

# Seismic Analysis of Facilities and Evaluation of Risk

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# Purpose

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- To discuss LANLs implementation of SAFER and lessons learned
- Background
- Results
- Lessons learned

# SAFER Project

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- ***Project Mission***

- *Conduct quantitative evaluation of seismic risk due to operations of Nuclear and High Hazard (DSA) Facilities at LANL operating under a Documented Safety Analysis/Safety Evaluation Report*
- *and Non-nuclear (BOP) Facilities operating under E.O. 12941.*

# Composition

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- **SAFER comprised of two major efforts:**
  - Non-nuclear Facilities termed “Balance of Plant” (BOP) Facilities consisting of 29 facilities including NSSB
  - Nuclear and High Hazard Facilities collectively termed “Documented Safety Analysis (DSA) Facilities” will analyze PF-4, Interim Radiography, RANT, RLWT, WCRR and WETF

# DSA Scope

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- For each facility operating under a DSA/SER (PF-4, Interim Radiography, RANT, WCRR, RLWT & WETF)
  - Identify safety function credited in DSA/SER for each SSC that performs a seismic safety function
  - Analyze the ability of that SSC to perform the safety function at the higher seismic load
    - Code type evaluations under new hazard
    - Successively remove conservatism to approximate collapse (e.g.)
    - Calculate actual performance achieved vs. performance desired
  - Facility Engineering Manager prepares Justification for Continued Operations (JCO) if needed

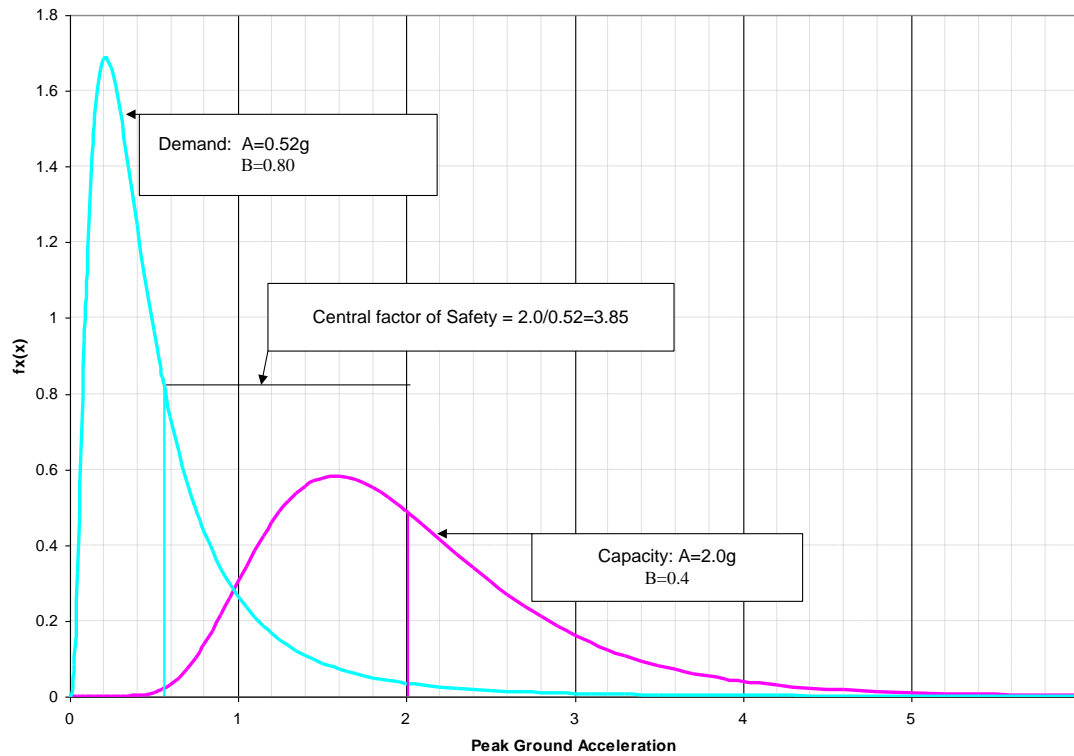
# General Approach

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- Use of code type evaluations specified in DOE-STD-1020-220 ( $F_{\mu}=1.0$ )
- Eliminate conservatism where required ( $F_{\mu}\geq 1.0$ , probabilistic approaches, nonlinear analysis tied to limit state defined in DSA)
- Walk downs of facilities to assess as-is condition.
- Condition assessment of existing facility should be undertaken if evidence of corrosion is significant

