Sustainable Use of Risk-Informed Regulation to Improve Plant Safety

Nuclear Regulatory Commission Briefing

May 11, 2017

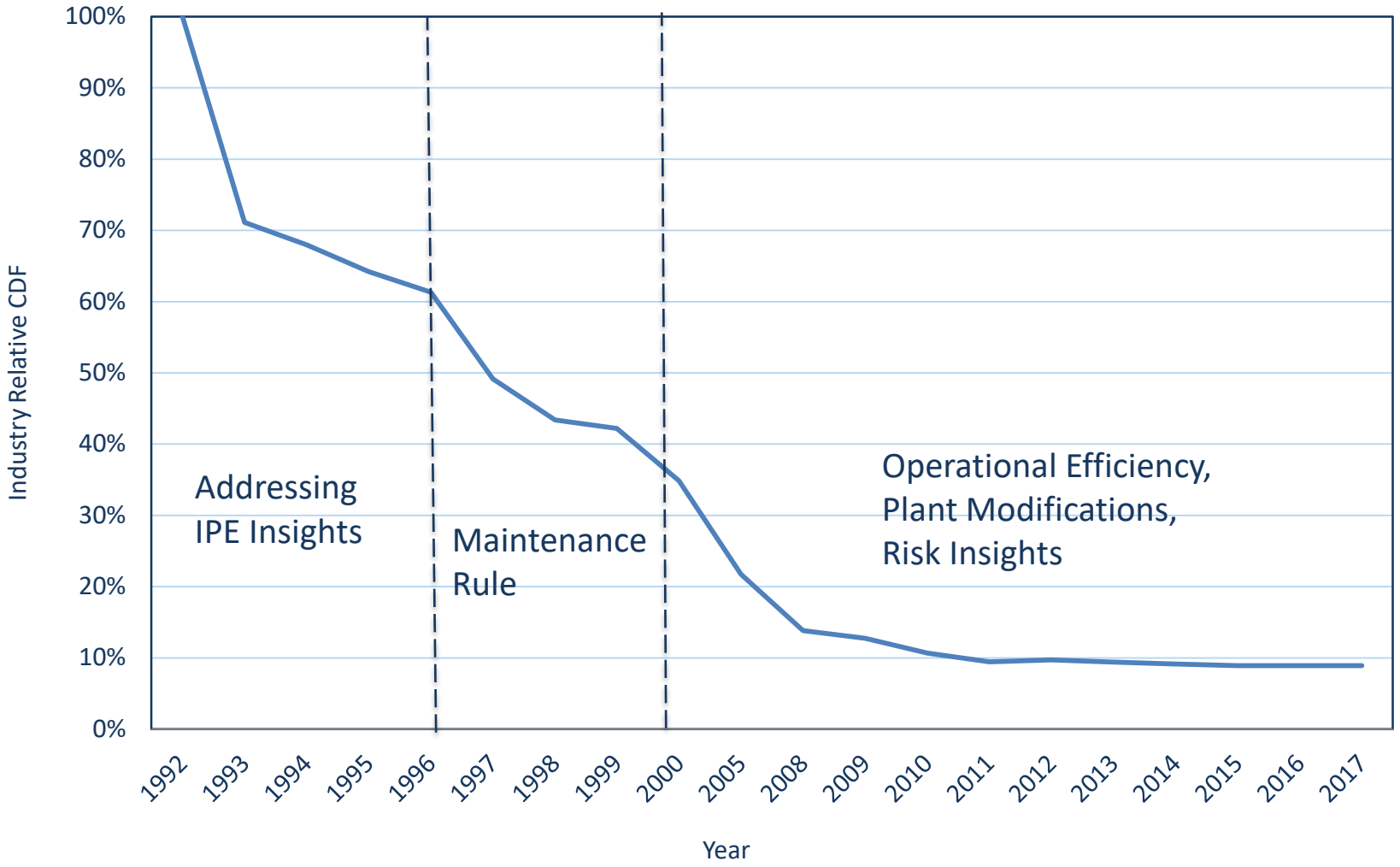
Risk-Informed Regulation in the U.S. Nuclear Industry

- Purpose of Probabilistic Risk Assessment (PRA)
  - Provide insights into strengths and weaknesses of the design and operation of a nuclear power plant
  - Allow licensees and NRC to use these insights to more completely inform operational and regulatory decisions
- NRC's PRA Policy Statement of 1995
  - Increase use of PRA in all regulatory matters, as supported by the state of the art
  - PRA should be as realistic as practical
  - Safety goals and subsidiary numerical objectives should be used with appropriate consideration of uncertainties

