Status of the FAVOR Code Development

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Advisory Committee on Reactor Safeguards
Pressurized Thermal Shock Screening Criterion Re-evaluation

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This Presentation Describes the Evolution of an Advanced Computational Tool for RPV Integrity Evaluations : FAVOR

1/ How FAVOR is Applied in PTS Re-evaluation

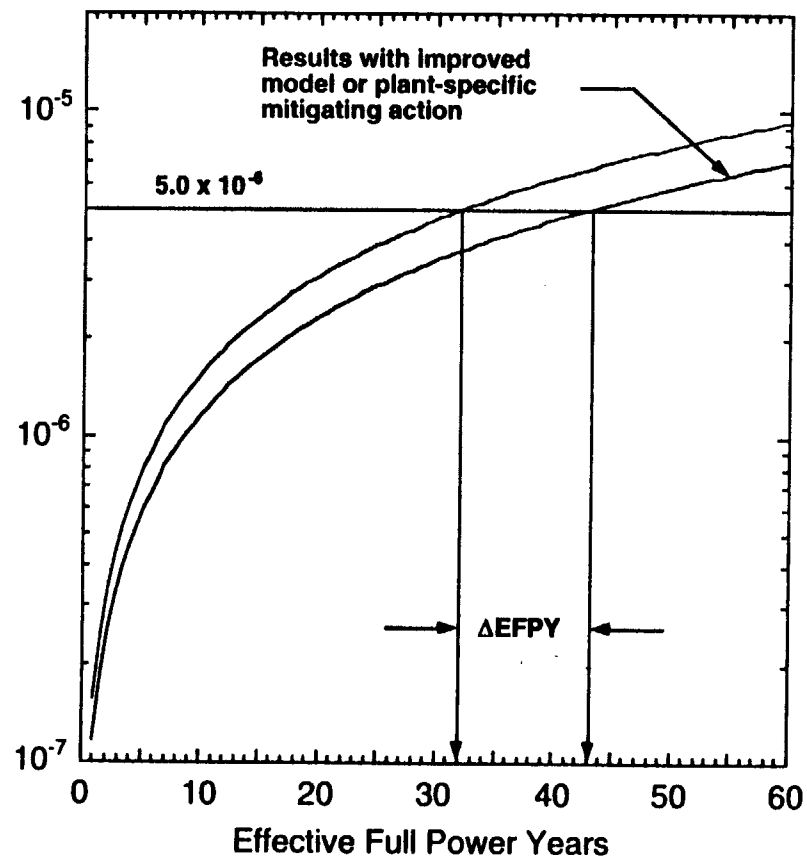
2/ Integration of Evolving Technology into FAVOR

3/ FAVOR Structure

4/ Overall PRA Methodology

5/ PFM Details

Application of FAVOR to PTS Re-evaluation Addresses the Following Two Questions



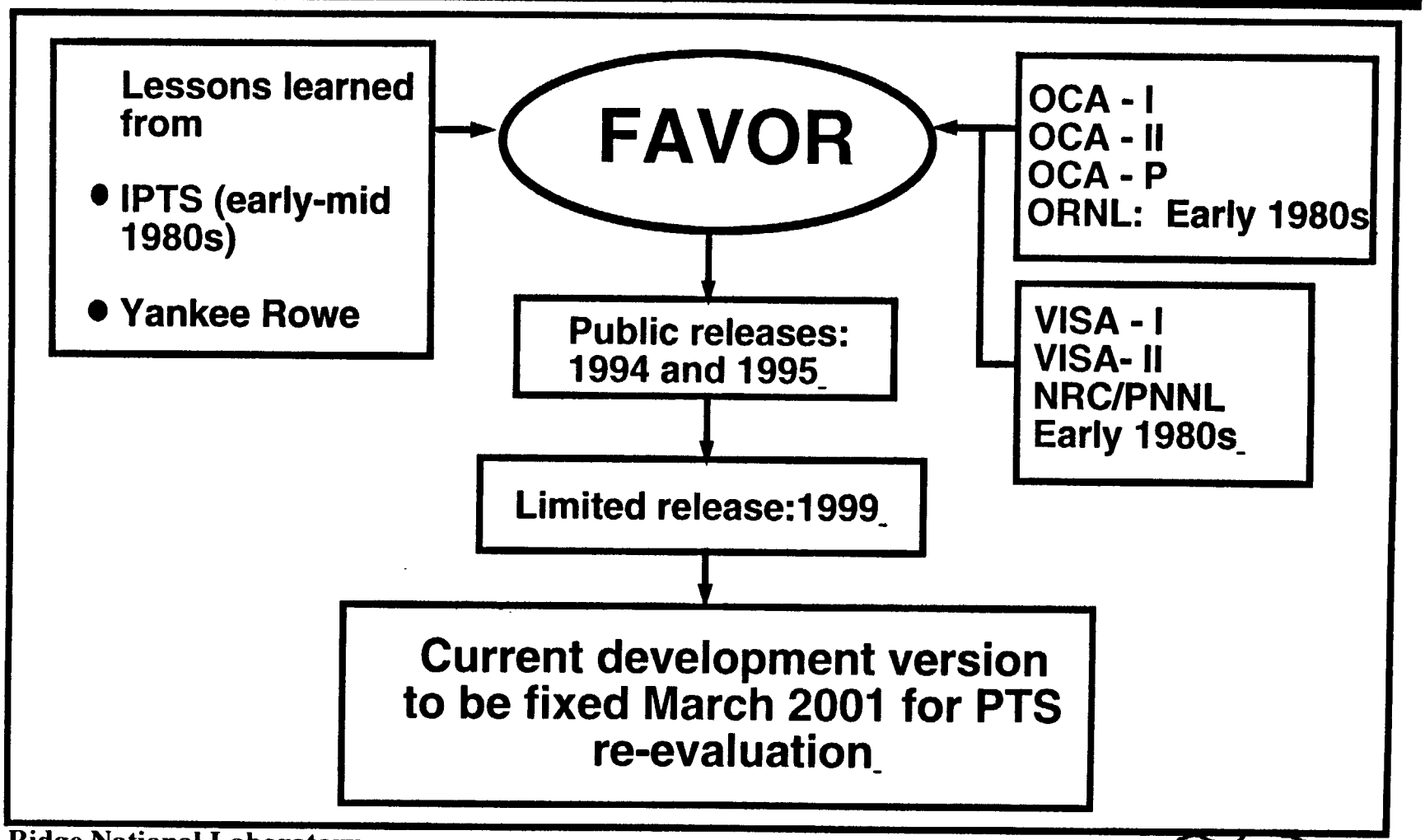
- At what time in operating life does frequency of RPV failure exceed acceptable value (currently 5 x 10e-06)?
- How does integration and application of advanced technology affect the calculated result?