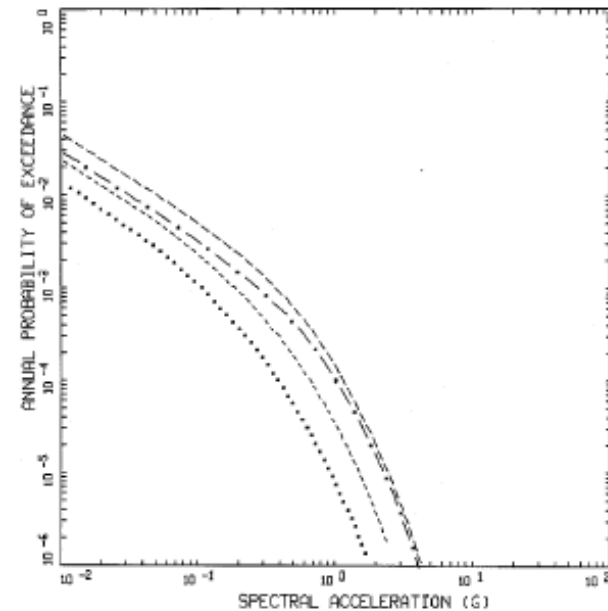
# DSA Scope

PMF Comparison



# Impact of PSHA Review

- SAFER involves conservative screens to show performance achieved
- Some SSCs will have failure rates calculated
  - Need to preserve fragility parameters ( $A_{med}, \beta_c$ )
  - Will recalculate failure for new hazard
  - Assumes similar spectral shape



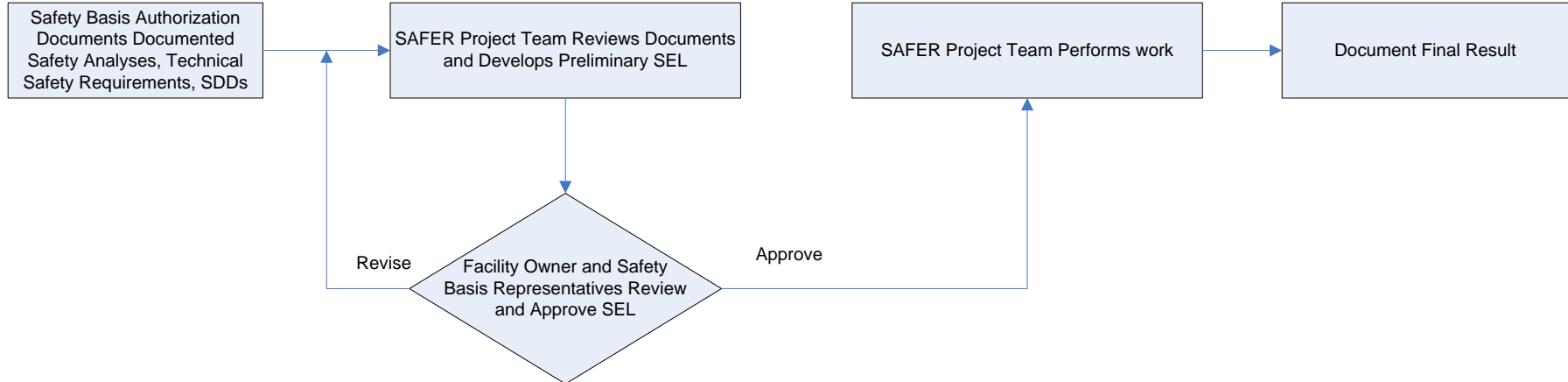
$$P_F = - \int_0^{\infty} \left[ \frac{dH(a)}{da} \right] P_{F|a} da$$



# SAFER Scope (PF-4)

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- Identify SSCs credited with performing a seismic related safety function



# SAFER Systems and Component Methodology

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- Develop Seismic Equipment List (SEL)
- Perform seismic screening
  - Perform DOE/EH-0545 seismic walkdowns
  - Perform structural and anchorage seismic analysis to DOE/EH-0545 criteria for 1.2g PSA seismic demand
  - Identify outlier components (not meeting DOE/EH-0545 criteria at 1.2g PSA)
- Calculate seismic fragilities for outlier components
- Calculate seismic failure probability using new seismic hazard curves

# Seismic Equipment List

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- Use plant documentation to identify and list individual components identified as safety class in DSA
- Identify safety function, functional requirements and seismic performance criteria for each component

# Lessons Learned

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- SEL
- Early involvement of cognizant systems engineers
- Need for close working agreement with seismic capability engineers and safety basis technical analysts
- Get management involved early