NRC Leadership in Risk-Informed Regulation

- NRC's early leadership in implementing risk-informed regulation has a demonstrated record of improving safety and focusing resources
  - Maintenance Rule
  - ROP
  - Risk-Informed Enhancements to Technical Specifications
- Need Commission-level support to continue to realize these benefits

Industry Internal Events CDF Trend



Long-Term Vision for Risk-Informed Regulation

- Risk information used in regulatory matters, to the extent supported by the state of the art
- Risk-informed decisions used on a daily basis to operate plants
- Efficient processes exist for using risk in decision making
- PRAs used in applications are realistic
- Broad implementation of existing initiatives

Ideal Implementation of Risk-Informed Regulation

- Realistic risk information used in all aspects of decision making
  - Licensing
  - Operations
  - Oversight
- Resources appropriately allocated to manage risk
- Use of risk information to efficiently disposition issues with very low safety significance

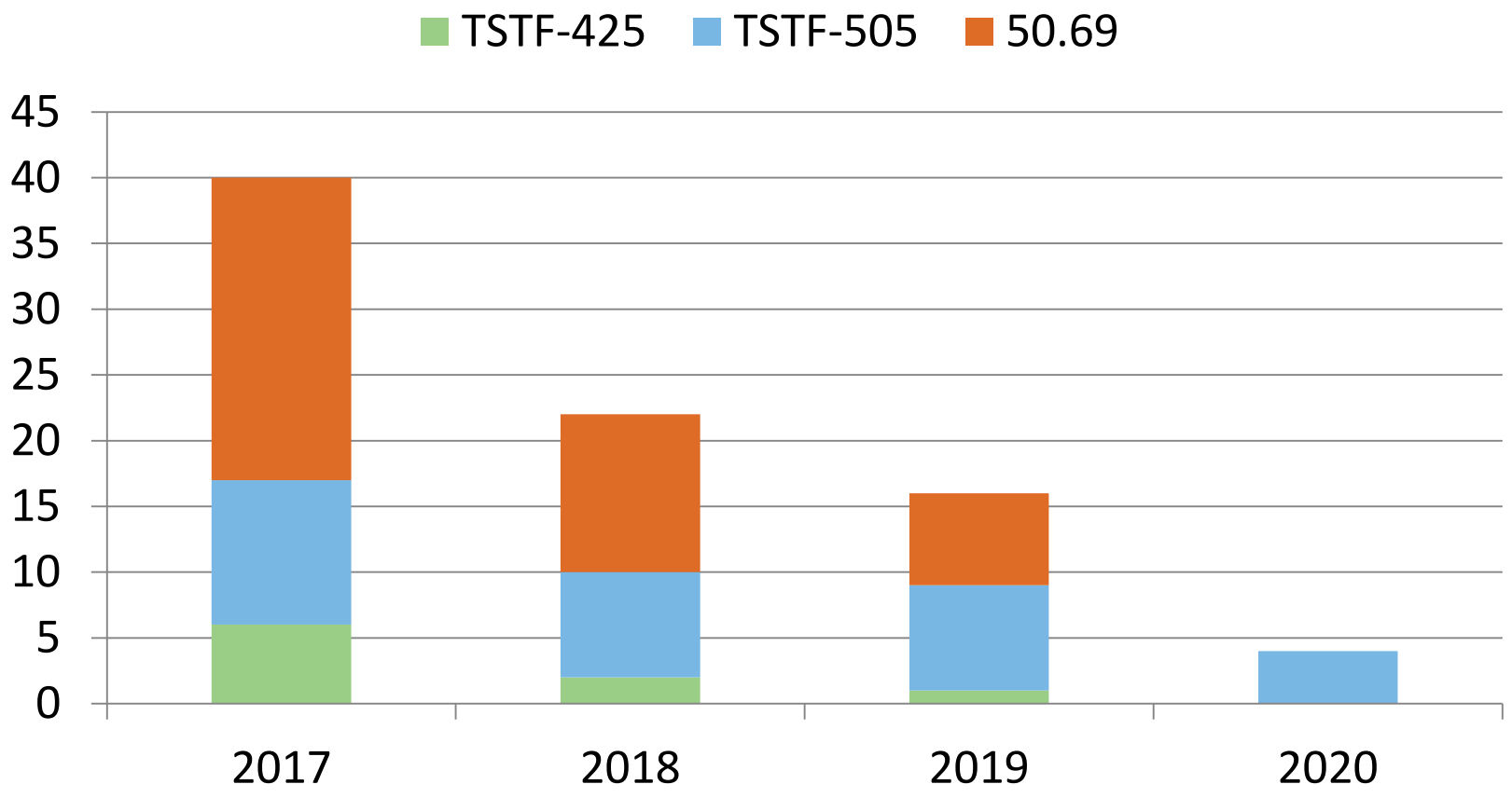
Industry Priorities for Continued Progress

