

# Diablo Canyon (DCPP) Power Plant



July 26, 2011

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# Agenda

- Progress in Implementing AB 1632 Report Recommendations
- Fukushima Daiichi Nuclear Plant Lessons Learned



## AB 1632 Recommendations Implementation Status

- Completed
  - Local Economic Impacts of Decommissioning the Diablo Canyon Power Plant
  - Evacuation Update
  - Tsunami Hazard Analysis
  - Kashiwazaki-Kariwa Nuclear Plant (KKNP) Lessons Learned Evaluation
  - Low Level Radioactive Waste
  - Reliability of Power Plant Buildings and Structures
- In Progress
  - Additional Seismic Surveys
  - Spent Fuel Storage Facilities



# Seismic Hazard Analyses

- PG&E plans to perform 3 tiers of seismic research
  - 3D high-energy offshore imagery
  - 2D onshore data collection and imagery
  - 2D/3D low-energy offshore work
- Installing 4 ocean bottom seismic monitors to expand the existing seismic monitoring network



# Anticipated Schedule

<b>Activity</b>	<b>Completion Dates</b>
<b>IPRP Review/Comment on Plan</b>	<b>Q3 2011</b>
<b>Ocean Bottom Seismometer Installation</b>	<b>December 2011</b>
<b>2D/3D low energy marine study surveys</b>	<b>December 2011</b>
<b>2D onshore high energy study surveys</b>	<b>December 2011</b>
<b>3D high energy marine study surveys</b>	<b>December 2012</b>
<b>Preliminary Seismic Evaluation</b>	<b>April 2013</b>
<b>IPRP Review/Comment</b>	<b>Q2/Q3 2013</b>
<b>Final seismic report</b>	<b>August 2013</b>



# Spent Fuel Storage Facilities

- NRC near-term task force review of the Fukushima Daiichi accident recommended enhancing spent fuel pool makeup capability and instrumentation
- NRC's 2002 interim compensatory measures order required mitigation capabilities for spent fuel pools. These mitigation measures include:
  - Additional sources of cooling water for and methods to inject or spray into the spent fuel pools
  - Methods to control leakage from damaged spent fuel pools
  - Dispersal of higher-decay power fuel assemblies among older, lower-decay power assemblies
- National Academy of Sciences (NAS) 2006 Report:
  - Cladding fires can be reduced substantially by surrounding freshly discharged spent fuel assemblies with older spent fuel assemblies
  - This configuration may be more effective for reducing cladding fires than removing older spent fuel from the pools



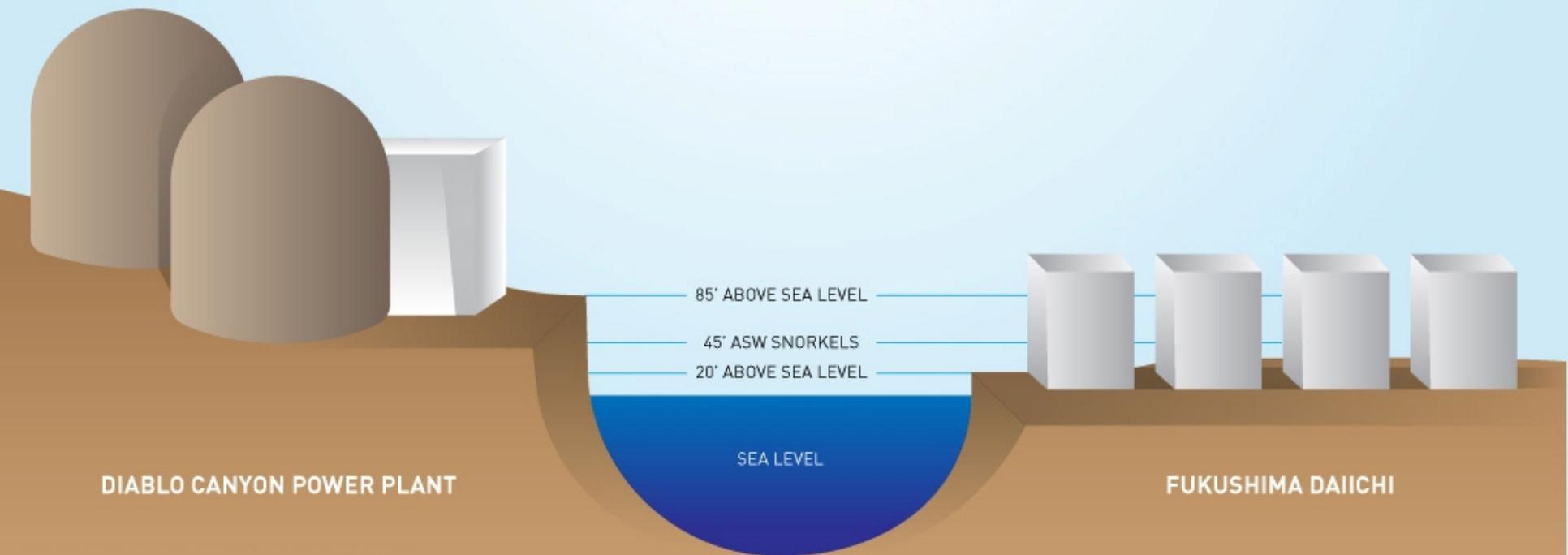
# Spent Fuel Storage Facilities

- Additional DCPD dry cask spent fuel storage capabilities being provided on site
  - Twelve storage casks, arrived at DCPD in June 2011
  - An order has been placed for an additional 10 casks with delivery dates in 2012 and 2013
  - The third campaign to move spent fuel from wet to dry storage is scheduled to start in January 2012. Seven casks will be loaded with 224 fuel assemblies
- Both dry and wet storage processes utilize a “regionalized” approach where older spent fuel is mixed with spent fuel recently discharged from the reactors
  - More efficient for heat transfer and dose reduction
  - Adds safety margin for beyond-design-basis spent-fuel-pool events



