

**Probabilistic Seismic Hazard  
Assessment (PSHA) at Yucca  
Mountain**

**Nuclear Waste Technical Review Board  
Structural Geology and Geoengineering Panel  
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**Tim Sullivan  
U.S. Department of Energy**

# Overview

- **How will when “enough is enough” be determined?**
- **Integration between volcanism and tectonics**
- **How is PSHA in priority setting? What are critical elements?**
- **What is role of “expert judgment”?**
- **What is role of “deterministic” hazard assessment?**
- **How will PSHA be used in programmatic and statutory decisions?**

## **Preclosure Tectonics**

**Site Characterization Plan -- *characterize tectonic events and processes that could impact design of facilities important to safety (FITS) through the operational phase (until permanent closure is obtained) and during the retrieval period.***

**Result will be to provide repository seismic design bases.**

**To do this, DOE intends to incorporate frequency or rate of occurrence in developing the design bases through a PSHA.**

# **Probabilistic Seismic Hazard Analysis**

**Seismic sources in the Yucca Mountain area have different frequencies of occurrence, PSHA allows combination of all sources in a single hazard curve or family of curves.**

**Develop hazard curves for ground motion.**

**Develop hazard curves for potential fault displacement.**

# **ESF and Repository Design**

**ESF: Current design basis assumes conservative values**

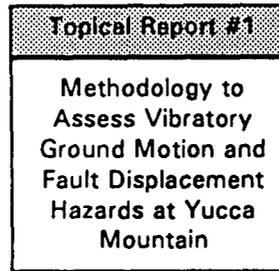
- **ESF seismic design basis to be updated by 6/94 (Technical Assessment Review)**

**Repository: Current design basis is 0.4g**

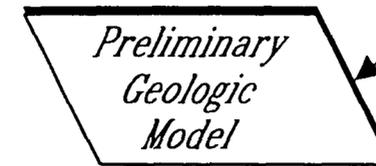
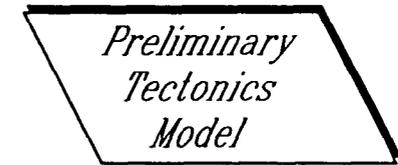
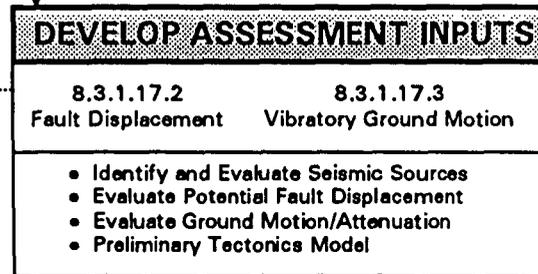
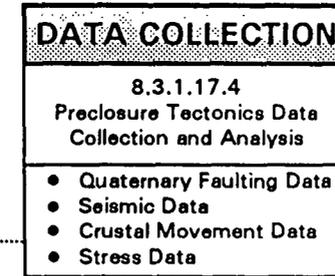
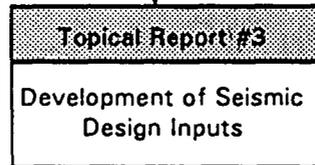
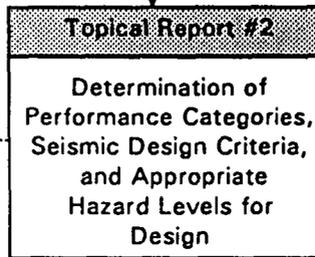
- **Repository seismic design basis to be updated in FY96, based on the preliminary PSHA, which is a major milestone in the Preclosure Tectonics Program.**