Near-Term Schedule for Development of the FAVOR Code has been Defined

- Current schedule specifies FAVOR to be ready for PTS re-evaluation analyses on March 1, 2001

- In the interim period:
  - models are being finalized
  - finalized models are being implemented
  - scoping studies are being performed

Development of the FAVOR Code was Initiated in Early 1990s by Combining Best Attributes of OCA/VISA with Evolving Technology



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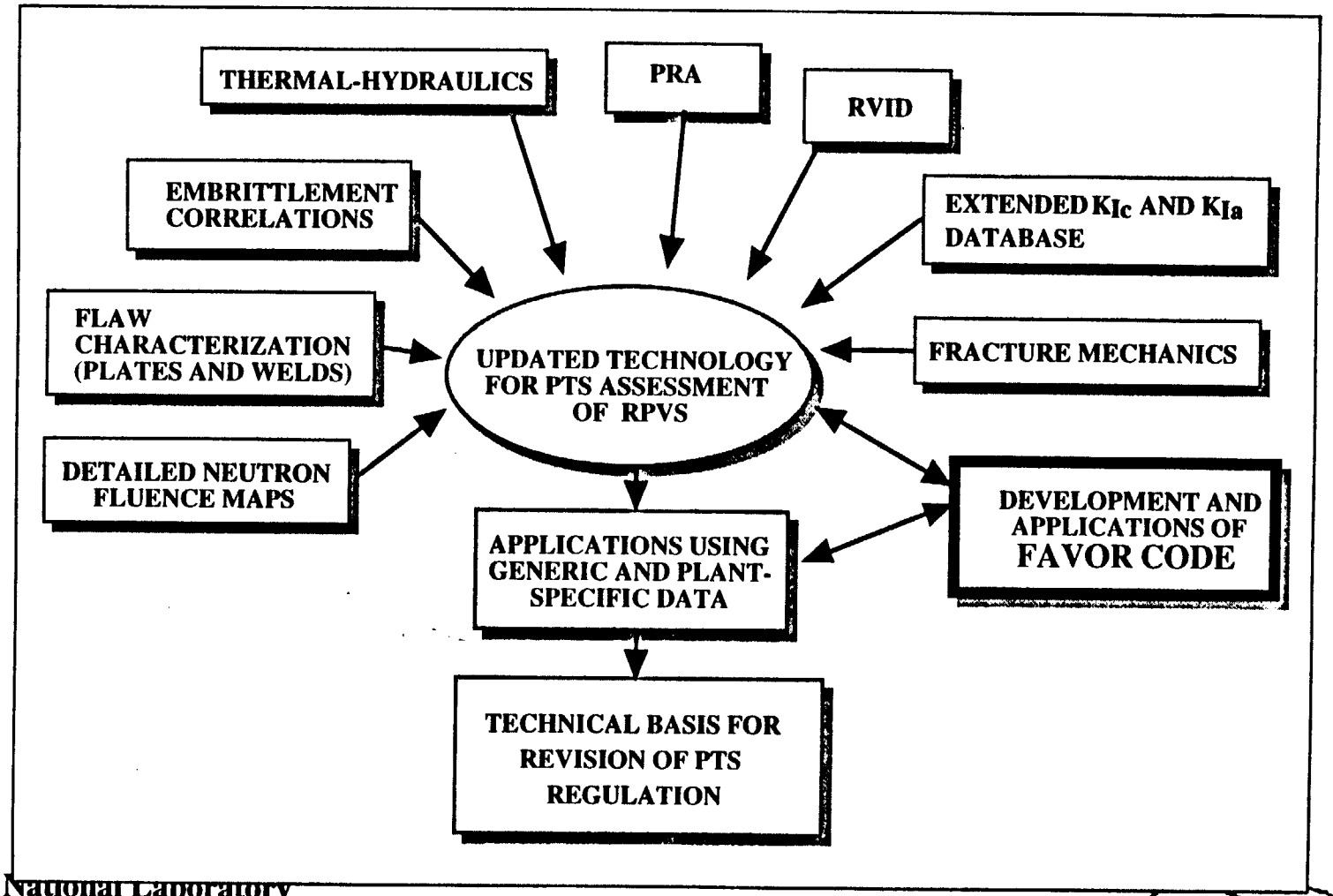
Elements of updated technology are currently being integrated into the FAVOR computer code to re-examine the current PTS regulations*

