



U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

RIC 2010

***Containment and Reactor Coolant System Pressure
Boundary Materials Degradation***

**Insights from the Pressurized Thermal
Shock (PTS) Technical Basis**

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Overview of Presentation

- What is PTS?
- Why we developed an alternative rule
- Highlights of the alternative rule
- Lessons learned

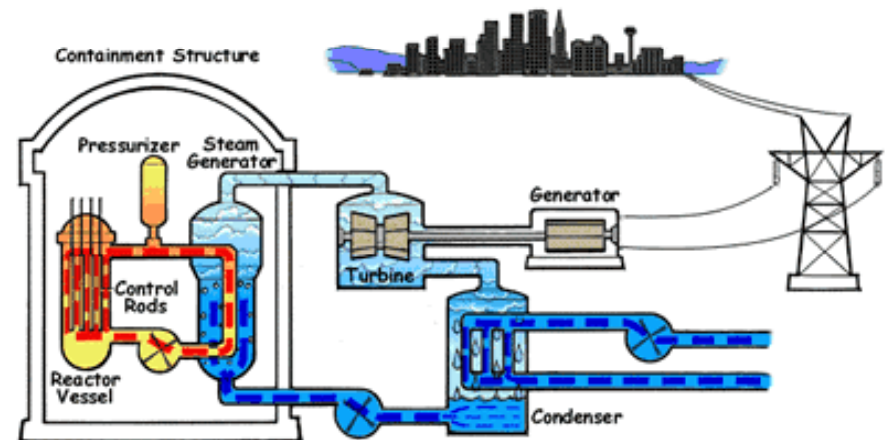
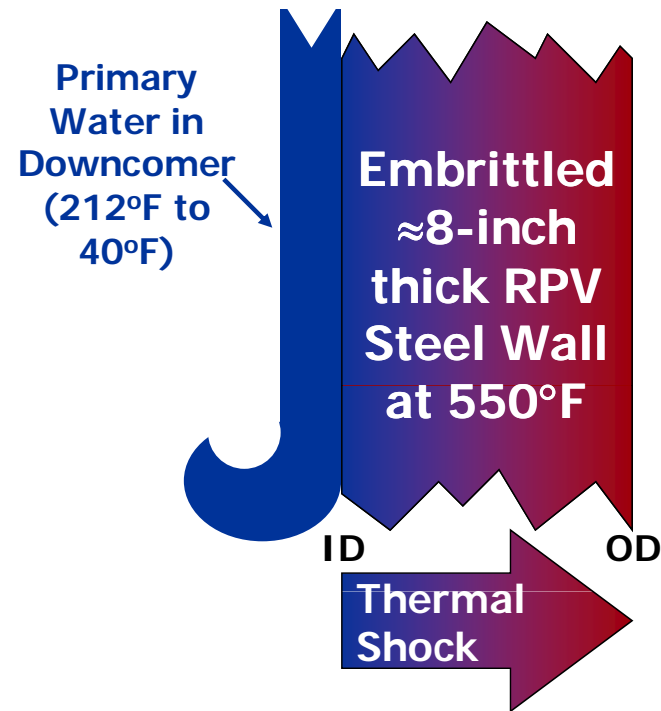
What is PTS?

Primary Side Break

- Inventory (water & steam) lost through the break is replaced by colder (40-70°F) water held in external tanks

Secondary Side Break

- Loss of pressurization in the secondary leaves water boiling (212°F) at atmospheric pressure
- Primary side inventory just across the heat exchanger also approaches 212°F
- Natural circulation in primary draws colder water into downcomer





Why we Developed an Alternative Rule

Technical motivations

- Existing rule (circa 1980s) excessively conservative in many areas
- Conservatism unduly limited operations

Practical motivations

- Conservatism produced more work for
 - NRC
 - Industrywith no resultant increase in safety



