EPRI Perspective on the Increased Use of Risk-Informed Decision-Making

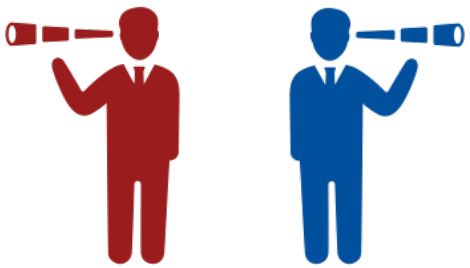
Ashley Lindeman
Principal Project Manager

NRC RIC: Building on a Strong Foundation: A Voyage through Risk-Informed Decision Making
March 14, 2023

EPRI's Experience in the RIDM Journey

- It's been a long, hard road to get here

- But risk-informing has delivered and works
  - Focuses on safety significant issues
  - Adaptable to new information, evolving aspects
  - Not meant to replace traditional engineering (risk analysis is engineering)
  - Helps understand what we know and don't know
    - And evaluate the options on what to do about it

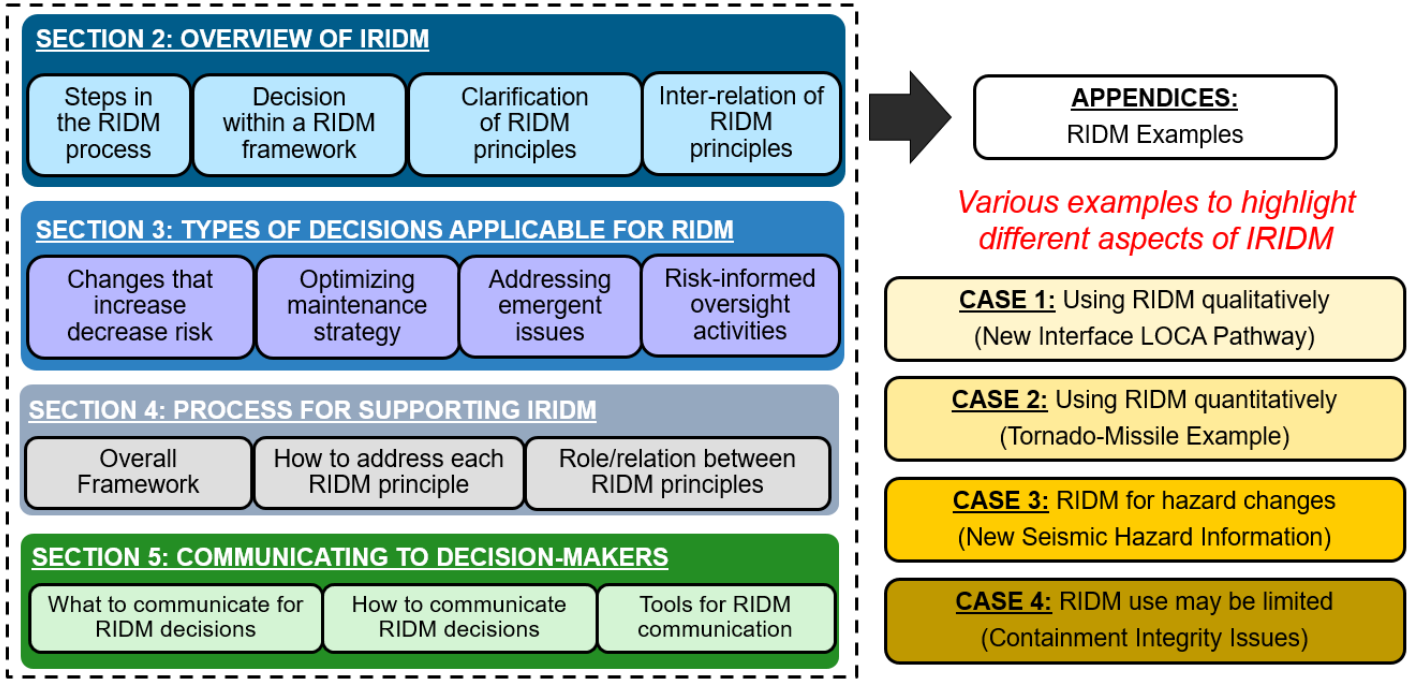


- A strong past and stronger future (is possible)!