# Fukushima Daiichi Nuclear Plant Initial Lessons Learned

# PLANT ELEVATIONS



# DCPP Elevations

310' Dry Cask Storage and Fresh Water Reservoirs

85' Power Block; Diesel Generators

~45' Auxiliary Saltwater Snorkels

140'  
Surface of Spent Fuel Pools

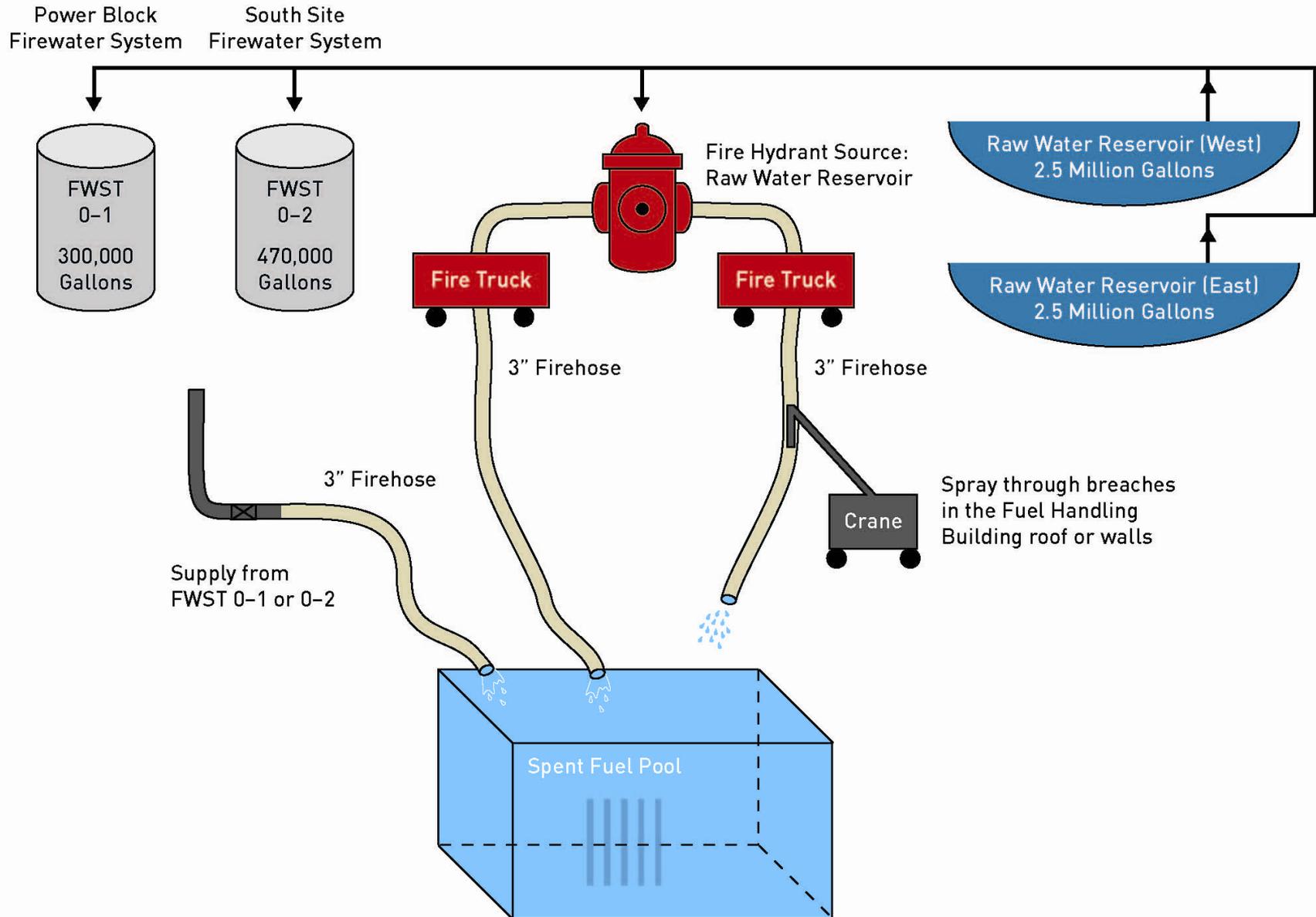




# DCPP Beyond Design Basis Capabilities

- **Emergency Power**
  - Six air cooled diesel generators; three per unit with cross-ties to allow a generator from one unit to supply both units
  - Two underground diesel fuel storage tanks with a seven day supply of fuel for each diesel generator
  - EDGs, switchgear, and batteries at grade level ( $\geq 85$  ft above seal level) and above
- **Spent Fuel Pool**
  - Makeup available from multiple sources