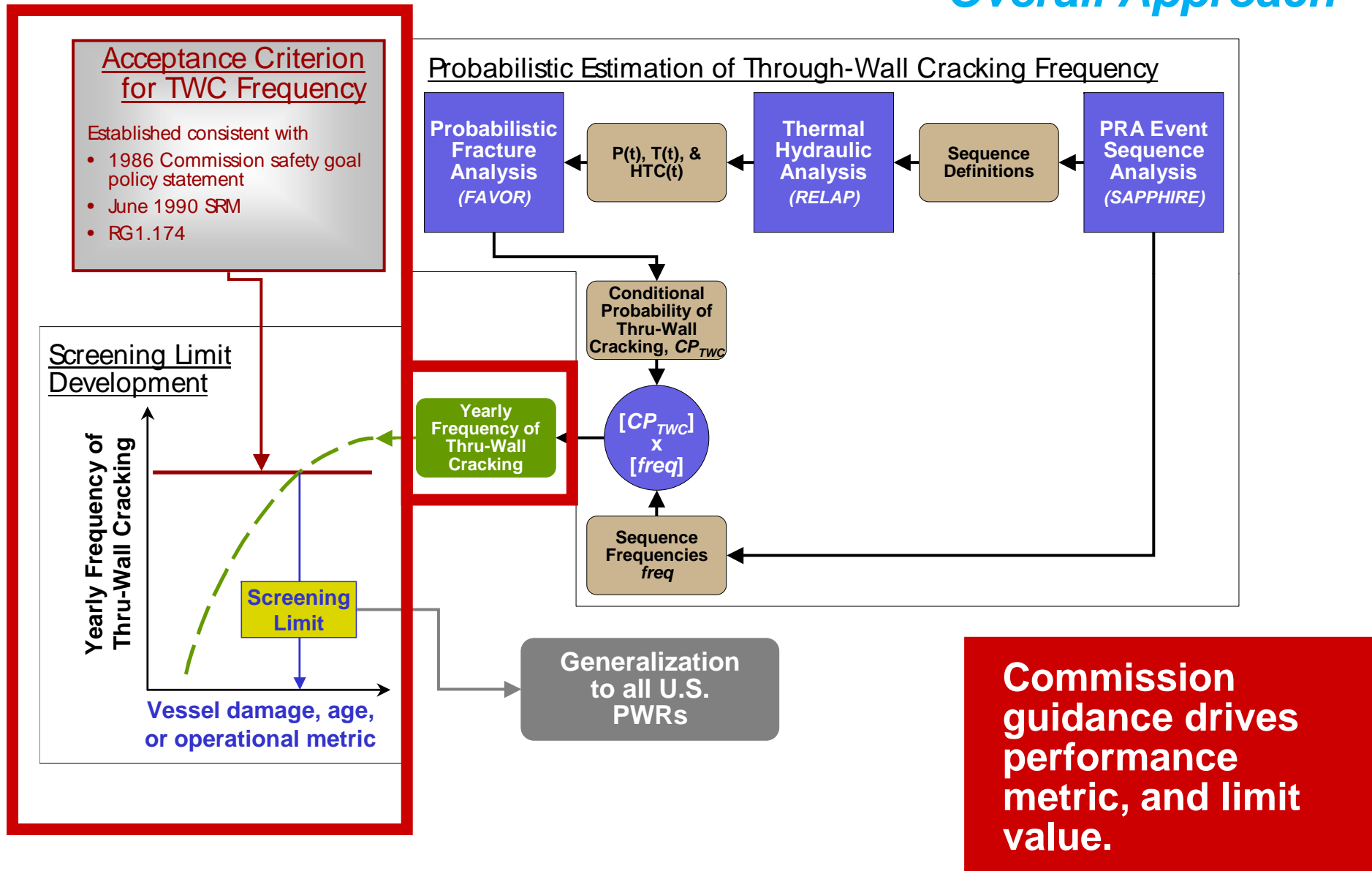
Tech Basis Work

Participants



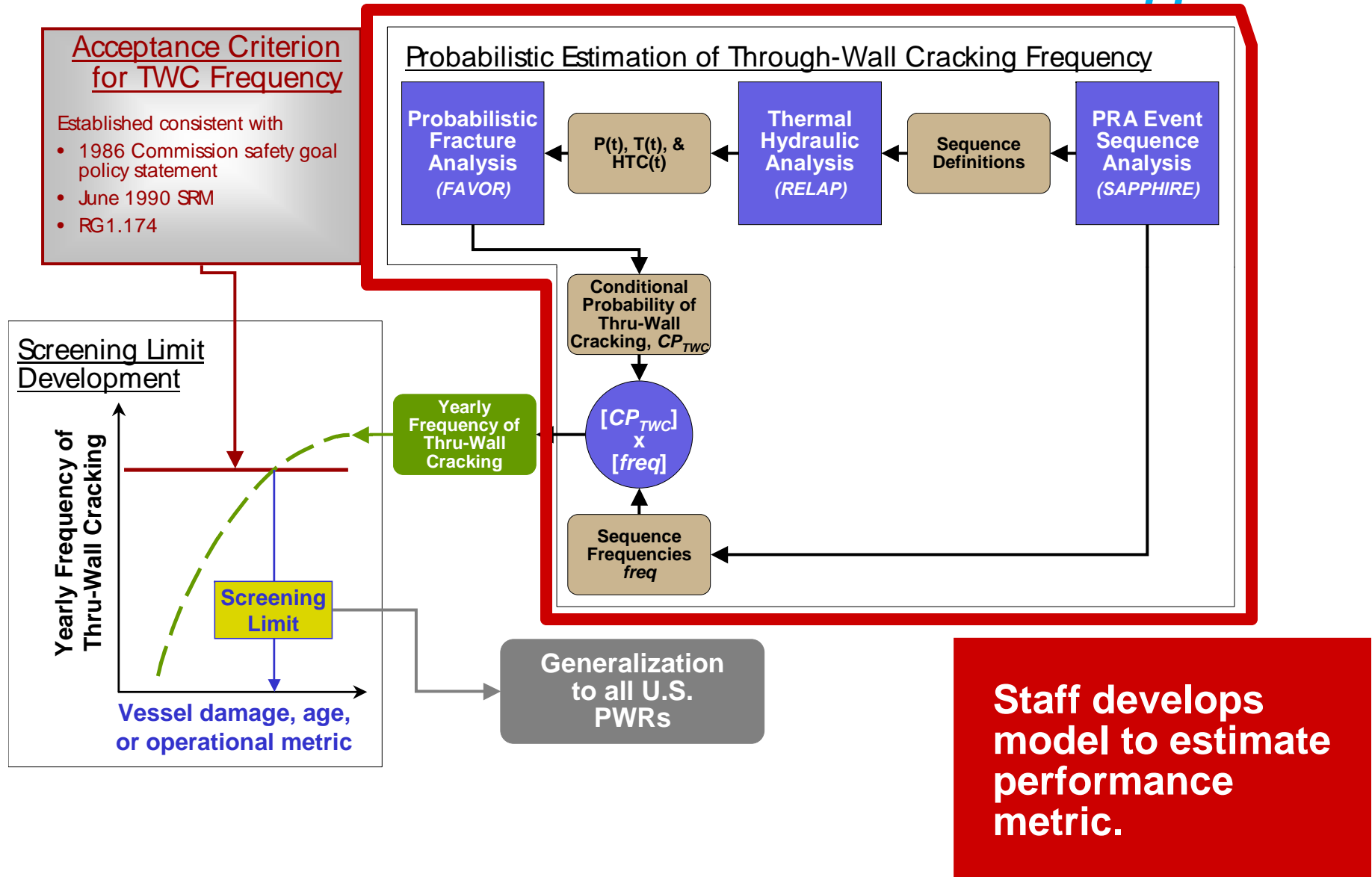
Tech Basis Work

Overall Approach