- Implement the PRA finding closure review process
- Support efficient reviews of key risk-informed licensing applications
- Improve PRA realism (top priority for fire PRAs)
- Develop efficient process for making new PRA methods available for use
- Develop appropriate PRA aggregation methods
- Improve realism in oversight activities

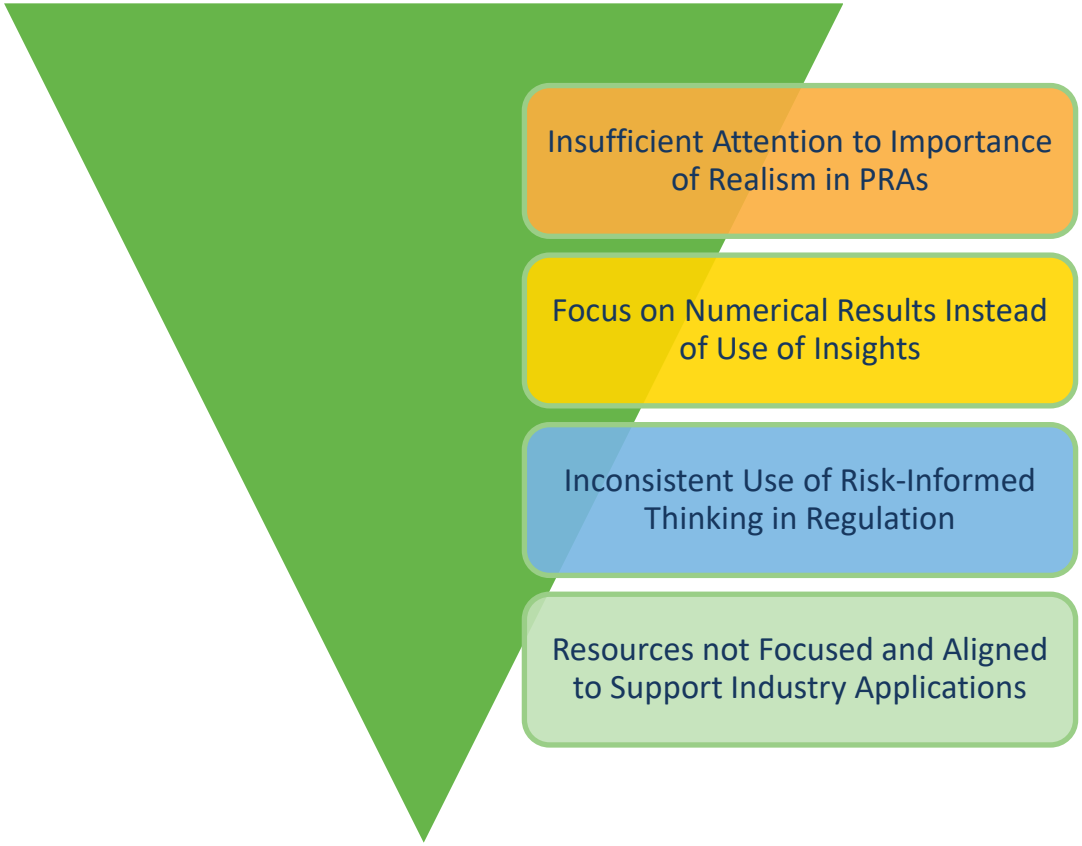
Industry Investment in Risk-Informed Regulation

- Personnel
  - Increase in utility PRA personnel
    - Fire PRA has most impact across all sites
  - Incorporation of risk-informed regulation training for site personnel
- Operations
  - Moving towards integration of FLEX equipment
  - Risk-informed decision-making tools
- Average industry investment of $15-20 million per site