Advances in RIDM Application

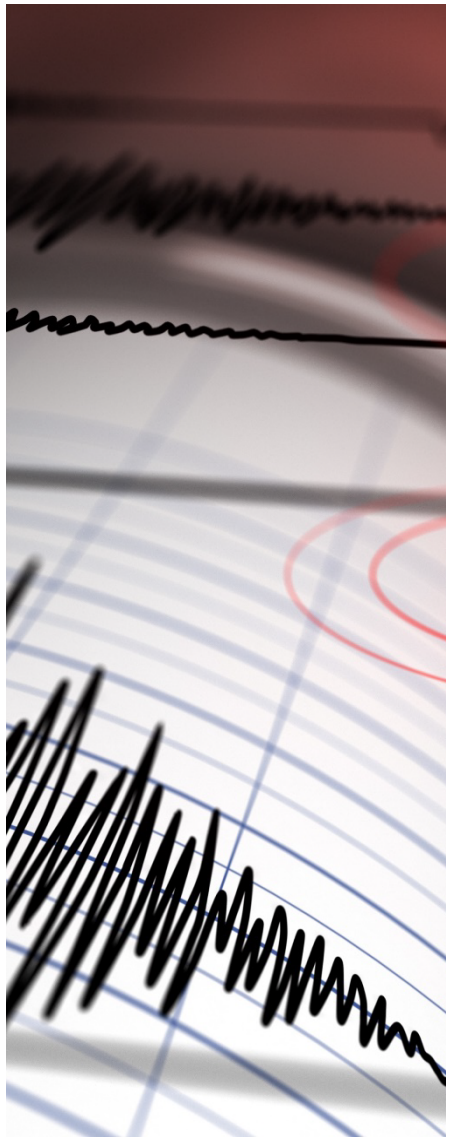
- Better with a structured process
- Lack of transparency or confusion is not an element of RIDM, it's:
  - Poor implementation, poor communication, poor training
- It is ok to consider whether RIDM should be used
  - Maybe it shouldn't
  - Could be adapted
  - Approach may look different for different issues
- But it should be consistently applied AND basis, outcome should be clear

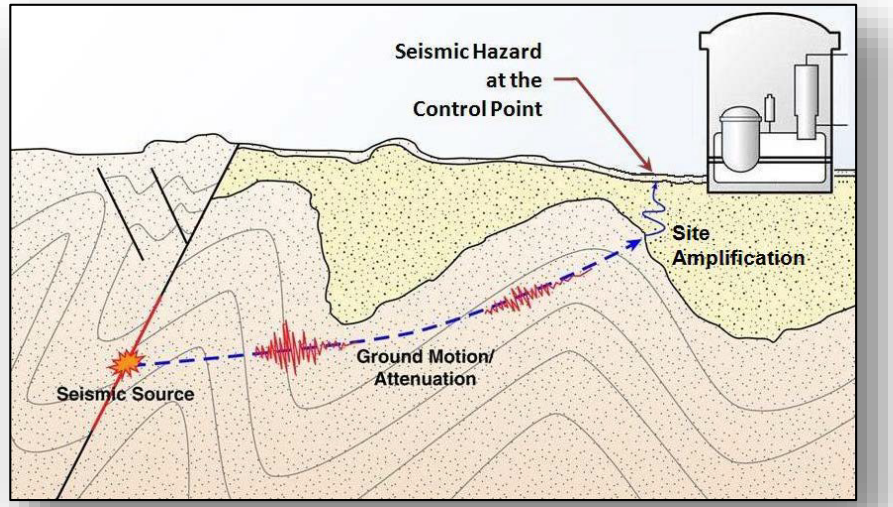
RIDM should not look like a "Rorschach test"