*(Fracture Analysis of Vessels: Oak Ridge)



Advanced Technology is Integrated into FAVOR to Support Possible Revision of PTS Regulation

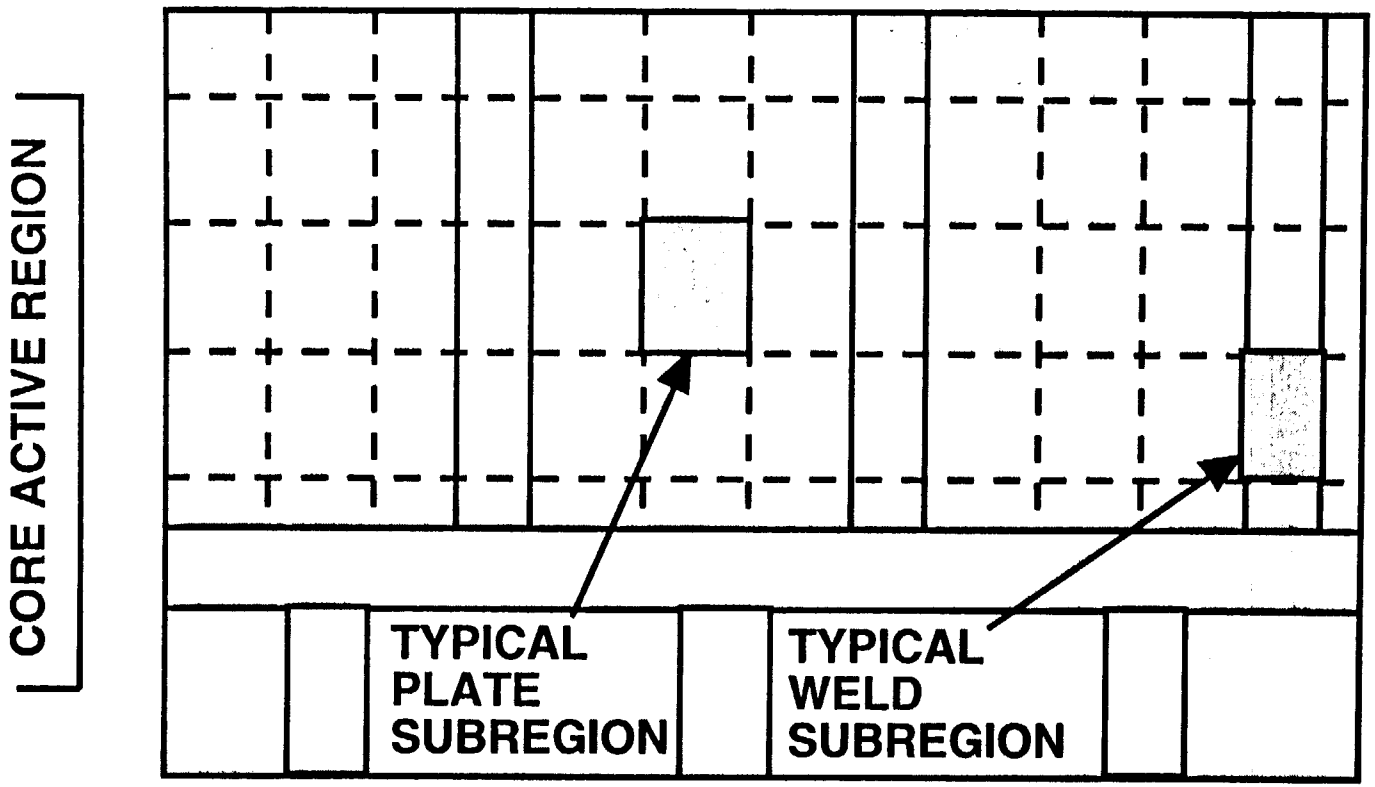
- Flaw characterizations from NRC research (plates and welds)
- Detailed fluence maps
- Embrittlement correlations
- RVID
- Fracture toughness models
- Surface-breaking and embedded flaws
- Inclusion of through-wall weld residual stresses
- New PFM methodology

A Significant Improvement Since the Derivation of Current PTS Regulations is Flaw Characterization*

** analyses assumed all flaws were inner-surface breaking flaws*

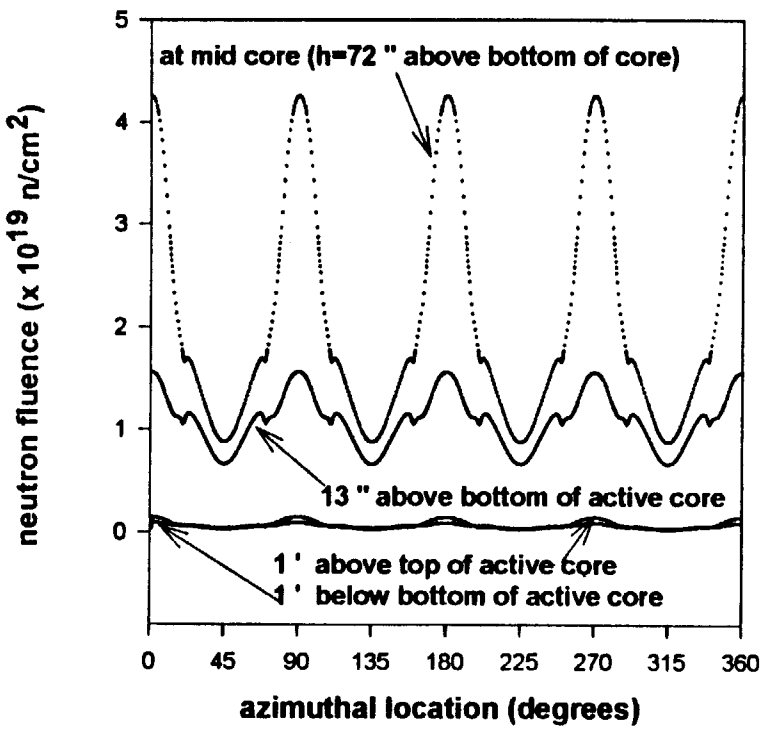
- Recent NDE and DE of RPV material at PNNL has established an improved technical basis for flaw-related data used as input for PFM analyses
- A significantly higher number of flaws were found than was postulated in PFM analyses from which current PTS regulations were derived; however, all flaws detected thus far are embedded
- Application of PVRUF flaw densities to commercial PWR results in over 3500 flaws in 1st 3/8 thickness of RPV wall