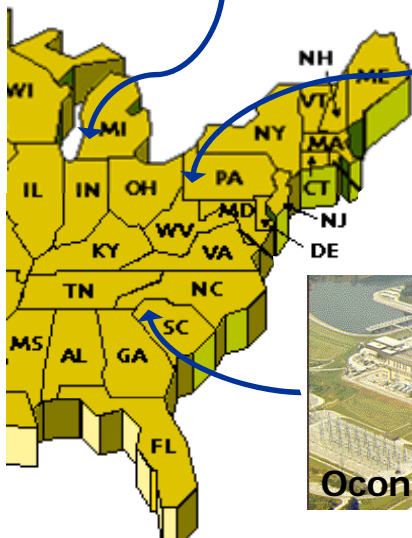
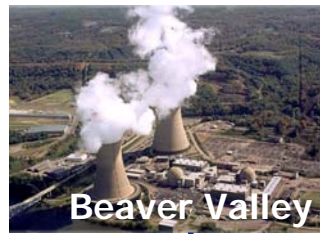
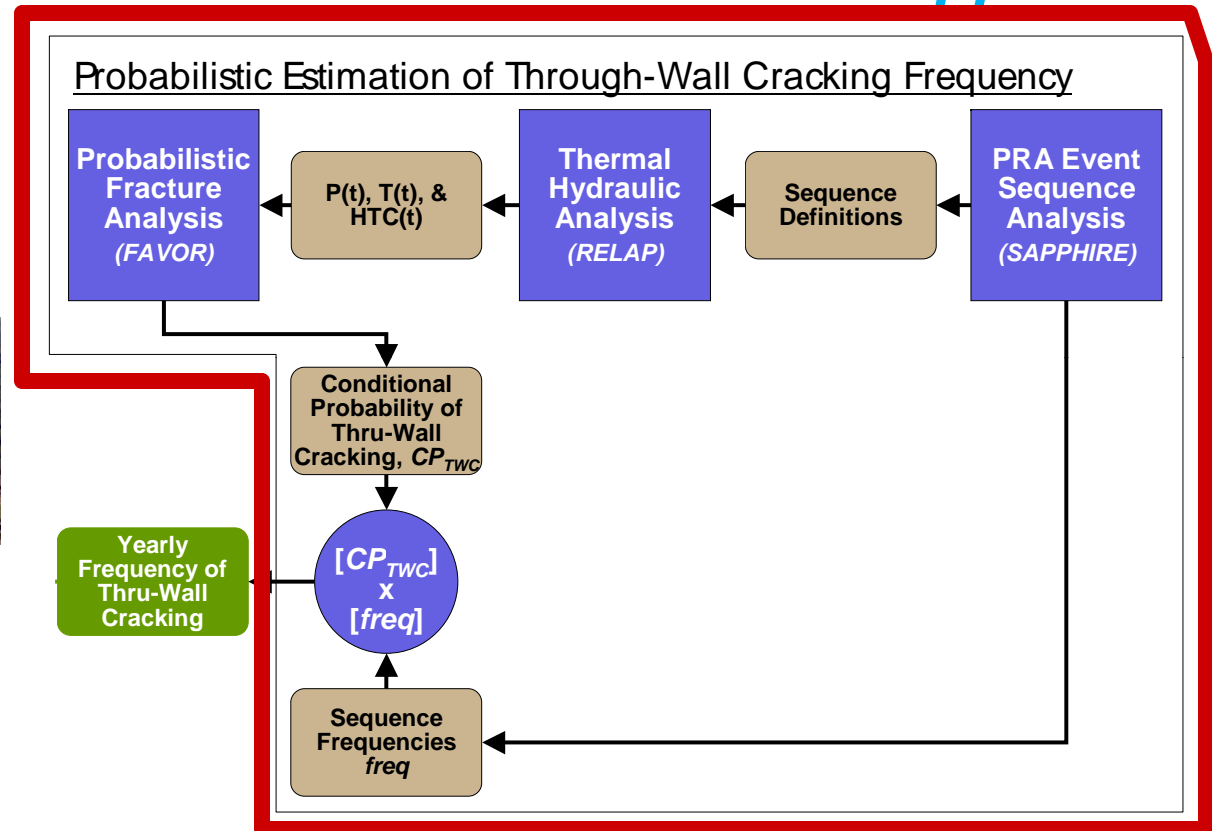
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Overall Approach



Tech Basis Work

Overall Approach



Metric estimated based on detailed analysis of 3 plants.

