

RIC 2011
Seismic Studies near Diablo Canyon Power Plant
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Diablo Canyon Power Plant




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DCPP-1984
Seismic Issues Dominate Operating License Approval

- Advisory Committee on Reactor Safeguards (ACRS) recommends comprehensive reevaluation with four conditions
- Long Term Seismic Program (LTSP-1984-1991)
- NRC issues SSER-34 license conditions satisfied
- NRC & PG&E agree the LTSP will continue as permanent program to ensure adequate seismic margins



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Post SSER-34 Developments:

Lessons Learned from investigating earthquakes to check LTSP assumptions with a goal to understand and characterize earthquake hazards and effects in coastal central California

Topics Included:

- Fault segmentation characterizations and interpretations
- New empirical ground motion models based on a vastly expanded Next Generation Attenuation (NGA) data set since 1991
 - New near-fault ground motion effects considered
- Improvements in numerical modeling for ground motions
- Updated DCPD tsunami hazard assessment

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LTSP-Update Seismic Hazard Assessment:

- **LTSP is a continuing process with significant new information since 1991**
- **Investigation of relevant earthquakes (13) (1999 Turkey SS Eq's, 1999 Ci-Chi Taiwan RS Eq, 2002 Denali fault SS Eq)**
- **Source Characterization**
 - New tectonic models for the Central Coast Region - Collaboration with USGS, Seismic monitoring
 - » Geologic mapping
 - » Offshore and Onshore Geophysical data
 - » GPS & Geodetic data
 - **Ground Motion Characterization**
 - New empirical NGA models - Collaboration with Private/Public Partnership at Pacific Earthquake Engineering Research Center
 - New numerical simulation models - Collaboration with DOE, USGS, and SCEC
 - **Hazard Calculation at DCPD - Completed with deterministic and probabilistic approaches**

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LTSP-Update Seismic Hazard Assessment:

- **Updated Seismic hazard from improved understanding of seismic sources**
 - **Source Characterization**
 - Magnitudes
 - Fault geometry and Style-of-Faulting
 - Earthquake Source - rates of activity (slip-rates, mm/year)
 - Distance to DCPD
 - **Ground Motion Characterization**
 - Adopting new NGA ground motions
 - **Hazard Calculation**
 - Probabilistic and deterministic

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USNRC RIC 2011 **Historical Perspective**
 Small faults in Southwest Boundary Zone (PG&E 1988 to 1990)
 Discovery of Shoreline fault, 2008

(PG&E Map 1988)

DCPP

2008 Seismicity alignment named Shoreline fault

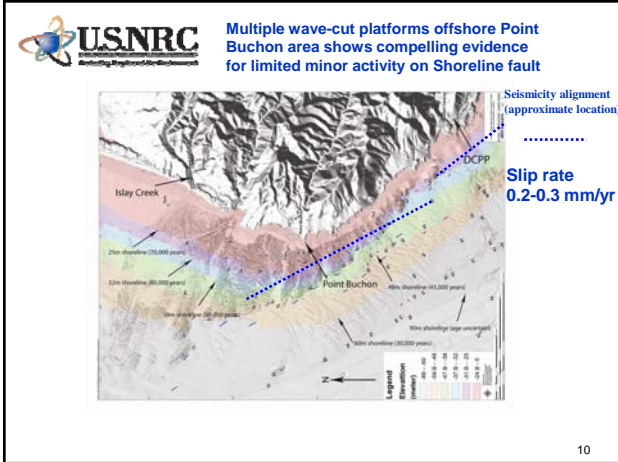
ESPLANATION
 A Topographic profile (Figure 5)
 B Structurally complex area
 C FAULT, dashed where approximately located

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Shoreline Fault Evaluation
 Goal: Characterize and constrain behavioral aspects of Shoreline

- Location & segmentation
 - Geophysical profiling to assess fault location
 - Mapping offshore wave-cut platforms (tectonic strain gauge to assess activity rate)
- Constraints on:
 - Fault activity (fault slip-rate)
 - Fault length and rupture area
 - Magnitude of potential earthquakes
 - Contributions to ground motions

USNRC RIC 2011 **Ancient wave-cut platforms (tectonic strain gauge)**

120,000 year-old Terrace



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 Understanding Earth's Past to Predict the Future

Conclusions
 Shoreline fault segmented

- **Northern segment**
 - Seismicity lineament only
 - Geometry not favorable for rupture with Hosgri fault
- **Central segment**
 - Alignment of seismicity
 - Topographic lineaments
- **Southern fault segment**
 - Weak alignment of seismicity
 - Juxtaposes different rock types
 - Topographic lineaments (possible faults) enhanced by erosion

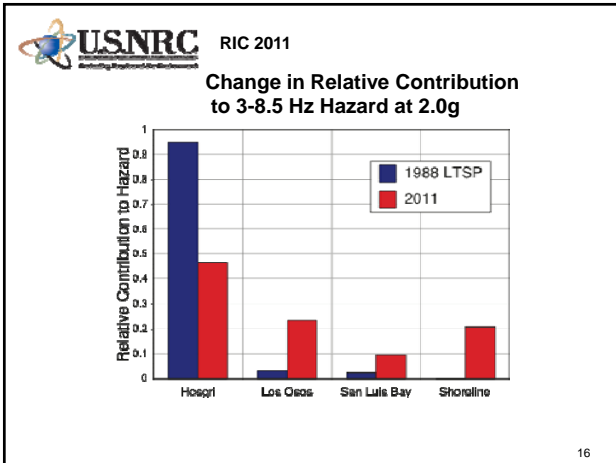
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 Understanding Earth's Past to Predict the Future

Shoreline fault conclusions (cont.)

- Several wave-cut platforms eroded into bedrock offshore west of DCPP (all are older than 40,000 years)
- Evidence for the northern segment, mostly seismicity alignment
- The presence of undeformed wave-cut platforms that cross the Shoreline fault at multiple locations shows compelling evidence of very small or no surface fault deformation
- The slip-rate is estimated to range from 0.2 to 0.3 mm/year
- Single segment rupture of the Shoreline fault is most likely, constraining earthquake magnitude

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USNRC RIC 2011 **Continuing Studies**

- **3-D Seismic Surveys**
 - Shallow (1/2 km depth) initial focused surveys currently being conducted and scheduled for completion, April 2011
 - More comprehensive shallow survey area (San Simeon to Avila Bay) scheduled for completion, January 2012
 - In process of obtaining permit for high-energy (1/2 to 10 km) deep survey scheduled to begin in 2012
 - Results will be incorporated into LTSP update
- **LTSP Update**
 - SSHAC (Senior Seismic Hazard Analysis Committee) Level 3 process to begin in 2011

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