# Spent Fuel Pool Supplemental Water Sources

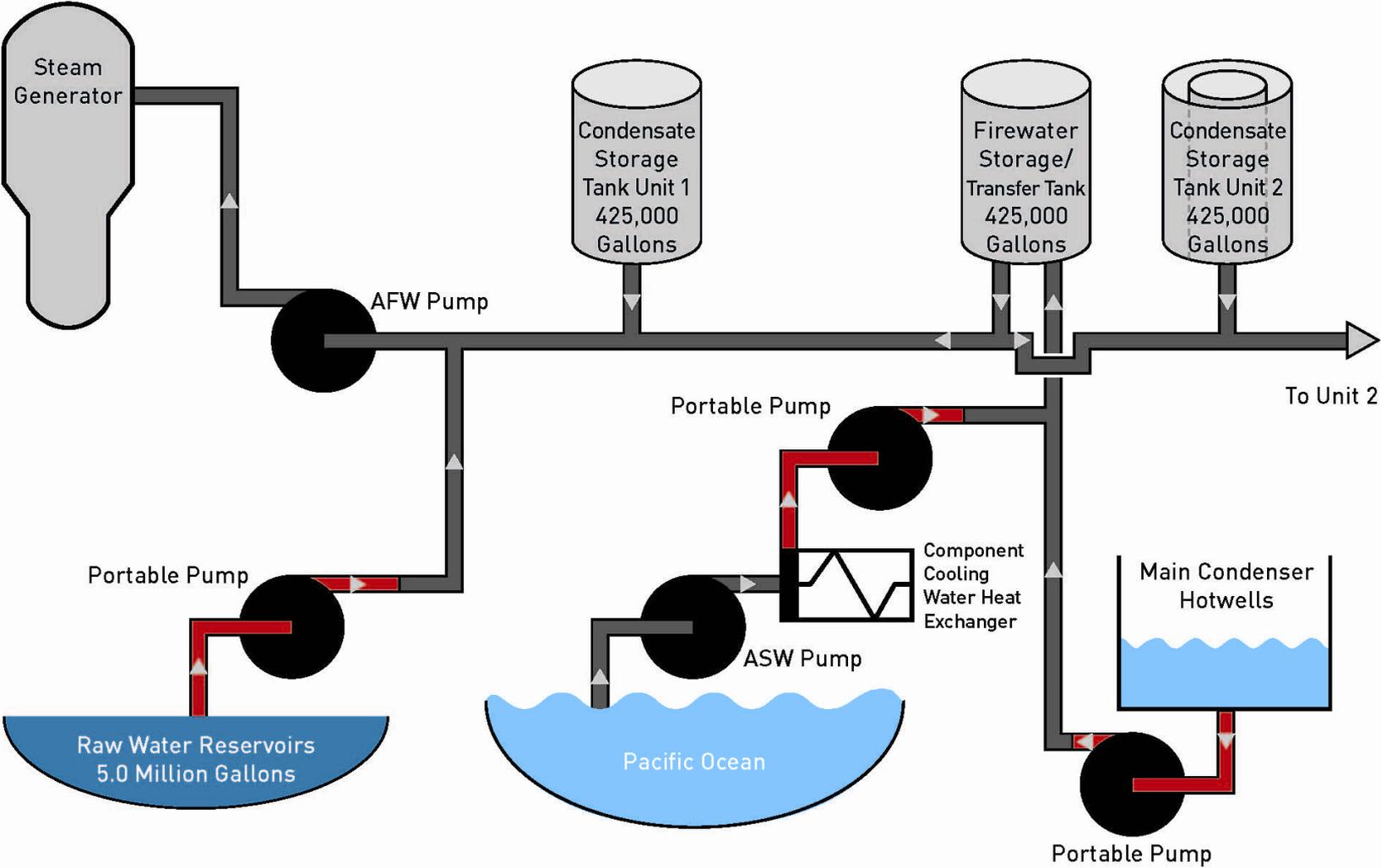




# DCPP Design Overview

- **Emergency Cooling Capabilities**
  - Decay heat removal through steam generators to condenser or atmosphere
  - Emergency feed water supplied by auxiliary feed water pumps, motor and turbine driven
  - Seismically qualified water supplies include:
    - Refueling Water Storage Tanks
    - Condensate Storage Tanks
    - Shared Fire Water Storage Tank
  - In addition, two 2.5 million gallon fresh water reservoirs with a diesel driven portable pump with hoses that can take suction from either reservoir and supply make-up water to the plant cooling systems
  - Pacific Ocean

# Plant Alternate Water Sources





# Fukushima Daiichi Nuclear Plant Initial Lessons Learned

- **Multiple unit events from beyond design basis natural phenomena**
- **Importance of robust capability to prevent/recover from station blackout conditions**
- **Importance of managing spent fuel pool conditions under upset conditions**



# NRC

## Follow Up Actions

**NRC has the following focus areas:**

- **Protection from design basis natural phenomena**
- **Consideration of beyond-design-basis natural phenomena**
- **Mitigation for long-term Station Black Out, including multiple unit events**
- **Emergency Preparedness**



# Evaluation of B.5.b Capability

- **Verified mitigating equipment for beyond design basis events bounded by security events is available and functional**
- **Verified procedures to implement the strategies for the events described above are in place and executable**
- **Verified training and qualifications of staff needed to implement the procedures are current.**
- **Verified applicable agreements and contracts are in place and are capable of meeting the conditions needed to mitigate the consequences of assumed events.**
- **Deficiencies and enhancements were identified and entered into the corrective action program**



# Evaluation of SBO Capability

- **Verified capability to mitigate station blackout (SBO) conditions required by station design is functional and valid.**
- **Verified required materials and equipment for design basis internal and external flooding are adequate and properly staged.**
- **Verified through walk downs and inspections of important equipment needed to mitigate fire and flood events that the equipment's function would not be lost during seismic events appropriate for the site.**
- **Deficiencies and enhancements were identified and entered into the corrective action program**



# DCPP Beyond Design Basis Response Team

- **Modifications to strengthen the ability of the plant and ISFSI to withstand beyond-design-basis events**
- **Emergency preparedness enhancements for beyond-design-basis events**
- **Ability to implement emergency procedures for multiple unit events**
- **Training and qualifications enhancements for beyond-design-basis procedures**
- **Strategies for acquiring supplies and equipment from offsite in the event of a beyond-design-basis event**
- **Coordinate DCPP response to industry and NRC initiatives**



# Future Plant Modifications

- **Backup ASW cooling water system**
- **Low leakage design reactor coolant pump seals**
- **Enhanced capability for diesel generator restart following a beyond design basis blackout**
- **Additional diesel generator-powered charging pumps**