# Schematic Integration Diagram for Pre-closure Tectonics Program

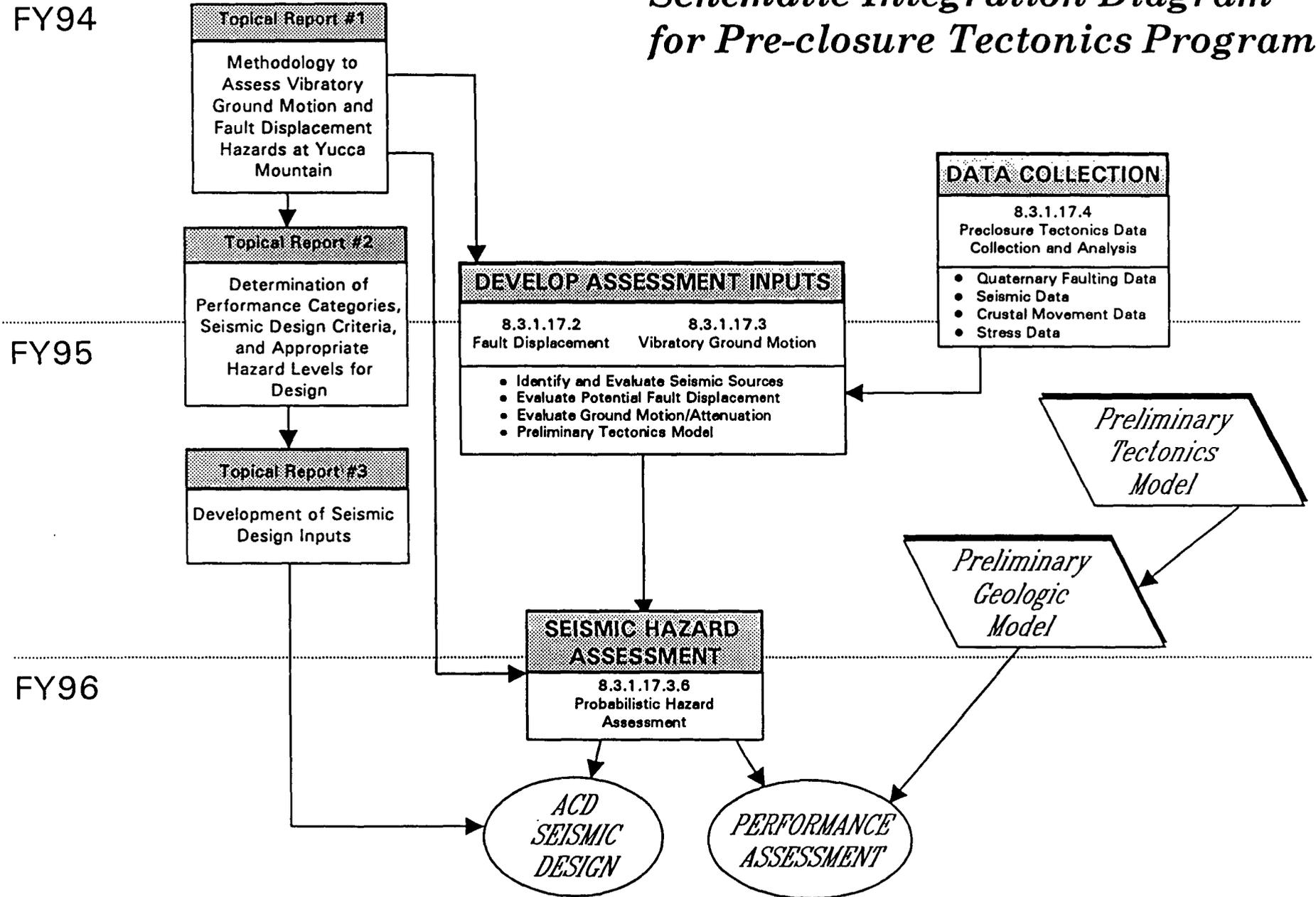
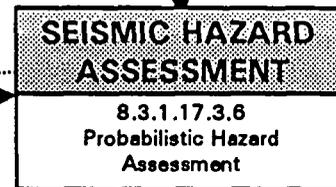
FY94



FY95



FY96



# **Tectonics And Site Suitability**

**Early Evaluation of Site Suitability (Jan. 1992) -- first of a series of evaluations by outside experts.**

## **Results:**

- **Disqualifying condition not present--HLF (conclusion will not change).**
- **Qualifying condition likely to be met--LLF**
- **Tectonic hazards can be accommodated by reasonably available technology.**

**These conclusions strengthened by DOE decision that baseline Waste Package/EBS will be based on in-drift emplacement.**

# **Design Criteria**

**Appropriate exceedence levels for design features will be established in DOE Topical Report #2**

## **Basis will be:**

- **DOE guidelines for nuclear facilities**
- **ASCE guidelines**
- **Nuclear Power Plant experience**

**Design bases will be established using hazard curves and exceedence levels.**

## **Most Critical Activities**

- **Assess Background EQ Source**
- **Complete Paleoseismology Studies - constrain rates of occurrence, uncertainties**
- **Subsurface Information - down dip geometry of site faults**

## **Use of “Expert Judgment”**

- **DOE experts who have collected the data will analyze, interpret, evaluate uncertainty, and determine if data set is adequate.**
- **Independent technical review.**
- **Peer review will likely be the mechanism for ensuring diversity of interpretation or completeness**

# **Role of Deterministic Hazard Assessment**

**None identified in DOE Topical Report #1**

**PSHA is consistent with performance assessment and design needs**

**DOE recognizes that past reactor licensing practice has been to use deterministic hazard assessment, but this was 20 years ago**

**PSHA has evolved to “state of the practice”--for design evaluation (preclosure) there is recent precedent as Kevin will discuss**

## **Performance Assessment (PA) Modeling**

- **Total System Performance Assessments 1991 (TSPA I) and 1993 (TSPA II) considered tectonic effects in relatively little detail**
- **Total Performance Assessment 1995 (TSPA III) will consider tectonic effects in greater detail**
- **Tectonics program will support TSPA by providing:**
  - **Tectonics model(s)**
  - **Probabilities of occurrence for initiating events (e.g., fault displacement)**
  - **Models of Postclosure tectonic effects on**
    - » **waste package**
    - » **water table elevation**
    - » **fracture permeability and effective porosity**
    - » **rock geochemical processes**

# **Licensing Strategy --Establish Reasonable Assurance**

**Develop adequate database and sound  
methodology (PSHA)**

**Document methodology and submit to NRC**

**Assess consequences of EQ hazards -- no  
special design measures seem warranted**

- **Surface - results of Midway Valley studies**
- **Underground - in-drift emplacement is now baseline**