EPRI 3002014783, "A Framework for Using Risk Insights in Integrated Risk-Informed Decision-Making" (2019)

Successes and Benefits of RIDM – Seismic Risk

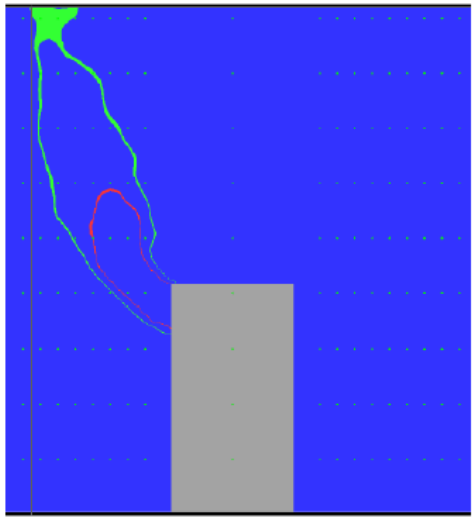


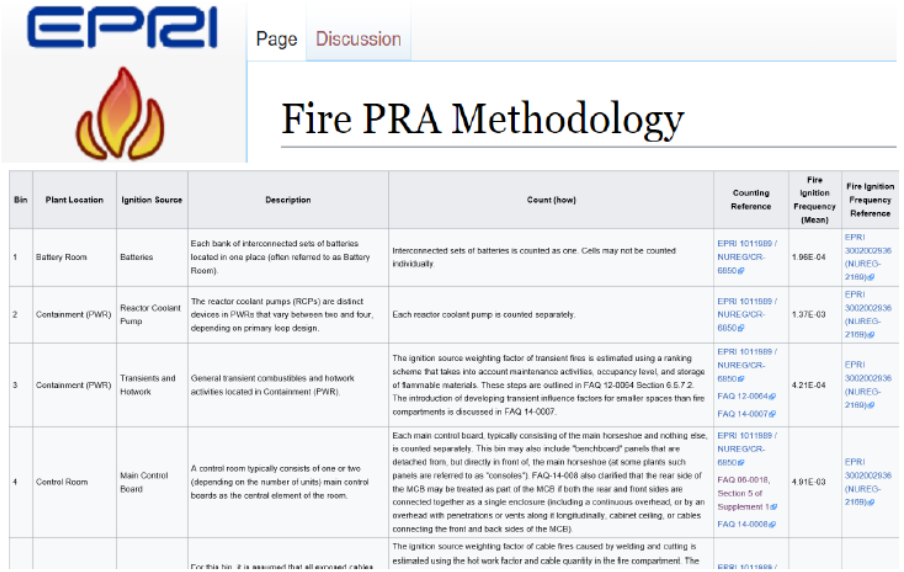


- Seismic hazard characterization
  - Improved guidance
  - Assessment of changes – (new information/methods)
- Fragility research, implementation
  - Detailed guidance on analysis, implementation, experience
- Integration in seismic PRA models
  - Implementation in PRA model logic, HRA modeling
  - Improvement in quantification and maintenance of SPRA
  - 50.69 Seismic Alternate Categorization development

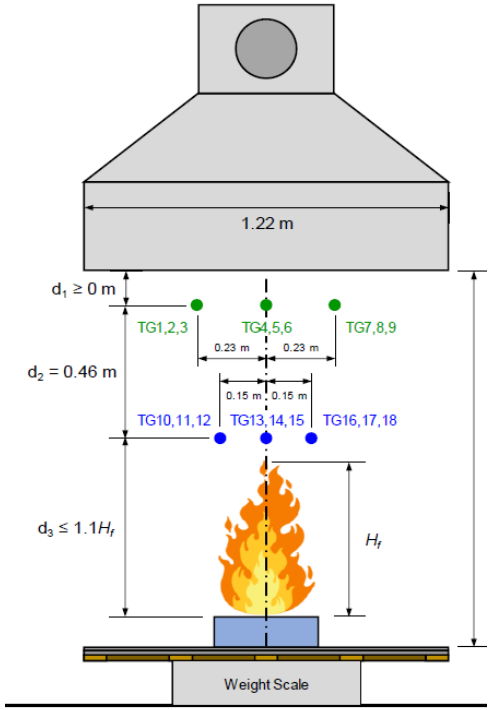
Successes and Benefits of RIDM – Fire Risk