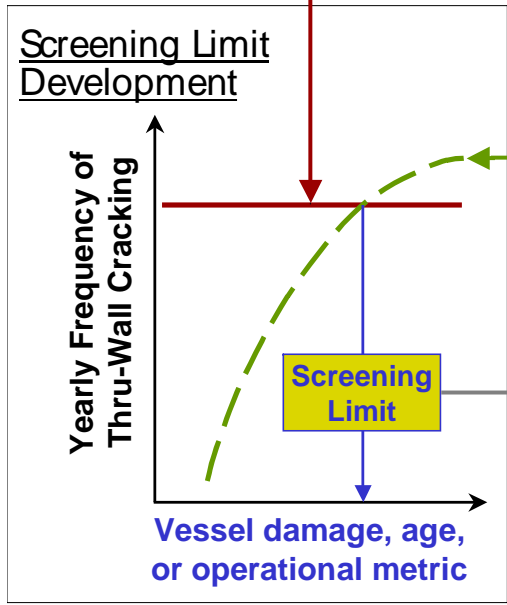
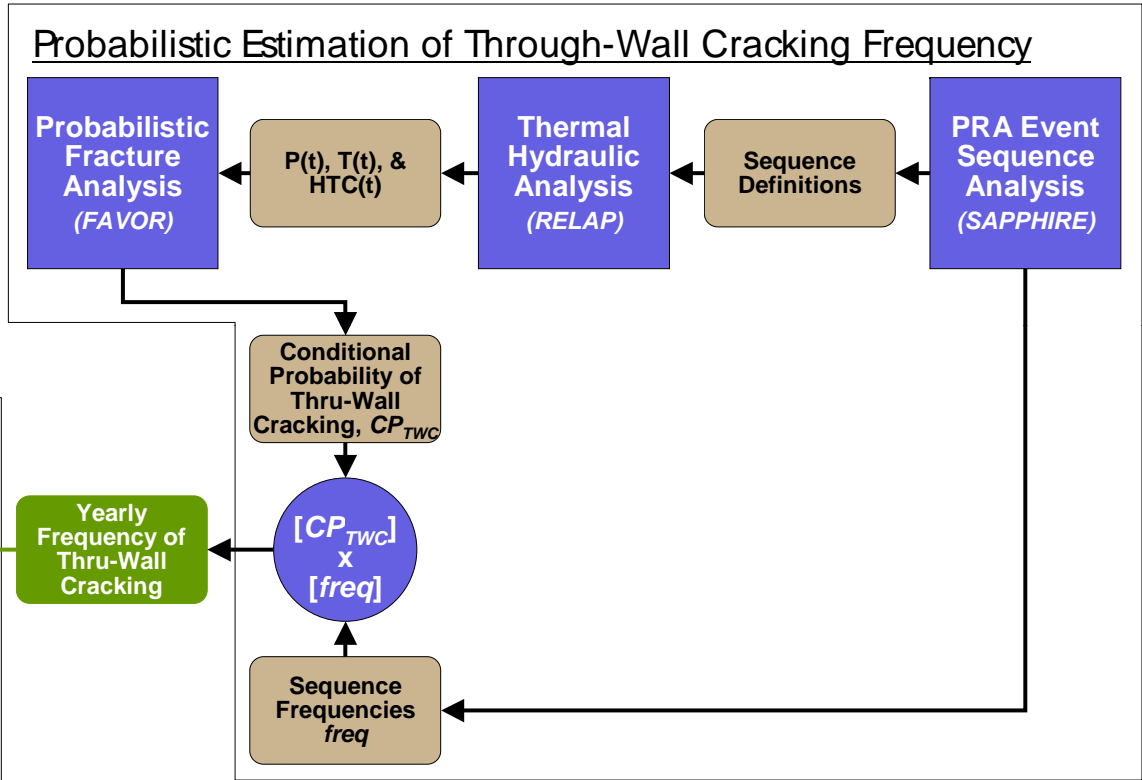
Tech Basis Work

Overall Approach

Acceptance Criterion for TWC Frequency

Established consistent with

- 1986 Commission safety goal policy statement
- June 1990 SRM
- RG1.174



Generalization to all U.S. PWRs

These results, + other insights, motivate generalization to all plants.



Outcome

Less restrictive reference temperature (embrittlement) limits enable longer operations, but gating criteria must be satisfied to use the new rule.

	10 CFR 50.61 <i>REQUIRED</i>	10 CFR 50.61^a <i>VOLUNTARY</i>
Reference Temperature Limits	More restrictive	Less restrictive
Plant-specific surveillance data check	Required – 1 test	Required – 3 tests
Plant specific inspection for flaws	Not required	Required



Lessons Learned

Project Timeframe

- Successful regulatory research program, however, development took a long time
- Review and approval procedures of large integrated analyses need to be created early
 - Decision processes and metrics
 - Review boards
 - Process to move forward absent consensus
- Risk metrics, while originating in policy guidance, do not come pre-defined
 - Define them up front

Lessons Learned

Data/Information Needs

- If one can measure it, measurement is likely to be done
 - Regardless of its risk-significance, and
 - Especially if measurement has been customary
- If we have data, it is likely to be used
 - Again, regardless of its risk-significance
- Lesson Learned
 - Focus on risk-significance (probabilistic assessment)



Lessons Learned

Data/Information Needs

- Less realistic models:
 - Make lesser challenges seem important
 - Tend to be “plant specific”
- Inclination is to adopt less realistic models
 - Simplification (especially if conservative)
- Penalty for adopting less-realistic models
 - Less generic regulations
 - Extensive validation requirements
- **Key point**: Mathematical abstractions drive real actions