

**U.S. DEPARTMENT OF ENERGY  
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

**NUCLEAR WASTE TECHNICAL REVIEW BOARD  
FULL BOARD MEETING**

**SUBJECT: DISCUSSION OF DISQUALIFYING  
CONDITION OF 10 CFR 960  
TECHNICAL GUIDELINE FOR  
POSTCLOSURE TECTONICS**

**PRESENTER: DR. WILLIAM W. DUDLEY JR.**

**PRESENTER'S TITLE  
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**PRESENTER'S  
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**DALLAS, TX  
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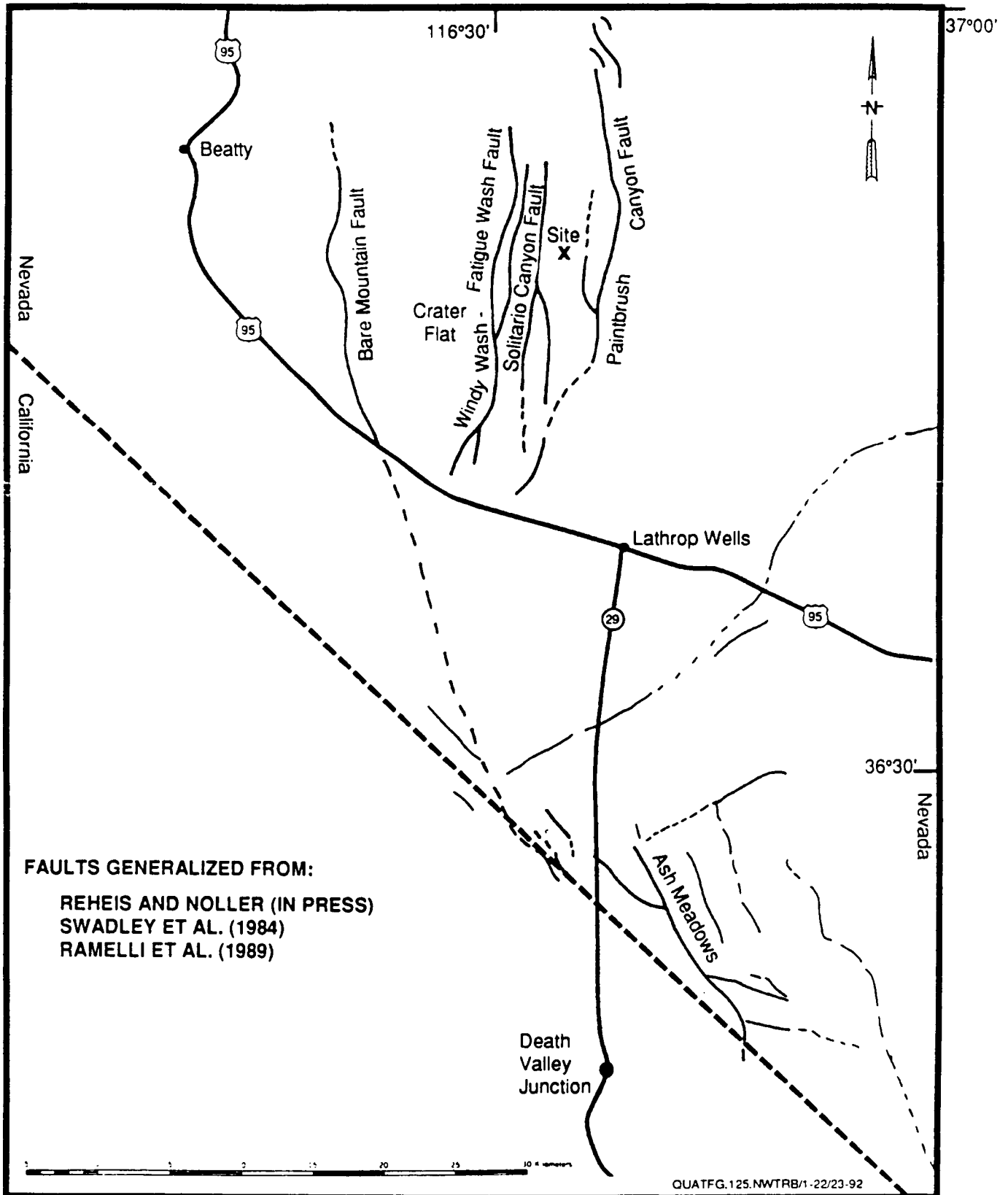
# Outline