Risk-Informed Licensing Application Plans



Potential Barriers to Moving Forward



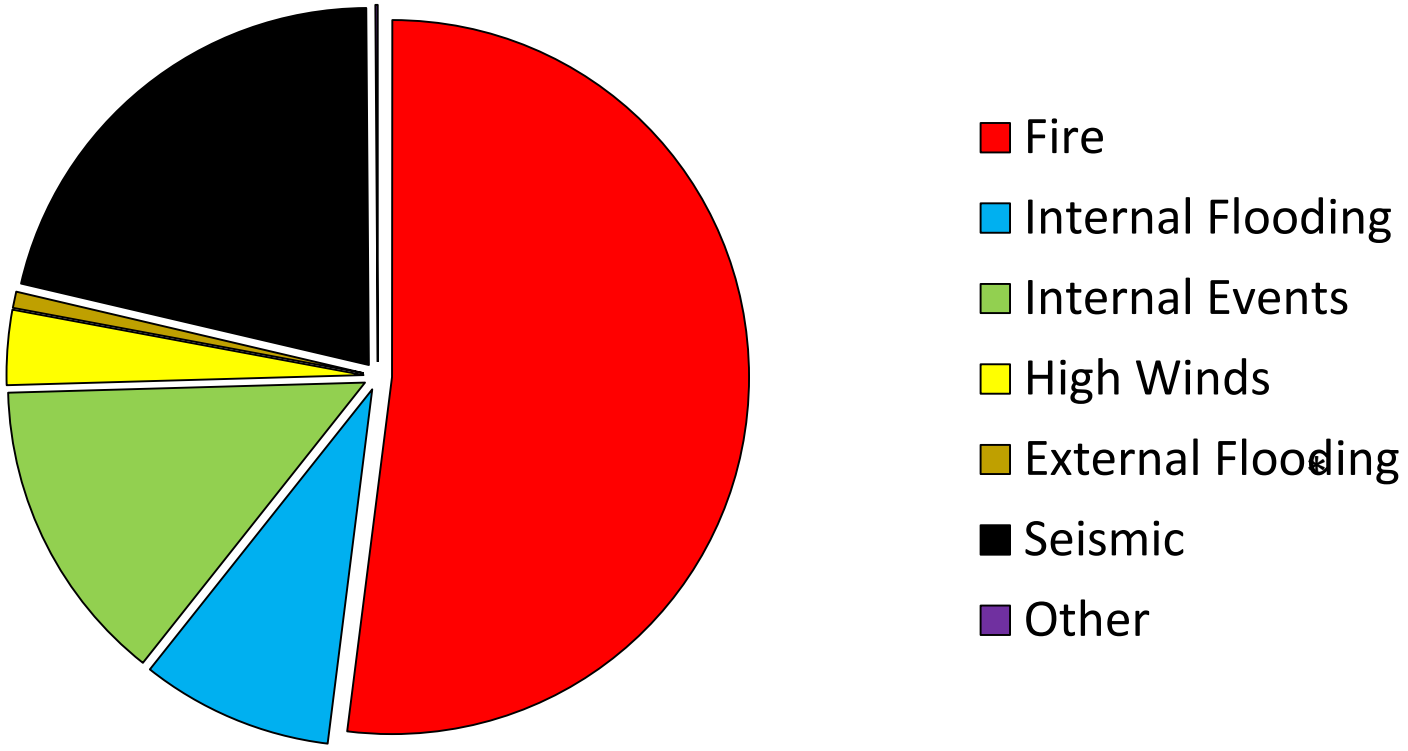
Overcoming These Barriers Allows Improvement in Safety

Insufficient Attention to Importance of Realism in PRAs (Fire PRA)

- Current Fire PRAs overstate risk due to fire events
  - Inconsistent with NRC's accident sequence precursor and reactor oversight program data
  - Simplification via "binning" results in bounding approach
- Uneven conservatism can mask key insights

Fire characterization does not comport with operating experience – Current methods over predict the number of severe fire and assumed rate of growth and severity