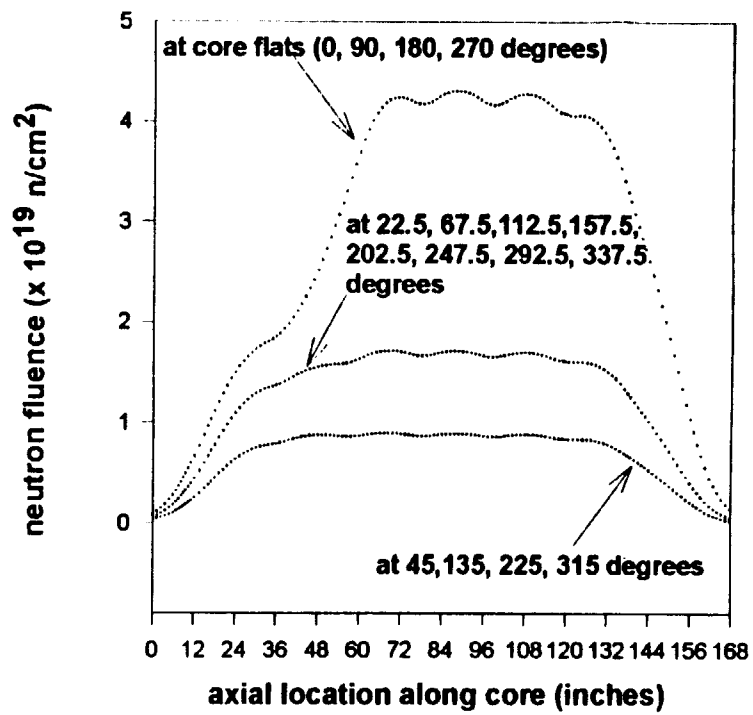
FAVOR utilizes a methodology that allows the RPV beltline to be discretized into sub-regions, each with its own distinguishing embrittlement-related parameters. This accommodates chemistries from the RVID and detailed neutron fluence maps