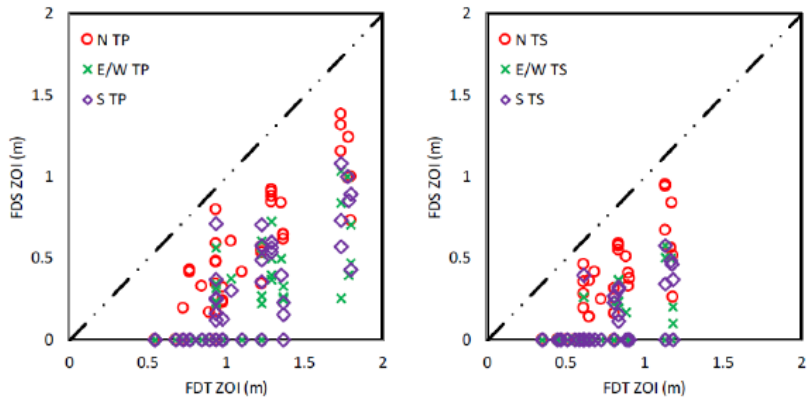
- Extensive improvements in state-of-practice, realism

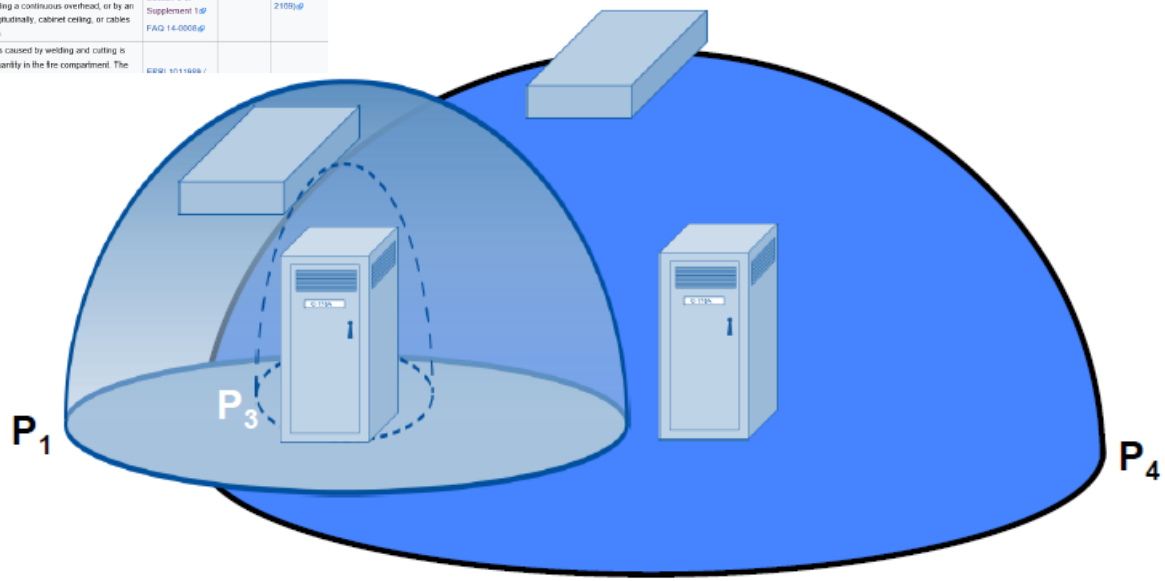




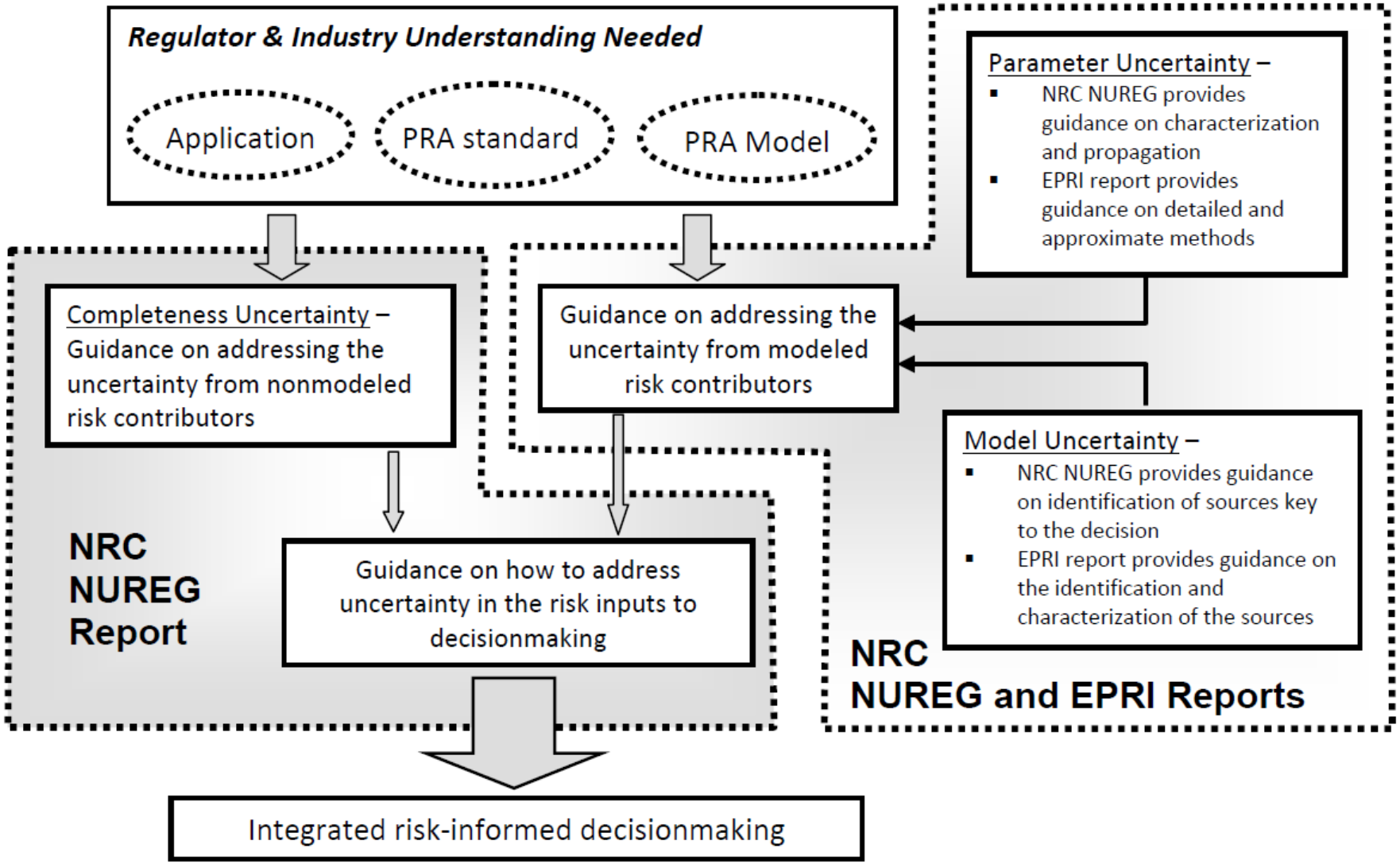
Bin	Plant Location	Ignition Source	Description	Count (how)	Counting Reference	Fire Ignition Frequency (Mean)	Fire Ignition Frequency Reference
1	Battery Room	Batteries	Each bank of interconnected sets of batteries located in one place (often referred to as Battery Room).	Interconnected sets of batteries is counted as one. Cells may not be counted individually.	EPRI 1011989 / NUREG/CR-6850	1.96E-04	EPRI 3002002936 (NUREG-2169)
2	Containment (PWR)	Reactor Coolant Pump	The reactor coolant pumps (RCPs) are distinct devices in PWRs that vary between two and four, depending on primary loop design.	Each reactor coolant pump is counted separately.	EPRI 1011989 / NUREG/CR-6850	1.37E-03	EPRI 3002002936 (NUREG-2169)