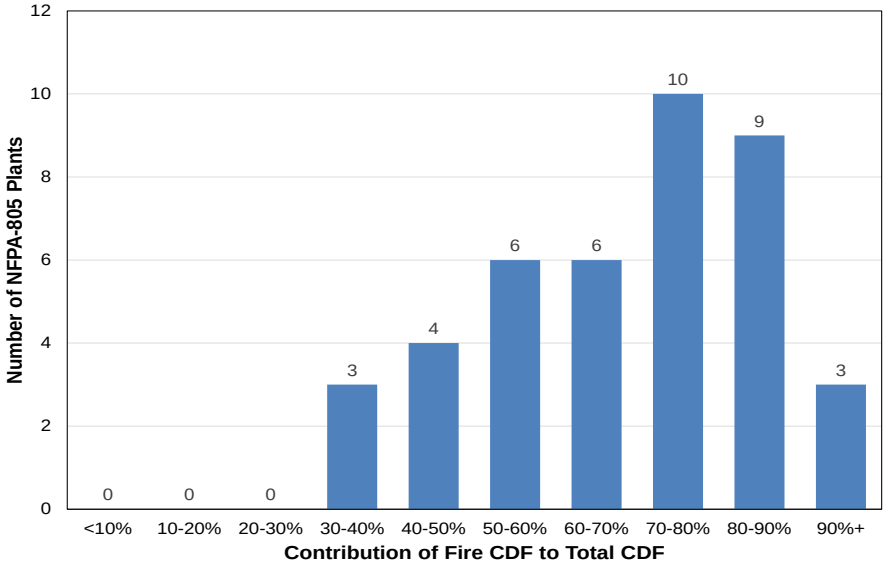
CDF Hazard Comparison (Typical Plant)

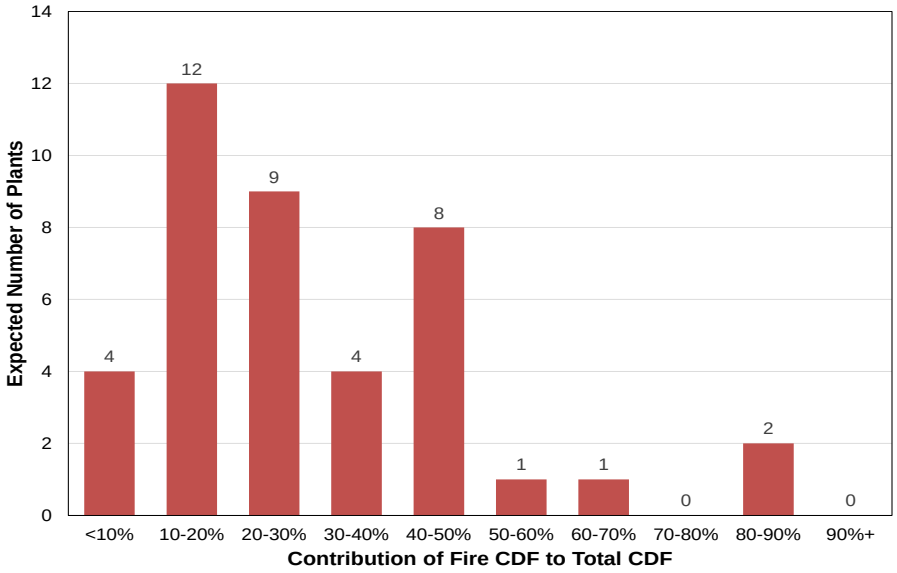


PRA Realism

- Technical Approach to PRA
  - Best estimate is necessary to gain correct insights
  - Available OE and expert judgment is used, testing not always useful or possible
  - Insights facilitate decision making
- Impact of current Fire PRAs
  - Inappropriate plant insights/decisions
  - Dis-incentive to install incipient detection systems due to incomplete or conservative testing
  - Testing and the last 10 years of methods development have incrementally changed the level of realism