- **Statement of disqualifying condition**
- **EA finding and basis**
- **General considerations**
- **ESSE approach**
- **Summary of evaluation**

## **10 CFR 960.4-2-7(d) - Disqualifying Condition:**

**"A site shall be disqualified if, based on the geologic record during the Quaternary Period, the nature and rates of fault movement or other ground motion are expected to be such that a loss of waste isolation is likely to occur."**

# Quaternary Scarps Recognized by Remote Sensing Studies



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# **Basis for Findings in Environmental Assessment (1986)**

- **DOE reached a lower-level finding that the site is not disqualified**
- **EA expectation based on**
  - **0.4g surface ground motion; less effect at depth**
  - **Some container ruptures from movement on faults**
  - **Small consequence--small number of containers ruptured, small ground-water flux, and long ground-water travel time**

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# Current Options for ESSE Recommendation

- **Support lower-level finding**
- **Reverse lower-level finding--disqualifying site**
- **Raise to higher-level finding:**  
**"The site is not disqualified, and information to be collected in the future is unlikely to result in disqualification under this condition."**



# Relation to Qualifying Condition

- **Fully embedded in the qualifying condition**  
**[10 CFR 960.4-2-7(a)]:**

**"The site shall be located in a geologic setting where future tectonic processes or events will not be likely to lead to radionuclide releases greater than those allowable under the requirements specified in 960.4-1."**

- **Narrower focus than the converse of the qualifying condition**
- **Key provisions of the disqualifying condition emphasize**
  - **Quaternary geologic record, not hypothetical processes and events**
  - **Expected conditions--consistent with Quaternary record**
  - **Fault movement and ground motion, not all tectonic processes**
  - **Likely loss of waste isolation--requires subsequent transport to accessible environment in violation of regulatory allowance**

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## **ESSE Defined Two Questions, to be Considered Sequentially:**

- 1. Based on the Quaternary record, is it expected that fault movement will occur within the repository or that ground motion within the repository from outside seismogenic sources will be so severe as to cause a loss of containment within the engineered barrier system?**
  - If "no," then the site is not disqualified
  - If "yes," then consider question 2
  
- 2. If fault movement or ground motion causes a loss of containment, is it likely to result in a loss of waste isolation?**
  - May require system performance assessment
  - If "no," then the site is not disqualified
  - If "yes," then the site is disqualified

# Considerations for First ESSE Question

- **Possible modes of EBS damage and release of waste resulting from fault movement or ground motion**
  - **EBS rupture or stress due to fault displacement in repository**
    - \* **Dimensions of faults and orientations relative to waste-emplacement pattern**
    - \* **Amount of fault displacement**
  - **EBS rupture or stress due to ground motion in repository**
    - \* **Acceleration and displacement spectra**
    - \* **Wavelengths relative to EBS dimensions**
  - **Hydrologic changes**
    - \* **Increase or concentration of ground-water flux**
    - \* **Hydrochemical changes that might accelerate EBS degradation**
- **Predicted EBS degradation and releases from repository, if occurrence of release modes is expected**