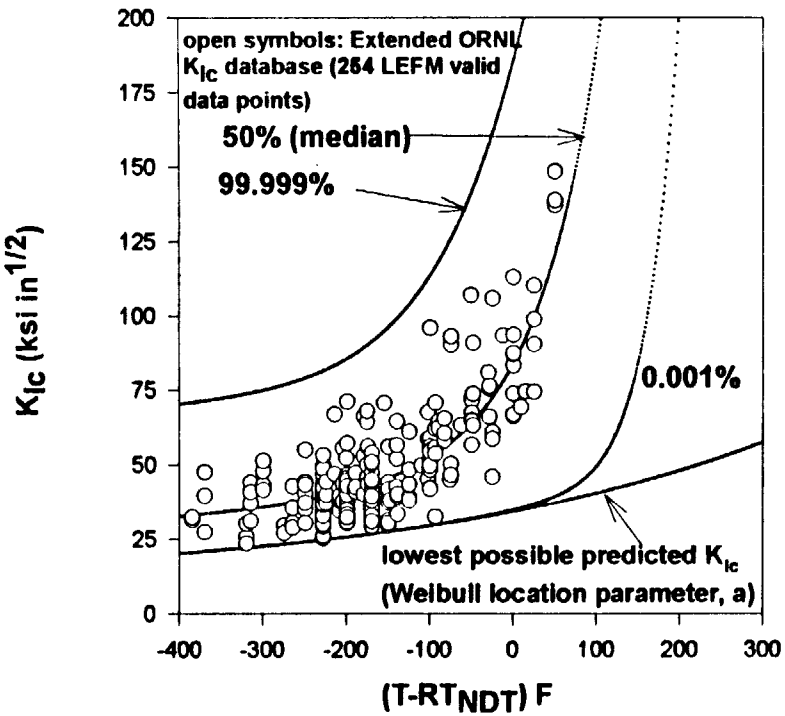
TYPICAL VESSEL BELTLINE LAYOUT

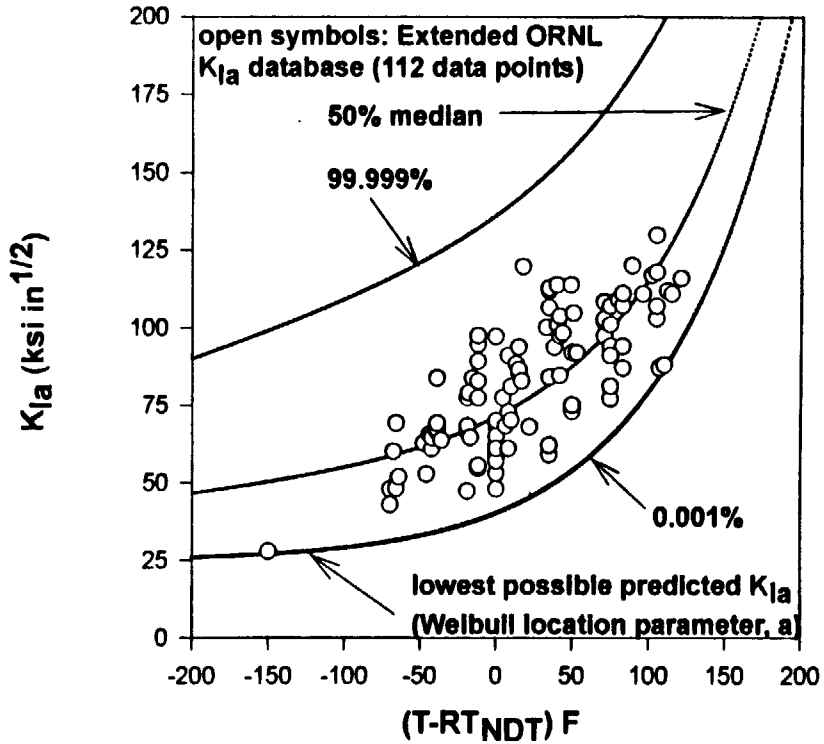
Brookhaven National Laboratory is generating very detailed neutron fluence maps for selected PWRs corresponding to 32 EFPY and 40 EFPY



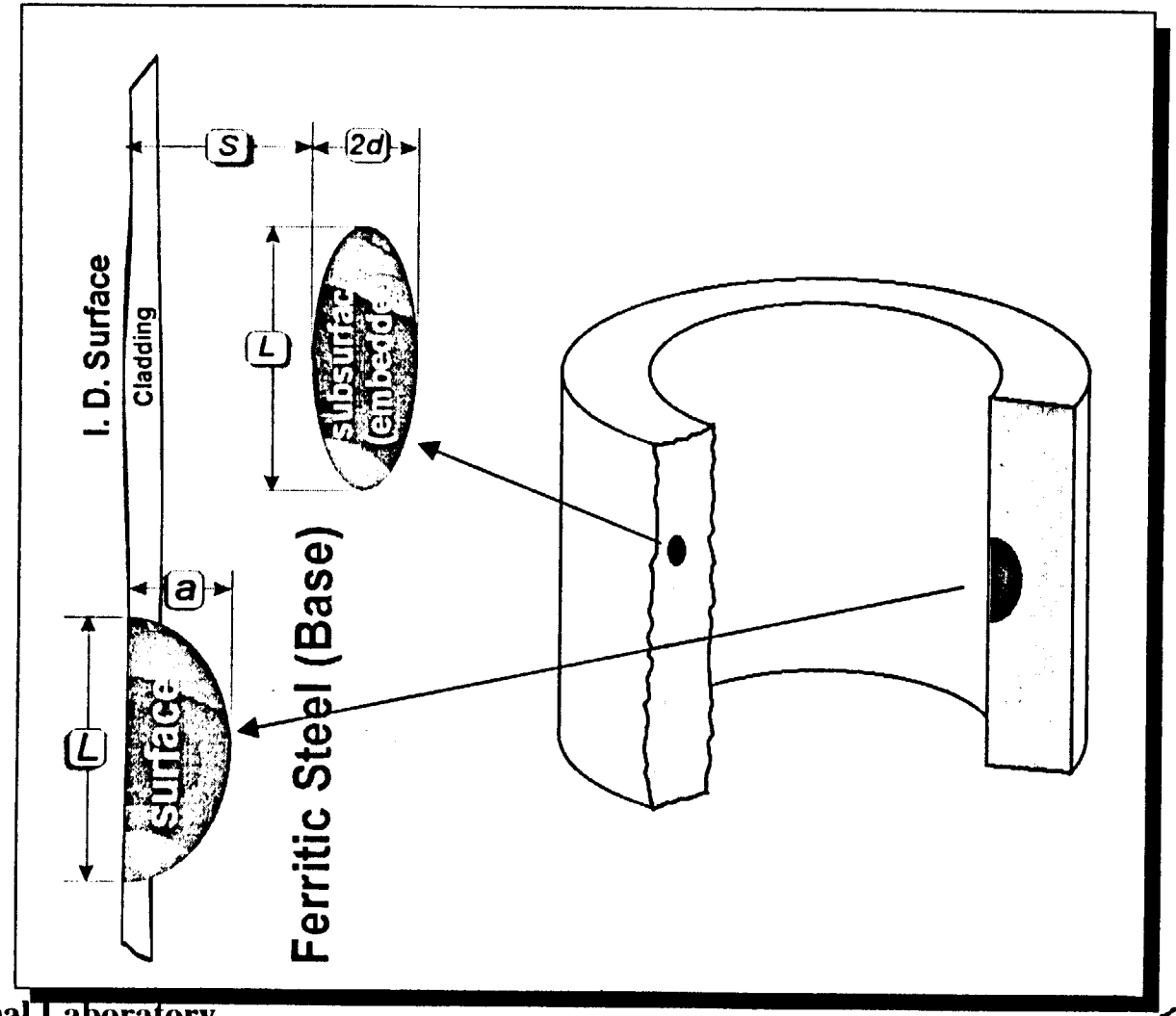


New Statistical Models for Enhanced Plane-Strain Static Initiation (K_{Ic}) and Arrest (K_{Ia}) Fracture Toughness Data Bases were Implemented into FAVOR