Shift in FCDF Contribution to Total CDF Incorporating Realistic Fire Modeling

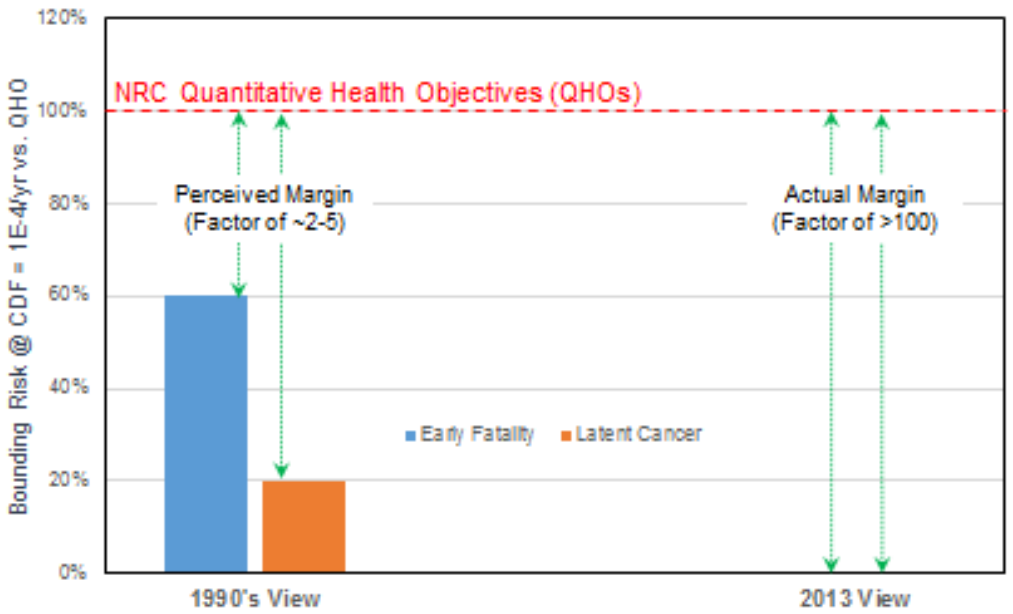




Path Forward for Improving Fire PRA Realism

- Identify key drivers for conservatism using licensee PRAs
  - Use EPRI's Fire Events Database (Operating Experience) to prioritize methods and data
  - Coupled with properly-designed testing, if needed
    - Recent HEAF testing was bounding, rather than realistic
- Use robust review process for making methods available for regulatory application

Margin to Safety Goals is Significant



- Increased understanding of severe accidents and better tools demonstrate that significant margin exists
- Improved efficiencies can be gained by applying risk insights in lieu of deterministic approaches

Ref. EPRI 3002003116, An Approach to Risk Aggregation for Risk-Informed Decision-Making

Lack of consideration of margin to the safety goals drive NRC/industry focus on issues that are not safety significant

Moving Toward Use of Insights

- Inappropriate to use hard numerical thresholds as key decision-making tool
  - Differences in level of conservatism between hazards make insights more useful
  - Undue focus on numbers moves us away from risk-informed regulation
- Example: Risk-Informed Tech Spec Completion Times
  - Allows licensees to use risk information to manage equipment allowed outage time
  - Implementation has been delayed by excessive focus on issues with minimal safety impact

Moving Towards Use of Insights

- Reviews are most effective if focused on application of risk, rather than details of PRA model
- Industry supports this via peer review process
  - NRC-endorsed process using industry peers to review PRA model details
  - Includes rigorous qualification process, licensee control, and formality of review
  - Enhanced by new PRA finding closure process to reduce volume of material reviewed by NRC staff
  - Duplicate staff reviews are inefficient and should be minimized

Implementation of framework in RG 1.200 and 1.174, as intended, would address majority of issues in risk-informed licensing reviews

Inconsistent use of Risk Information

- Not all agency staff have embraced risk-informed approaches
  - Some technical branches are deterministic by process and culture
  - Adds unnecessary review time, RAIs, and complexity
- Difficulties continue with risk-informed licensing
  - Risk-informed completion time applications undergoing unduly long reviews due to focus on PRA models rather than application in plant operations
- Encouraged that NRC has started evaluation of a process for dispositioning low-risk licensing issues
  - Need a robust process for final disposition

Inconsistent Use of Risk Information in ROP

- Reactor Oversight Process uses risk information to assist NRC in assessing safety significance of licensee performance and events
- Substantial potential for integration of risk information into regulatory framework
- Several improvements necessary to realize full potential
  - Use best available model
  - Treat failure events realistically
  - Use fact-based common cause treatment
  - Refine treatment for application of minimum human error probability

Organization and Resources to Support Risk-Informed Regulation

- Industry has invested heavily in resources needed to transition to more complete implementation of risk-informed regulation
  - Appropriate support resources critical
  - Developed efficiency improvements (e.g. templates, streamlined review processes)
- Vital that complementary capability from NRC are available
  - Capability to review anticipated applications
  - Depth and breadth of expertise to make judgements in reviews

Path Forward for Risk-Informed Regulation

- Principles of PRA Policy Statement remain valid now and in the future
  - Existing regulations and regulatory guides provide sufficient framework
  - Contemporary analyses show substantial margin to safety goals
  - Can continue to support improved efficiencies for NRC and industry
- Current implementation of risk-informed regulation is not sustainable
  - Application throughput rate problematic for industry plans
  - Cultural change necessary to realize full integration of risk considerations in all regulatory matters

PRA Policy Statement and existing framework can be effective. Industry urges Commission to issue an SRM to direct implementation as intended.

Proposed SRM Content

- Plan to improve realism in PRA information used in decision making
- Approach to more completely consider risk insights versus an overreliance on numerical results
- Development of process for supporting consistent use risk information in all decisions
- Targeting of organizational resources and expertise to support risk informed applications

Industry willing to support Commission by providing information necessary to develop SRM