

NRR Perspectives on Probabilistic Fracture Mechanics Calculations

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NRC Use of PFM Calculations

The NRC has been using probabilistic risk assessments to guide regulatory decision making in several areas for decades

The NRC has used the probabilistic fracture mechanics (PFM) code FAVOR to develop the alternate Pressurized Thermal Shock Rule (10CFR50.61a)

The NRC is cooperatively developing the “Extremely Low Probability of Rupture” (xLPR) Probabilistic fracture mechanics code to evaluate the leak before break methodology in systems with active Primary Water Stress Corrosion Cracking

The NRC is open to evaluating and using new PFM codes in the future to assist in regulatory decision making, and recognizes the powerful insights provided by PFM

Benefits of PFM Calculations

PFM Calculations can provide an overview of the probabilities of crack depths, leaks, or failure

One can decide on a probability of an event as opposed to the binary criteria of a deterministic calculation

PFM and Deterministic Calculations can be effective independently or may be complementary

Deterministic

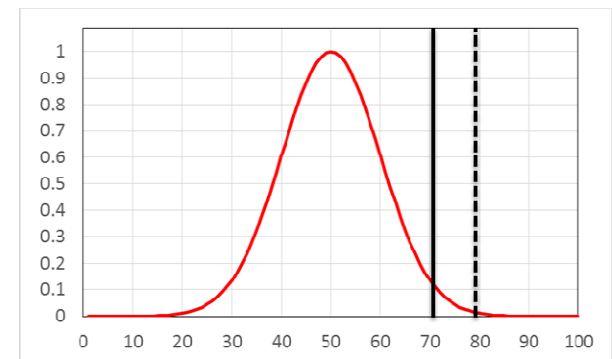


or



vs.

PFM



Confirmatory Calculations

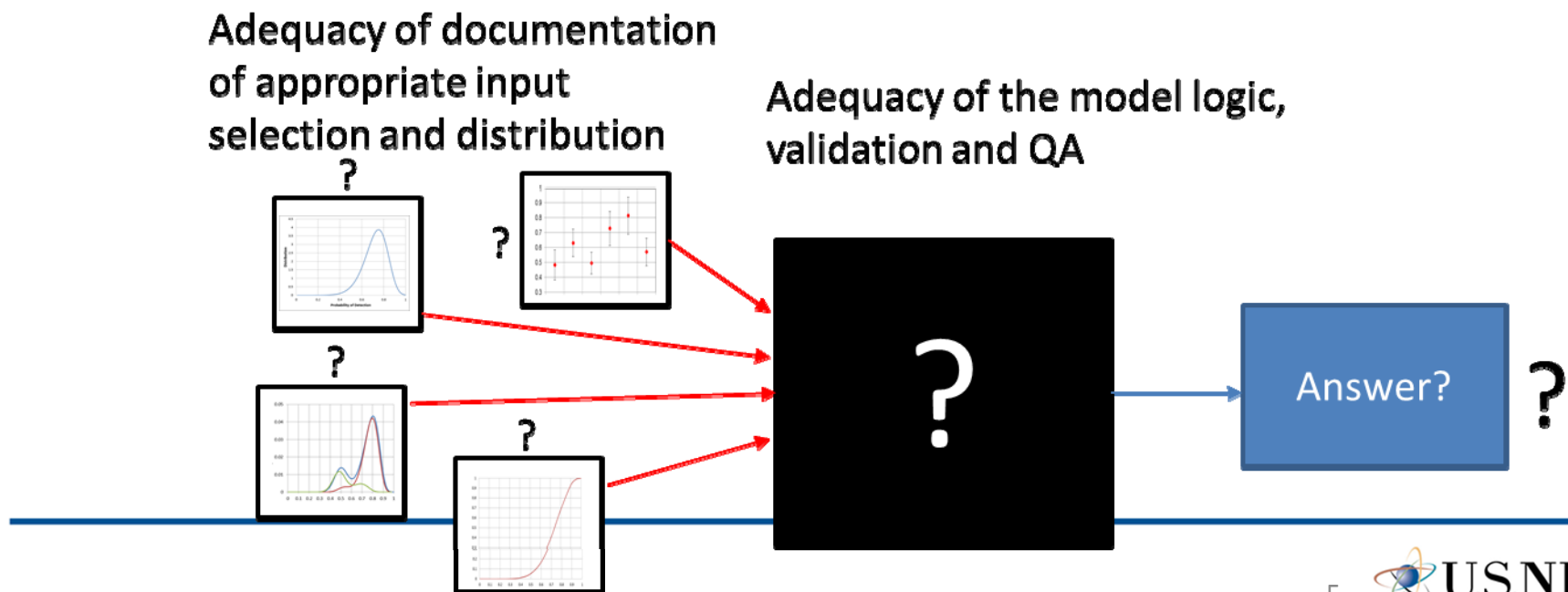
When the NRC staff performs a technical review, we check the important calculations performed in the submittal

The NRC has experts in a variety of fields, including PFM, to allow for this type of confirmatory work

PFM calculations present unique difficulties for performing confirmatory calculations

Novel PFM Codes

Without access to the code or independent review of the code it can be very challenging to determine if the PFM calculations are adequate



NRC Review of a PFM

Possible methods for verifying the code

- Having the code directly evaluated by NRC staff (Topical Report)
- Benchmarking the code against a code we have in-house (xLPR, FAVOR)
- Benchmarking the code against deterministic calculations
- Independent peer review by a body with no conflict of interest

Issues With Previous PFM Codes

Unusual assumptions (e.g. extremely low possibility of a circumferential flaw in a piping weld)

PFM did not account for degradation mechanisms seen in operational experience

Correction factors with little to no technical justification

Path Forward

The NRC is developing guidance on the use of PFM calculations in regulatory submittals

This guidance will help to make submittals using PFM calculations more robust, will allow for more timely and predictable reviews, and make acceptance of PFM submittals easier