The FAVOR PFM Model Now Includes Inner Surface-Breaking and/or Embedded Flaws



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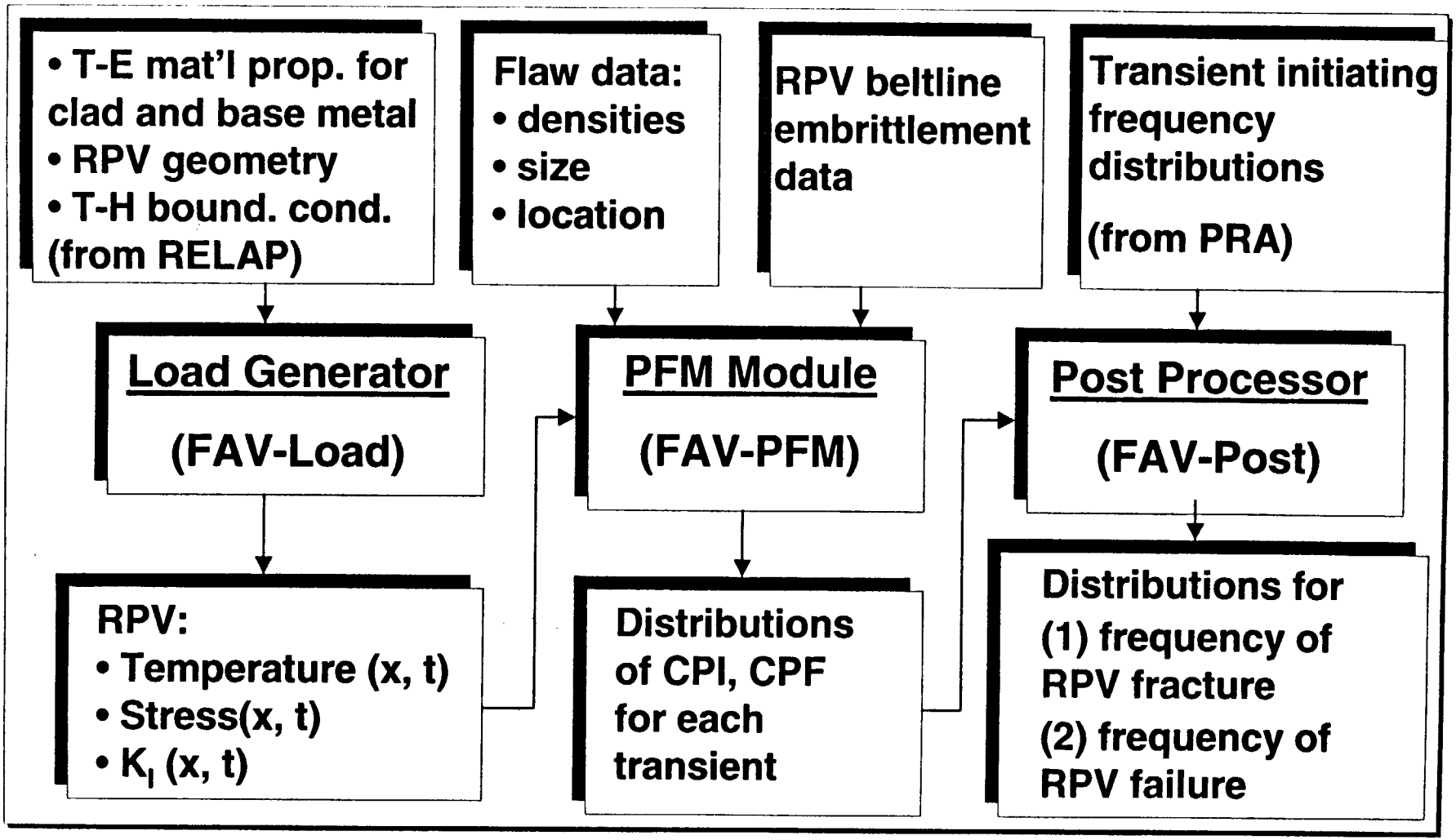
The Current FAVOR Code Consists of Three Separate Modules