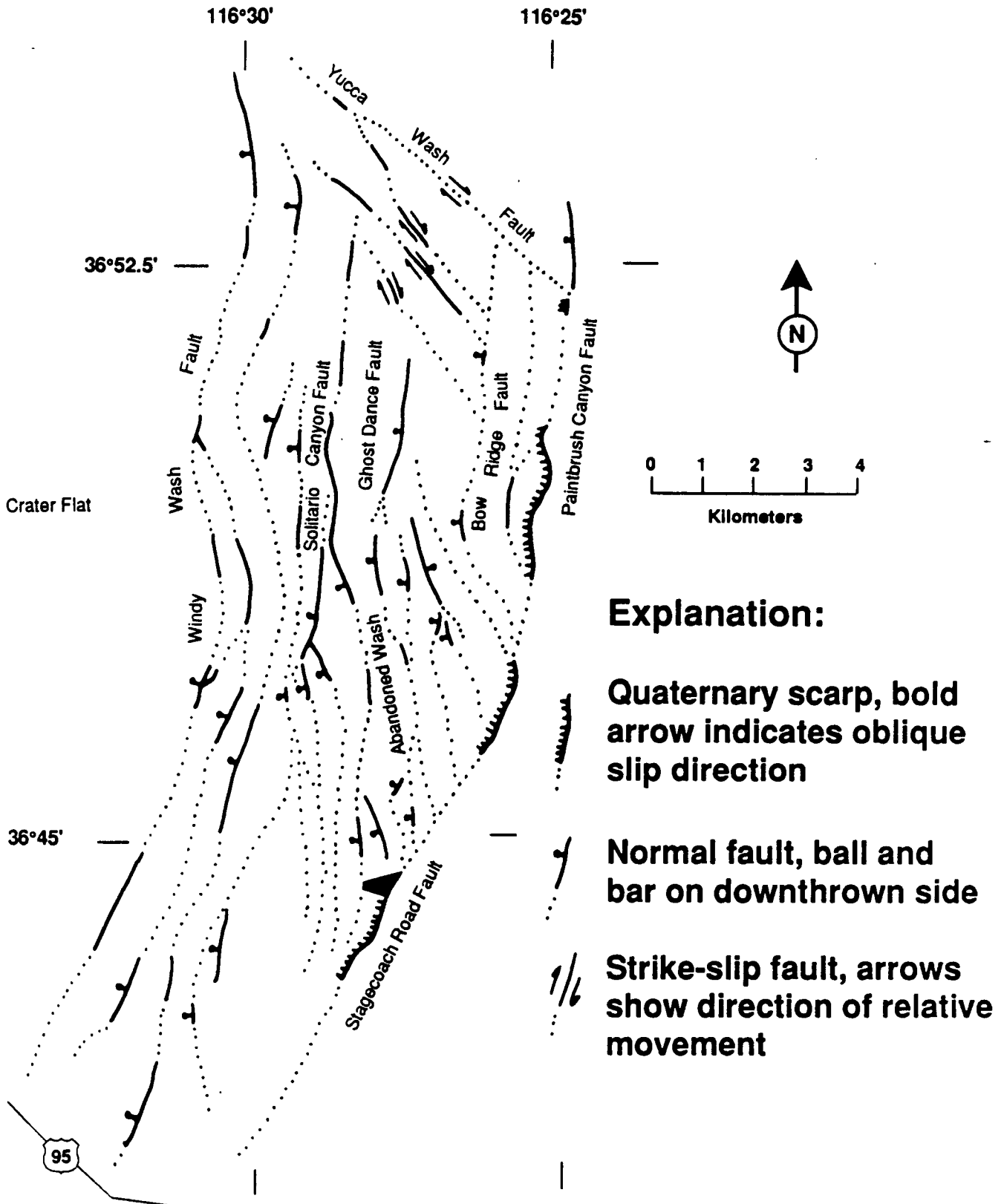
# Considerations for First ESSE Question

(Continued)

- **Damaging fault movement within repository is not expected**
  - **Geologic mapping, geophysical surveys, remote sensing, geomorphic studies have not identified evidence of faults with Quaternary movements within the potential repository boundaries.**
    - \* **Ghost Dance Fault has no Holocene and probably no Quaternary displacement; can be avoided in subsurface.**
  - **All nearby faults with demonstrated or likely Quaternary movement originated and accumulated most of their displacement during the Miocene.**
    - \* **In situ stress is consistent with movement on these faults, rather than initiation of new faults.**
    - \* **Extension axis from earthquake focal mechanisms is consistent with failure on these faults, rather than initiation of new faults.**
    - \* **Ground-water temperatures indicate N-striking faults are hydraulic pathways extending to significant depths. Maintenance of permeability on recognized principal faults is consistent with current tectonic framework.**

# Fault Map of Yucca Mountain Area

(Adapted from Scott, 1990, GSA Memoir 176)