3	Containment (PWR)	Transients and Hotwork	General transient combustibles and hotwork activities located in Containment (PWR).	The ignition source weighting factor of transient fires is estimated using a ranking scheme that takes into account maintenance activities, occupancy level, and storage of flammable materials. These steps are outlined in FAQ 12-0064 Section 6.5.7.2. The introduction of developing transient influence factors for smaller spaces than fire compartments is discussed in FAQ 14-0007.	EPRI 1011989 / NUREG/CR-6850 FAQ 12-0064 FAQ 14-0007	4.21E-04	EPRI 3002002936 (NUREG-2169)
4	Control Room	Main Control Board	A control room typically consists of one or two (depending on the number of units) main control boards as the control element of the room.	Each main control board, typically consisting of the main horseshoe and nothing else, is counted separately. This bin may also include "benchboard" panels that are detached from, but directly in front of, the main horseshoe (at some plants such panels are referred to as "consoles"). FAQ-14-008 also clarified that the rear side of the MCB may be treated as part of the MCB if both the rear and front sides are connected together as a single enclosure (including a continuous overhead, or by an overhead with penetrations or vents along it longitudinally, cabinet ceiling, or cables connecting the front and back sides of the MCB).	EPRI 1011989 / NUREG/CR-6850 FAQ 06-0018, Section 5 of Supplement 1 FAQ 14-0008	4.91E-03	EPRI 3002002936 (NUREG-2169)
				The ignition source weighting factor of cable fires caused by welding and cutting is estimated using the hot work factor and cable quantity in the fire compartment. The			