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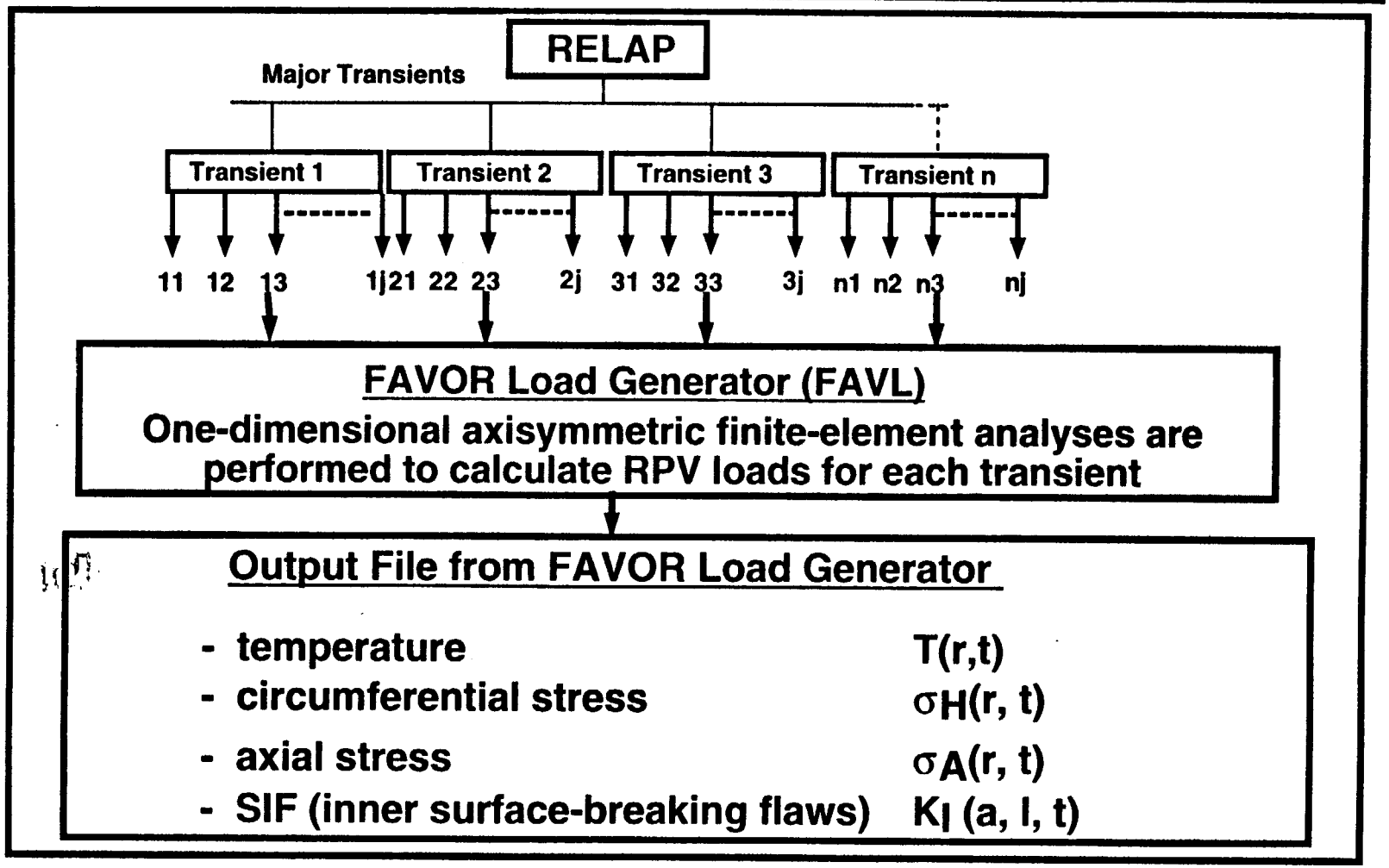
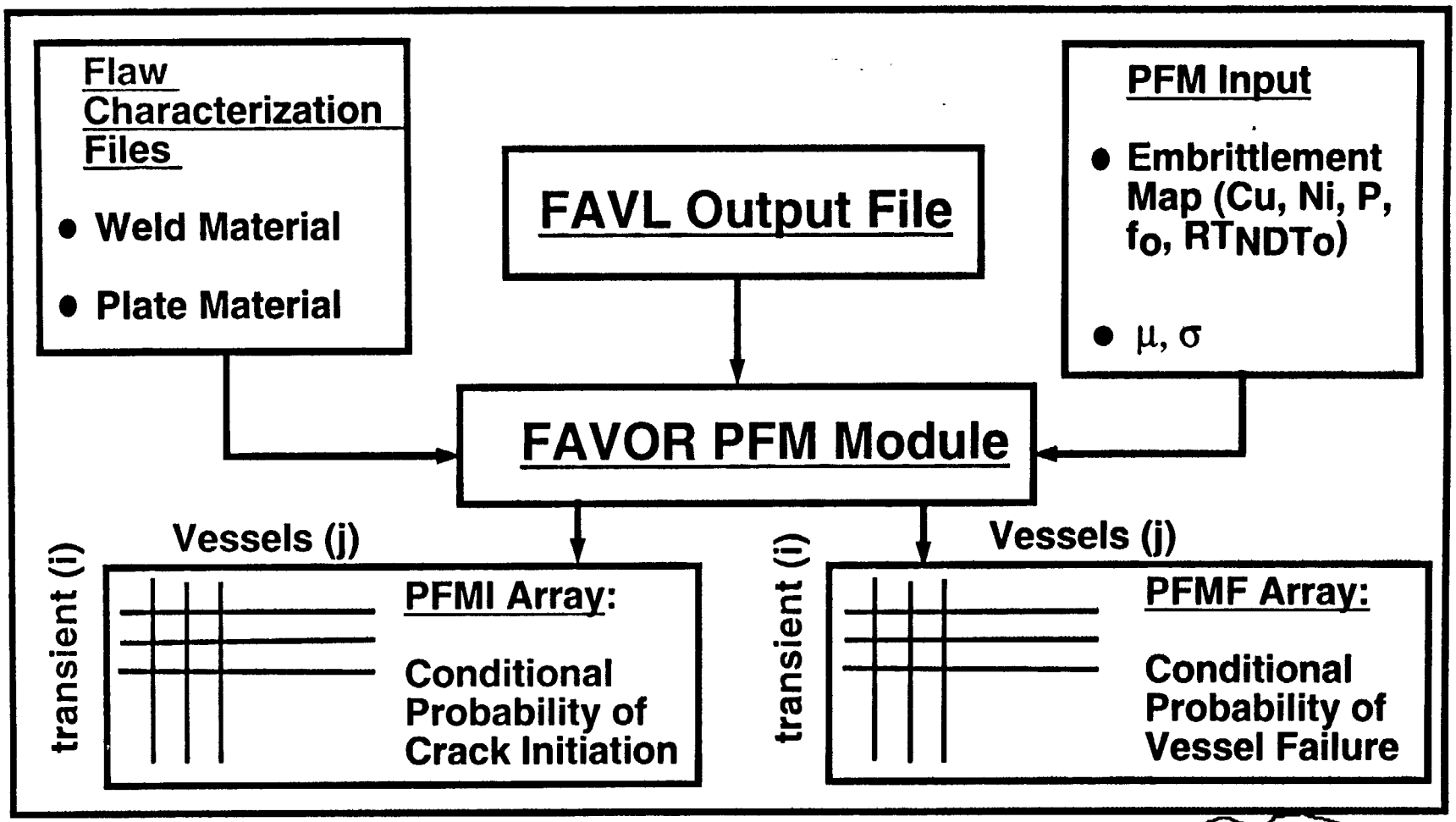
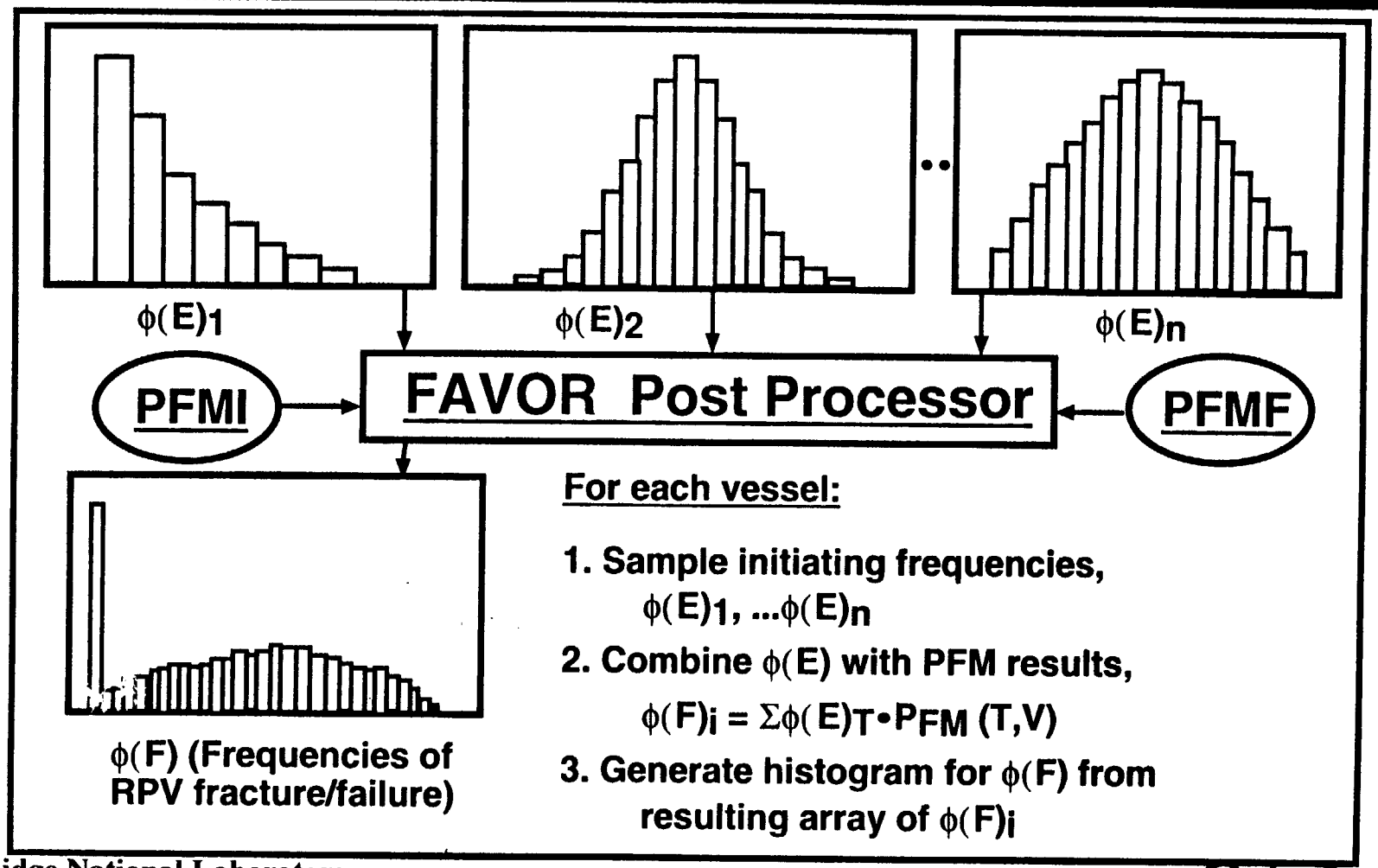
FAVOR Analyses Incorporate Uncertainty Associated with Thermal Hydraulics by Including Variants for Each of the Transients



The FAVOR PFM Analysis Module Generates Arrays Containing Conditional Probabilities of Initiation (PFMI) and Failure (PFMF) for Vessel(j) Subjected to Transient(i)



The FAVOR Postprocessor Module Integrates the Uncertainties of the Transient Initiating Frequencies with the PFMI and PFMF Arrays to Generate Distributions for the Frequencies of RPV Fracture and RPV Failure



For each vessel:

1. Sample initiating frequencies, $\phi(E)_1, \ldots \phi(E)_n$
2. Combine $\phi(E)$ with PFM results, $\phi(F)_i = \Sigma\phi(E)_T \bullet P_{FM}(T,V)$
3. Generate histogram for $\phi(F)$ from resulting array of $\phi(F)_i$

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