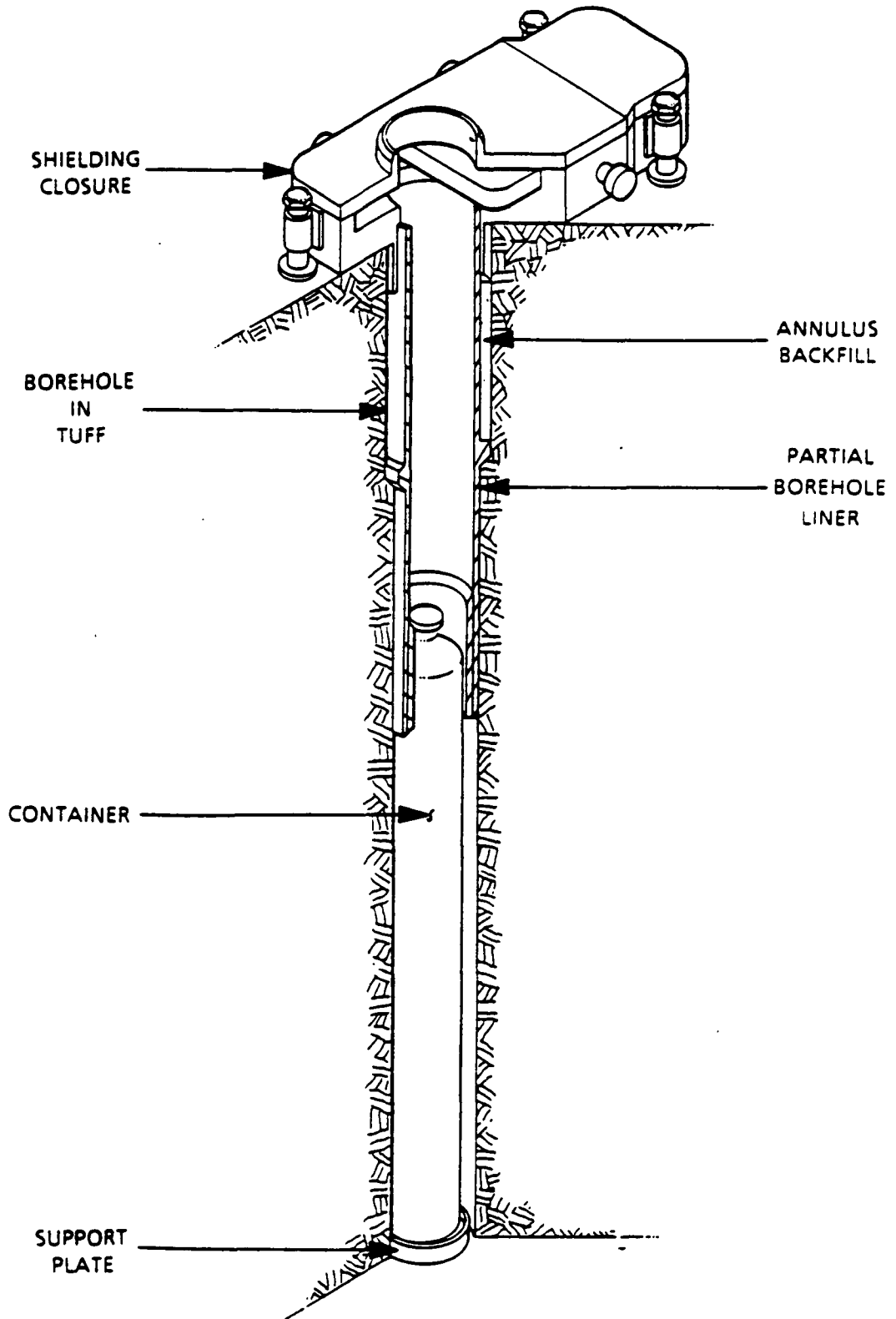
# Considerations for First ESSE Question

(Continued)

- **Damaging ground motion within repository is not expected**
  - **Paintbrush Canyon Fault is expected to control local ground motion**
  - **Paleoseismic studies indicate decreasing slip rates during last 12 million years**
    - \* **probably  $6 < M < 7$ , if major earthquake occurs**
  - **Heavily desert-varnished colluvial boulders rest unrotated on steep slopes**
    - \* **uncalibrated, but suggests  $< 1g$  for 100s of 1000s of years**
  - **Expected wavelengths  $\gg$  EBS dimensions**
- **Effective EBS designs are feasible**



# Vertical Borehole



# Considerations for First ESSE Question

(Continued)

- **Hydrologic changes are not expected to result from faulting or ground motion**
  - **Based on the Quaternary record and present conditions, fault movement within the repository boundaries is not expected**
    - \* **impoundment of water at the surface or in the subsurface (perched) by new fault offsets is not expected**
    - \* **development of new or strongly enhanced fault-zone permeability through existing impoundments to the potential repository is not expected**
  - **Expected ground motion will not exceed that experienced many times during the Tertiary-Quaternary history of the area**
    - \* **significant hydrochemical changes are not expected**
    - \* **significant new fracturing is not expected**

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# Summary of Evaluation

- **Neither faulting nor ground motion is expected to cause**
  - a physical loss of containment
  - hydrologic changes leading to accelerated EBS degradation or increased flux through the repository
- **Therefore, based on the Quaternary record, fault movement or ground motion are not expected to be such that a loss of waste isolation is likely to occur**
- **It is unlikely that new site characterization information will change these expectations**
- **The ESSE Core Team recommends a higher-level finding that the site is not disqualified under this condition**

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