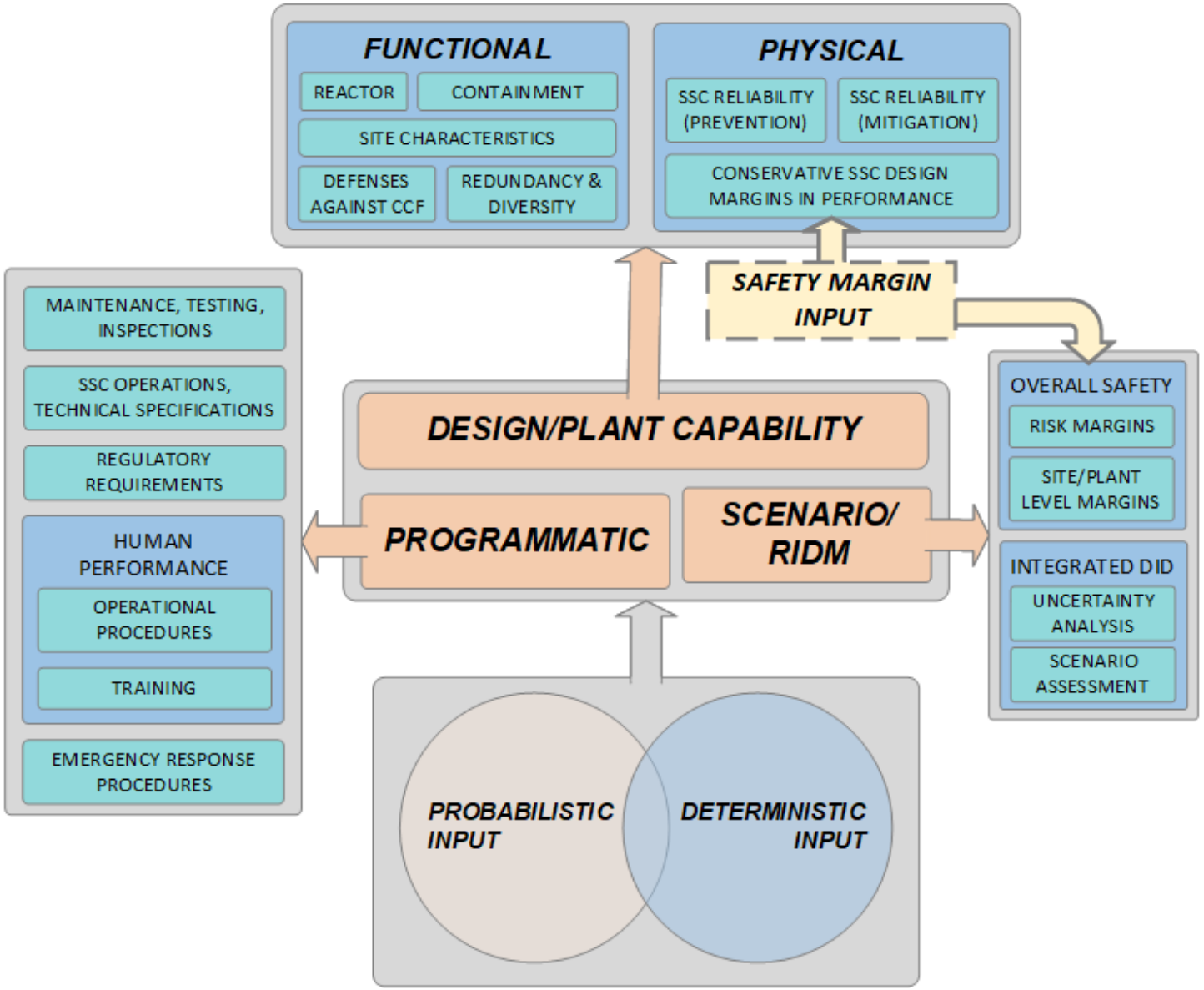


Successes and Benefits of RIDM – Treatment of Uncertainty



- NRC provides guidance; EPRI reports provide **practical implementation**
- Supports a more structured approach to treatment of uncertainty
- Focus on issues that can **impact insights (not just quantification)**

Reframing Defense-in-Depth/Safety Margin EPRI 3002014783



- Redefined framework for DID and SM built upon recent efforts for Advanced Reactor Design Licensing
- Goal is to bring together DESIGN DID, PROGRAMMATIC DID, SCENARIO DID
- But also to place SM in a better context, better guidance
- PRA insights are one input into the overall framework
- Goal is to provide better understanding, justification
- Very important internationally

Reframing Defense-in-Depth/Safety Margin EPRI 3002014783

- EPRI 3002020765 discusses reframed context in multiple areas:


- Internal events


- Internal fire


- Internal flooding


- Seismic events


- External Flooding


- Multi-unit accidents


- Spent fuel pool (SFP)