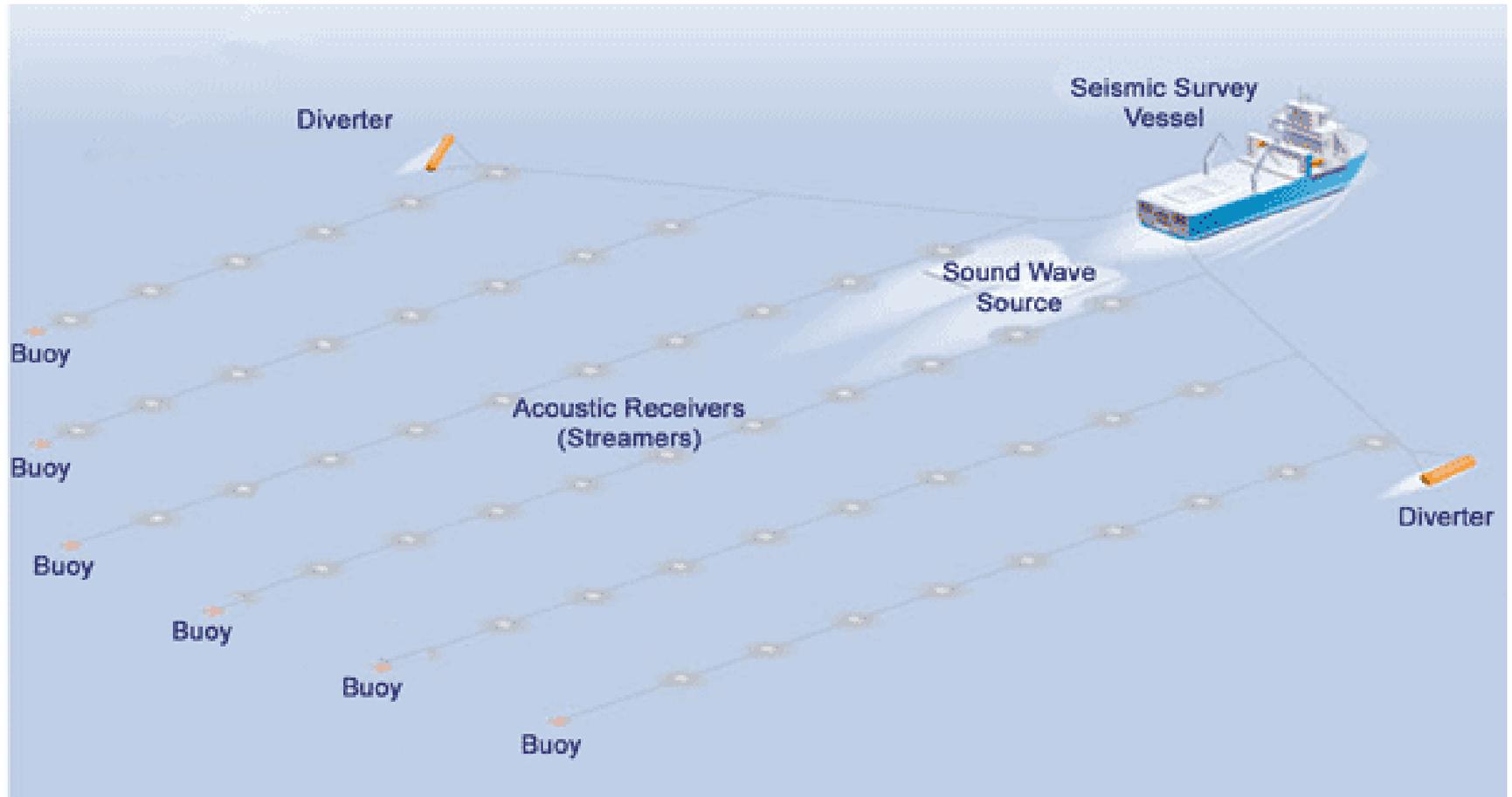
# Conclusions

- **Design features, procedures, and training lessen the vulnerability of DCCP to beyond design basis events**
- **Actions have been taken or initiated in response to the initial lessons learned**
- **Beyond design basis team chartered to develop and implement lessons learned**
- **NRC review of task force recommendations may produce additional actions**



