background
- Project status
- Comparison to current NRC/NEI risk-informed program



Rev. 3-2000 NRC Training ABB-ppt-01

ABB

Background

- Department of Energy (DOE) has started the NERI research program for future nuclear technologies
- Although currently operating nuclear plants are competitive on production cost basis (fuel plus O&M), new nuclear plants are not likely to be competitive in the long-term deregulated U.S. market unless capital costs are reduced by 35% or more.
- A long-term R&D program is needed in order to develop a next-generation nuclear plant design that can be economically competitive in a deregulated U.S. power market.



Rev. 3-2000 NRC Training ABB-ppt-01

ABB

Background....

- ABB CENP organized a team to submit 3 related proposals aimed at reducing the costs of future nuclear plants in the U.S.
 - Risk-Informed Assessment of Regulatory & Design Requirements (ABB Prime)
 - Smart Equipment (Sandia Prime)
 - Advanced Technologies for Design, Procurement, Construction, Installation, and Testing (Duke Engineering & Services Prime)



Rev. 3-2000 NRC Training ABB-ppt-01

ABB

Background....

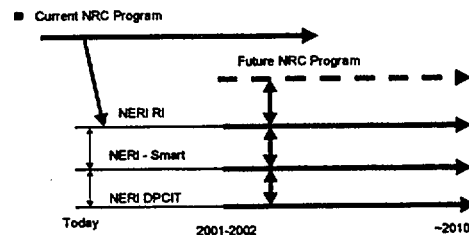
- Team includes:
 - ABB CENP
 - Duke Engineering & Services (DE&S)
 - Massachusetts Institute of Technology (MIT)
 - Pennsylvania State University (PSU)
 - North Carolina State University (NCSU)
 - Sandia National Laboratory (SNL)
 - Idaho National Engineering & Environmental Lab. (INEEL)
 - Egan & Associates



Rev. 3-2000 NRC Training ABB-ppt-01

ABB

Risk-Informed Program Relationships



Rev. 3-2000 NRC Training ABB-ppt-01

ABB

Time-Dependent Comparison of Regulatory Processes

Generation II (Current Plants)	Generation III (ALWRs)	Generation IV
Deterministic design and regulation.	Deterministic design and regulation, supplemented by PSA lessons learned.	PSA based design and regulation; deterministic methods used where appropriate.
Defense-in-depth is primary means for assuring safety.	Defense-in-depth is primary means for assuring safety.	Defense-in-depth used when uncertainties cannot be resolved by PSA.
CDF = $1.0E-4$ events/year used as general measure of "safe enough."	CDF = $1.0E-6$ and LERF = $1.0E-6$ events/year used as design goals to get "warm feeling" of overall plant safety.	WRR attempt to use probabilistic criteria as more than just goals.



Rev 3.2000 NRC Training - ABB-004.pdf

ABB

Potential Design and Regulatory Changes

- Based on new data and PSA results, evaluate complete set of accidents used as design basis
 - reduce the size of the pipe break assumed for design of containment and ECCS
- Based on PSA modeling and improved SSCs
 - include only necessary equipment in plant design
 - use "safety-grade" classification only when justified
- Based on the development of more highly monitored or "smart" equipment, use normally operating equipment to perform safety functions
- Perform integrated structures-systems analysis



Rev 3.2000 NRC Training - ABB-004.pdf

ABB

Potential Design and Regulatory Changes....

- Use passive components and systems where technically justified
- Evaluate signature analyses to decrease the limits of testing (e.g., full flow testing may not be required)
- Develop health monitoring systems to decrease quantity of equipment needed for plant operation and to provide up-to-date performance data into plant-specific PSA
- Propose revisions to regulations which may not be required given current knowledge and design & operating experience
- Pursue technical consistency in design and regulation



Rev 3.2000 NRC Training - ABB-004.pdf

ABB

Summary

- Favored approach for a new design and regulatory process for Generation IV plants
 - use risk-based methods to the extent possible
 - use defense-in-depth only when necessary to address uncertainties or public policy
- Advantages of a significantly risk-based process:
 - provides designers with the ability to significantly reduce plant cost while maintaining safety
 - provides the opportunity to introduce advanced technology and more efficient plant operations



Rev 3.2000 NRC Training - ABB-004.pdf

ABB

Summary....

- Advantages of a significantly risk-based process....
 - provides a method for an integrated assessment of uncertainties in design and regulation
 - avoids the need for item-by-item justification of the "thousands" of existing deterministic criteria
 - provides a self-consistent method for evaluating changes
 - provides a process that is readily applicable to non-LWR technologies
- The complete design and regulatory process must be revamped using risk-based methods to the extent practical to meet the 35% cost reduction goal



Rev 3.2000 NRC Training - ABB-004.pdf

ABB