- Dry cask storage


- Digital instrumentation & control


- Shutdown risk


- Periodic safety reviews


- Physical security


- Portable equipment


- Risk-informed applications

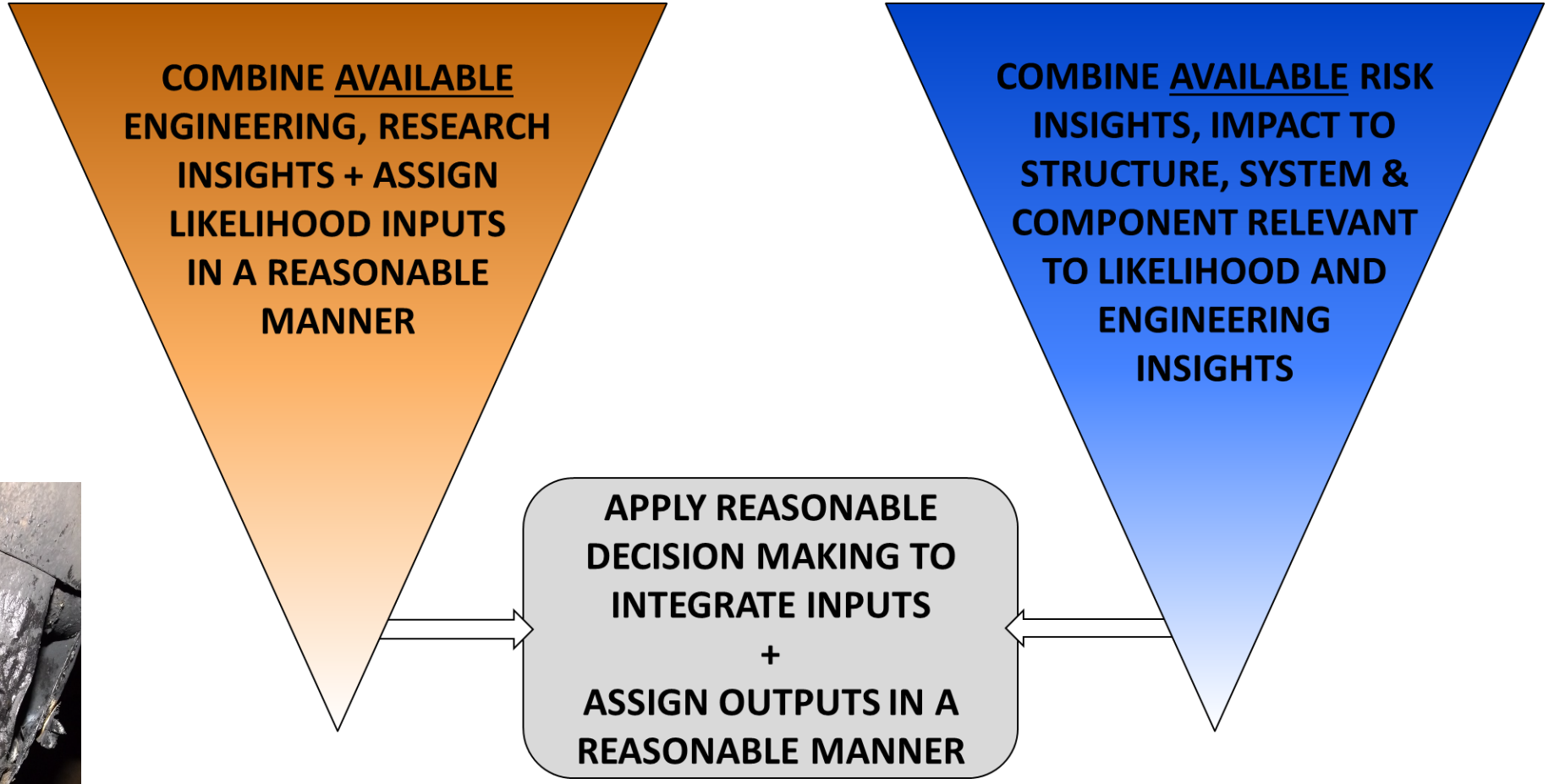
- **Note** that purpose is not how PRA can be used in all these areas, but how DID/SM can be better understood in RIDM (risk insights are leveraged, along with design/programmatic/scenario information)

Leveraging Risk Insights for Aging Management

- Major opportunity to prove RIDM can be used more widely
- Harmonization of applications

Selective Leaching

Medium Voltage



- Not intended to create an “aging PRA” effort
- Important for long term operations worldwide

Improving General RIDM Application

- Future of RIDM includes avoiding overfocusing on quantification, e.g.:
  - *What is The Number*-syndrome
  - *Is it Above or Below "The" Line*-mania
- Common catchphrase, *"numbers are not important, it's the insights that matter"*
  - Very true, but decisions need to be made
  - And engineers like numbers, it's a fact
- Solution: "look under the hood" to
  - Understand what is in the risk model and how it works
  - Understand the key risk contributors
  - Provide decision-makers with both "hard" and "soft" spots that can sway decisions
  - Need context for the numbers