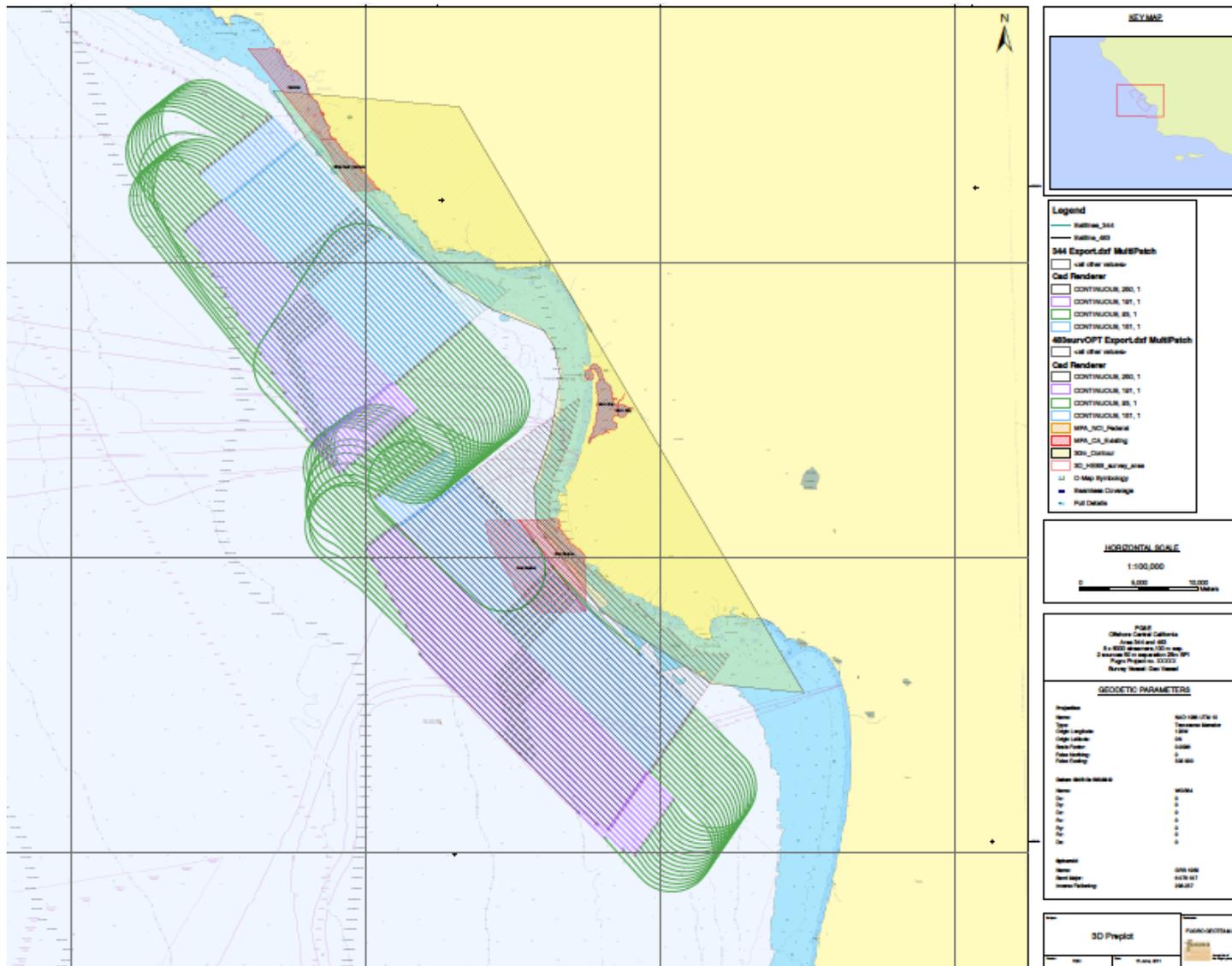
# BACK UP Slides

# Typical Air Gun and Streamer Deployment



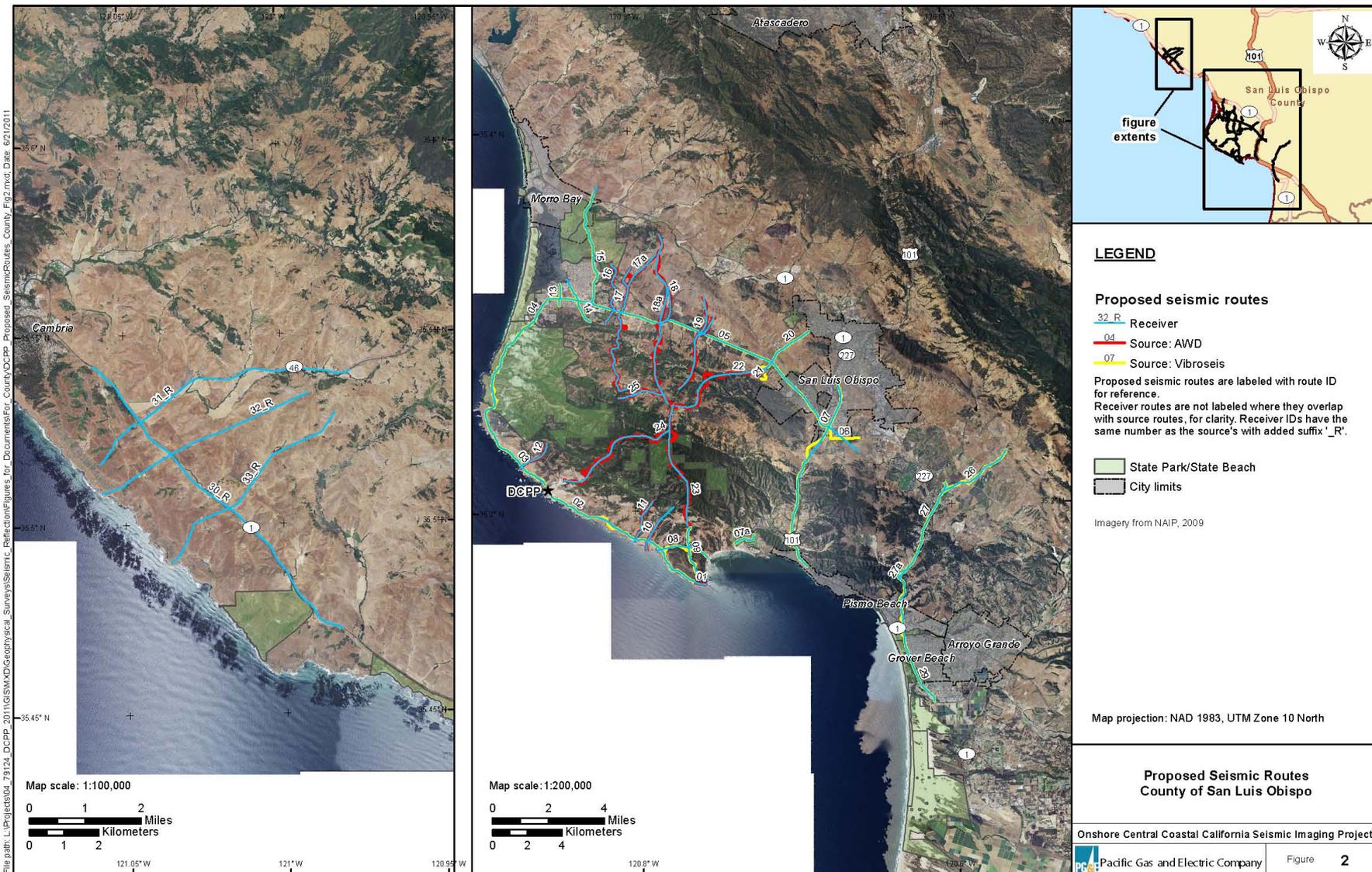


# Proposed Project Survey Track Line Map





# Proposed Seismic Routes



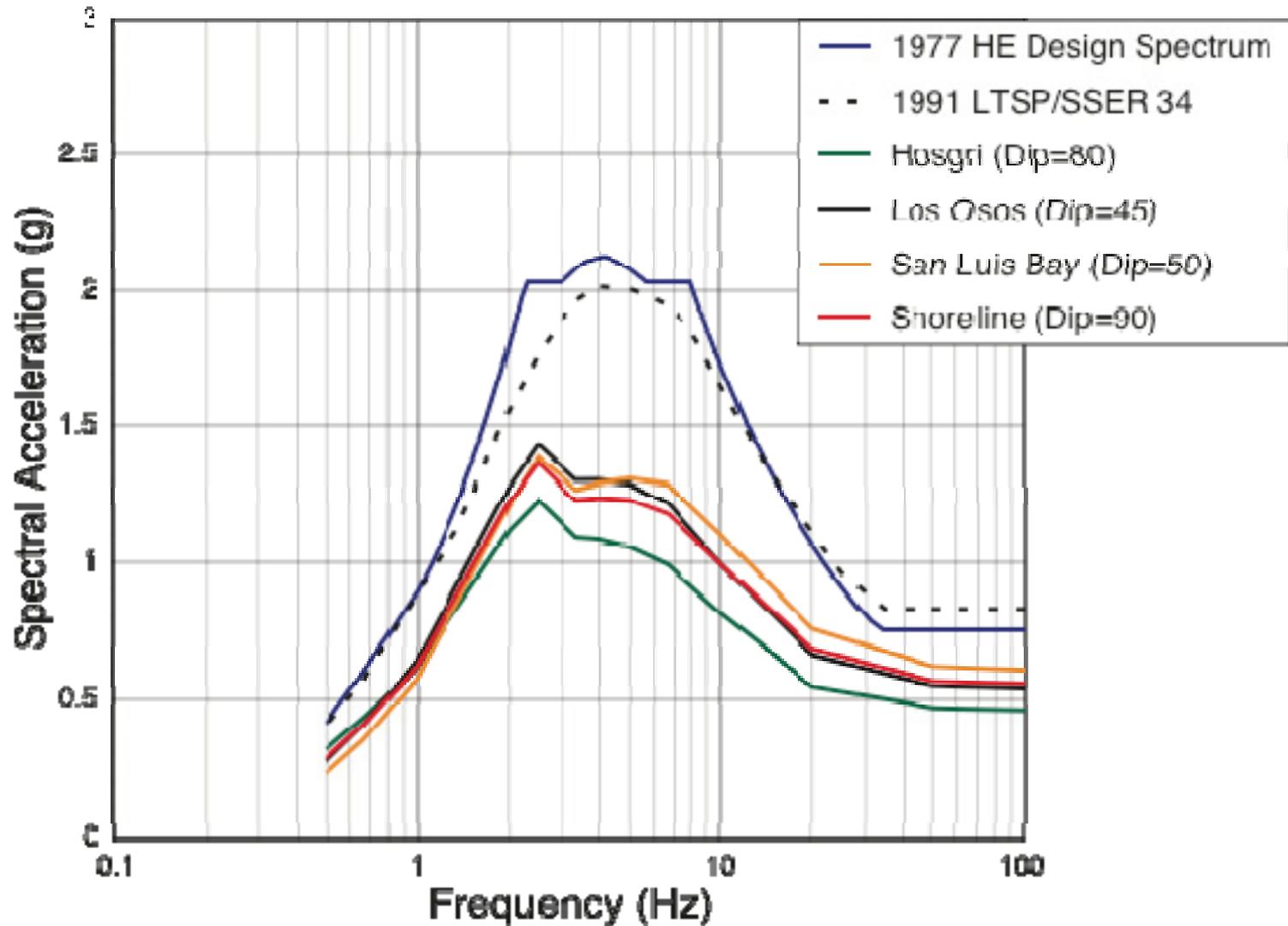


## Example of an Autonomous Wireless Nodal Land Recording System\* - Fairfield Zland

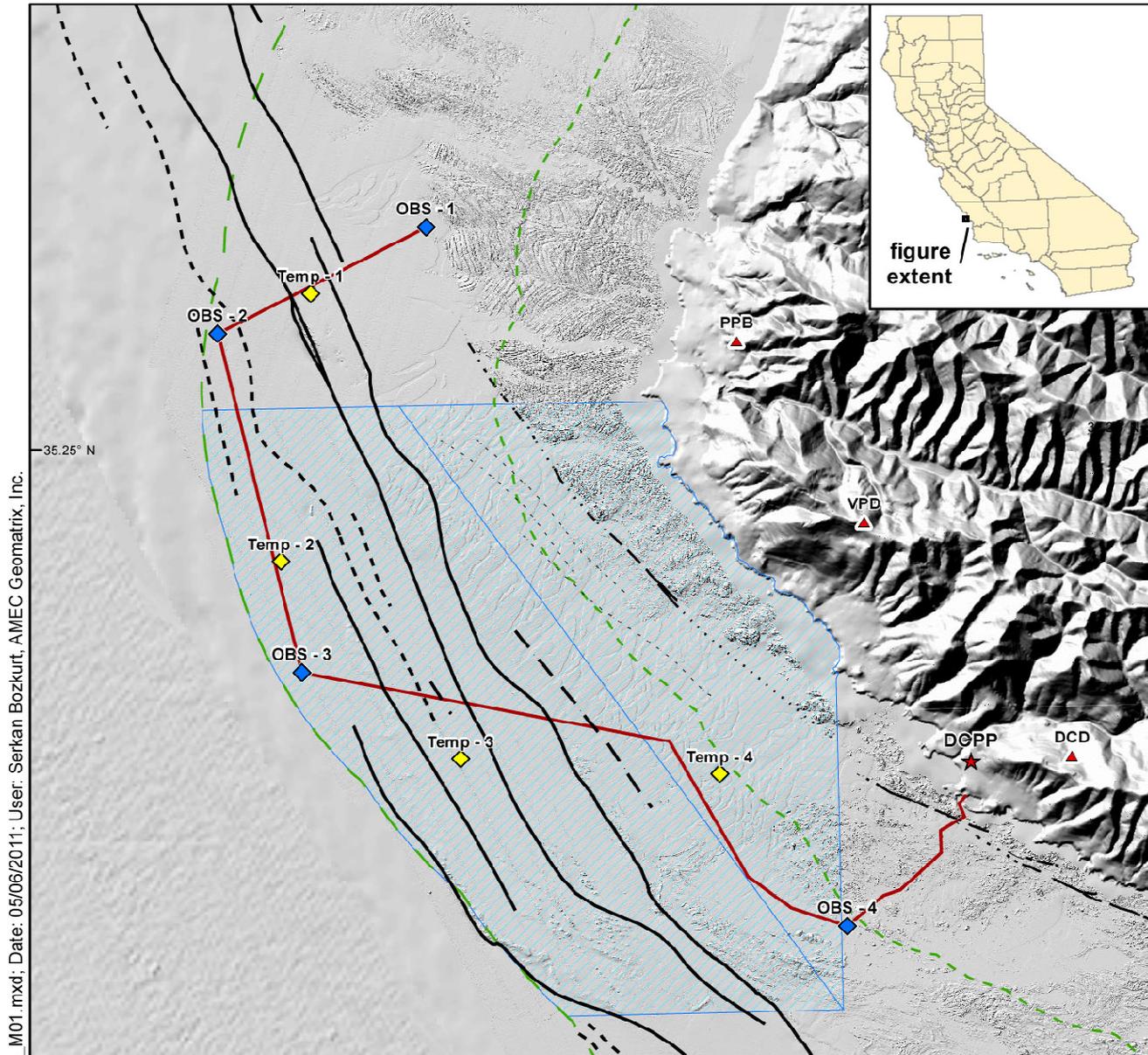
\* Includes a 5 inch spike, is 6 inches high, 5 inches in diameter, and weighs 5 lbs.



# Deterministic Comparison



# Ocean Bottom Seismometers





# Beyond Design Basis Assessment

- DCPP verified implementation of beyond-design-basis response capabilities required by NRC requirements and guidance (i.e. station blackout, large fires and explosions) to assess its applicability to mitigate a Fukushima type beyond design basis event.
- Any deficiencies identified were entered into the corrective action program and appropriately prioritized based on their significance. Examples of some of the deficiencies were fire doors that were not properly latching and a pump which failed to start upon test.
- Although meeting NRC requirements, some of this equipment would not be adequate to respond to a Fukushima event involving a multi-unit accident with significant offsite infrastructure impacts
- PG&E created a beyond design basis team to recommend plant enhancements and to respond to NRC lessons learned



# Reactor Cooling Water Supplies

- Seismically qualified
  - Condensate Storage Tanks (200,000 gallons per unit)
  - Refueling Water Storage Tanks (400,000 gallons per unit)
  - Firewater Storage Tank (300,000 gallons)
- Additional water supplies using portable pumps
  - Main condenser hotwells
  - Raw water storage reservoirs (5 million gallons)
  - Pacific Ocean



# Reliability of Power Plant Buildings and Structures

- Study was performed using EPRI world experience, walkdowns of plant equipment and associated anchorage
- Failure of non-safety related SSCs during a moderate earthquake would not result in an outage of greater than 120 days
- Stability of the slopes around the Raw Water Reservoirs, 230 kV and 500 kV switchyards, Intake and Discharge Structures will not be impacted by an earthquake
- PG&E has completed the turbine thrust bearing evaluation and concluded the thrust bearing would be damaged, but repairable.



# Kashiwazaki-Kariwa Nuclear Plant (KKNP) Lessons Learned

- DCPP has evaluated the lessons associated with the response of the KKNP Station to the 2007 Niigata Chuetsu-Oki earthquake, as summarized in INPO SEN 269.
- The current situation at DCPP either adequately addresses each lesson's objectives, or if actions were prudent, recommended enhancements have been developed to address the lesson's objective.
- The recommended enhancements have been entered into the plant corrective action system for implementation.



# Tsunami Hazard Analysis

- PG&E recently completed tsunami hazard study (2010)
  - Considered seismic and geologic evidence for tsunamigenic earthquakes and landslides
    - Not just historical events (over time periods of 100s of years)
  - Accounts for rare events (over time periods of 10,000s of years)
- These results confirmed the adequacy of the existing plant's design
  - The licensing basis tsunami wave height (34 ft) has a return period of about 50,000 years



# Evacuation Update

- An updated analysis has been performed to assess estimated evacuation times following a combined earthquake (including potential liquefaction) and radiological emergency at the Diablo Canyon Power Plant (DCPP).
- The study shows primary evacuation routes at DCPP and surrounding DCPP will experience no damage or slight damage to the large majority of bridges and roadways
- The overall extent of estimated damage to roads and bridges is lower than predicted in earlier studies.



# Radioactive Waste

- Low level radioactive waste storage and disposal
  - Class A waste is being shipped for disposal at the LLRW site in Clive, Utah.
  - Class B/C waste is being stored in the DCPD Radwaste Storage Building which has enough storage capacity through license renewal
- Spent fuel storage plans
  - PG&E's preferred approach for additional spent fuel storage is to either ship the spent fuel to a Federal waste repository or waste reprocessing facility
  - If the Department of Energy is unable to accept spent fuel by decommissioning, PG&E would have to permit and construct an additional ISFSI.

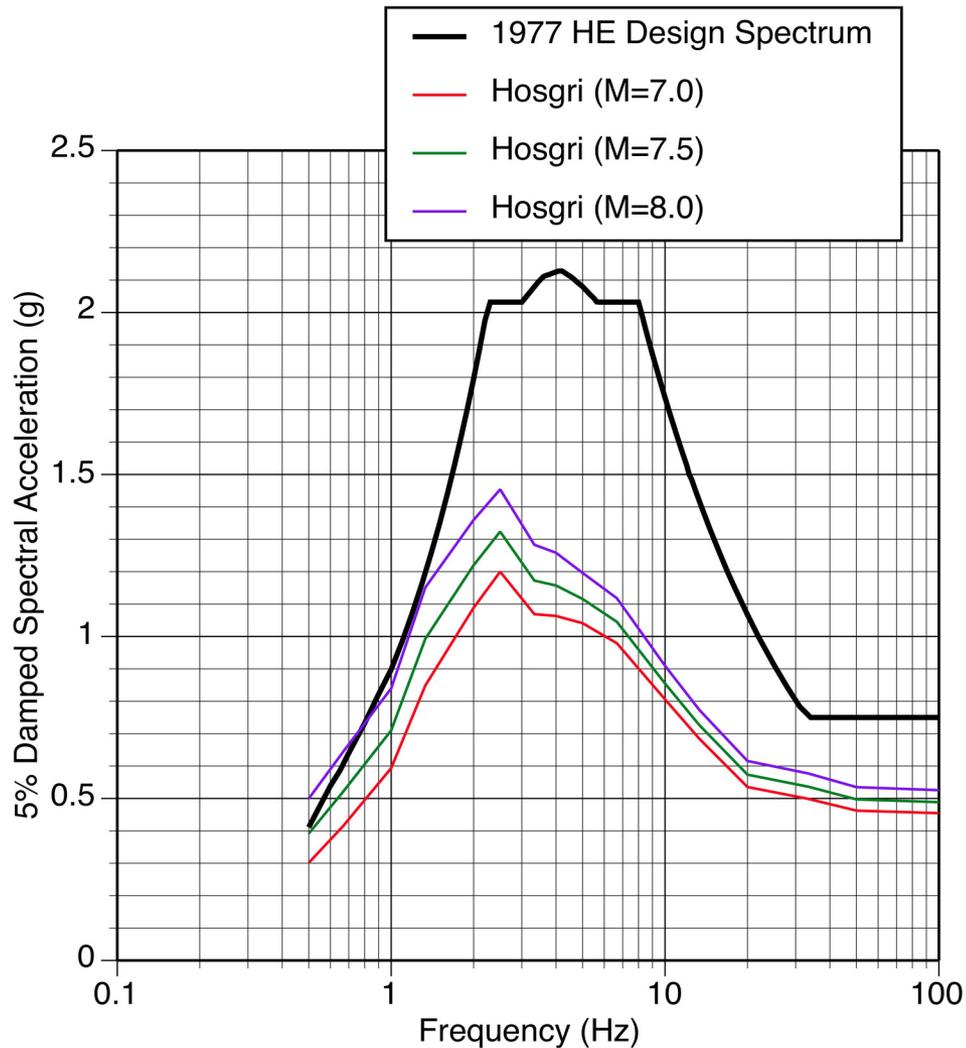


# Beyond Design Basis Event Documentation

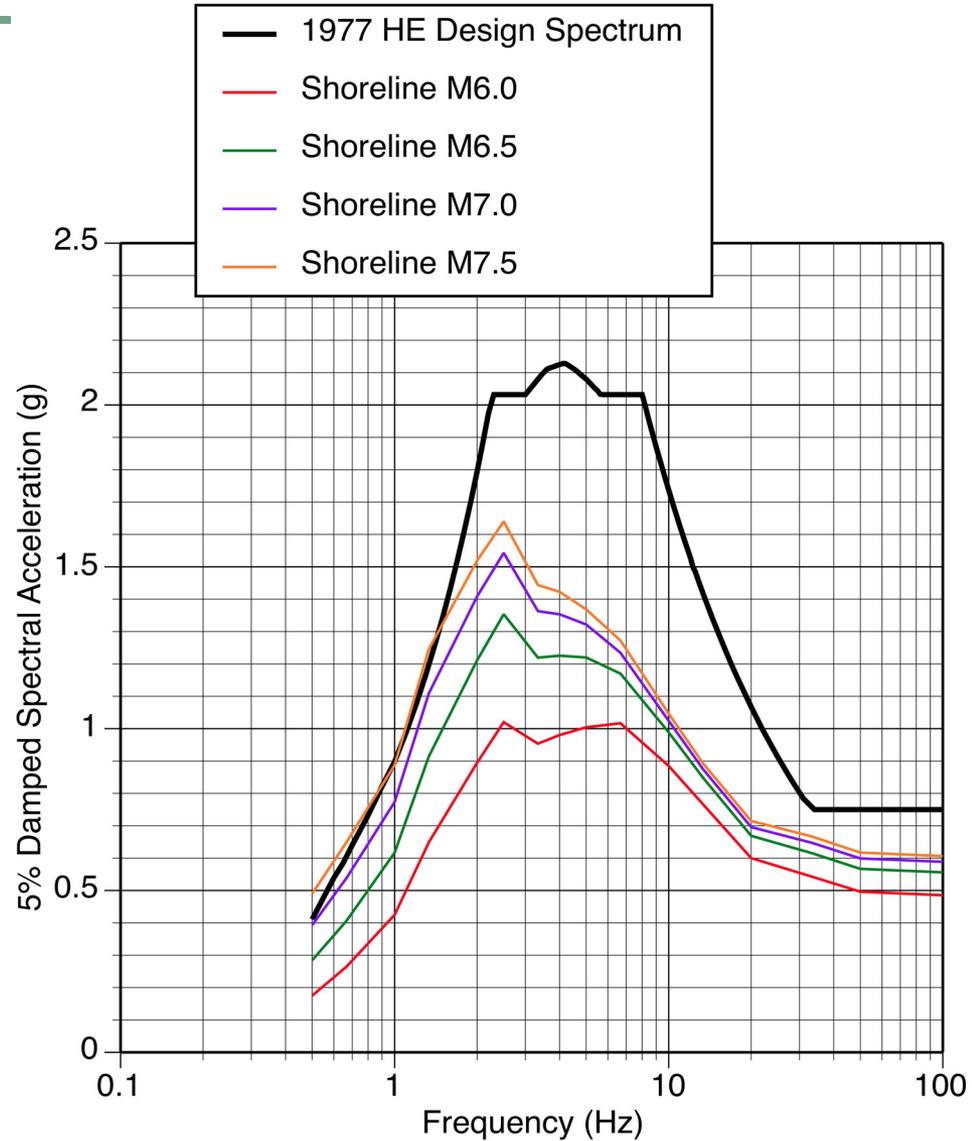
The following documents have been provided to the California Energy Commission:

- NRC Temporary Instruction 2515/183 Inspection Report, dated May 13, 2011
- NRC Temporary Instruction 2515/184, “Availability and Readiness Inspection of Severe Accident Mitigation Guidelines (SAMGs)”, dated May 26, 2011
- PG&E Letter DCL-11-065, Thirty-Day Response to NRC Bulletin 2011-01: “Mitigating Strategies”, dated June 10, 2011
- PG&E Letter DCL-11-081, Sixty-Day Response to NRC Bulletin 2011-01, “Mitigating Strategies”, dated July 11, 2011

# Magnitude Sensitivity (Hosgri)



# Magnitude Sensitivity (Shoreline)



# Deterministic Comparison

