Alan Morris

From: Alan Morris

Sent:28 May 2015 19:08:23 +0000

To:Ronald McGinnis; Kevin Smart; David Ferrill; Sarah Wigginton

Subject: Diablo Canyon IMHO

For what it's worth:

As far as I can tell from the reports and presentations available to us, the Central Coastal California Seismic Imaging Project from Pacific Gas & Electric seems fine, that is:

- (1) I think they characterized the kinematics of the area/region accurately
- (2) The fault model choices seem logical, although not very broad in scope
- (3) Without working through a complete example with the data, it seems that their slip rates and fault kinematic models are reasonable and therefore...
- (4) The hazard conclusions are probably also reasonable

Another caveat:

There are clearly normal faults along parts of the Hosgri fault zone and it is not obvious how they have been incorporated into the kinematic model(s).

With respect to displacement on the Hosgri fault zone as measured by displaced channels, I feel the need to work through this from data to hazard curve. The relevant data seems to be the 2D/3D low-energy seismic surveying (LESS) discussed in chapter 3 of the Central Coastal California Seismic Imaging Project report. I think the data were collected by Fugro in 2011 - 2012, we probably don't want the raw data, but the final cut together with their interpretations in seg-y form for import into both Petrel and Move.

Another dataset that would be nice is the USGS (Jeanne Hardebeck's) re-calculated hypocenter data, she sent us the older set a while back, but I think she has both new events and a newly calculated set of hypocenters.

There may be other things but that's my \$0.02.

Alan

Alan Morris.

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Tel: 210.522.6743 Fax: 210.522.5155

Web page: http://www.swri.org/4org/d20/geosci/structur.htm

http://3dstress.swri.org/

From:John Stamatakos

Sent:27 Mar 2015 20:00:44 +0000

To:Ronald McGinnis; David Ferrill; Amy Minor; Kevin Smart

Cc:Miriam R. Juckett

Subject: Diablo Canyon Review

I've place most of my Diablo Canyon files on the DEMPS server (Demps\regios).

There are a series of reports that Pacific Gas & Electric (POG&E) produced over the last few years.

- Shoreline and RIL: The Shoreline report was submitted by PG&E in 2011 and we (with NRC review if in 2012). The Regulatory Information Letter (RIL 12-01) is that review. This report and review focused on the Shoreline fault and potential implications to the Licensing Basis for the plant. But the reports offer some good general background information. Other files in this folder are related to the Shoreline Report and the RIL.
- 2. **DCPP Shoreline and Thrust Fault Allegation**: In addition to the Shoreline Report, NRC had us look at an allegation made by about other possible faults and the plant. Alan helped me on one of the allegations (possible blind thrust beneath the plant site).
- Central Coastal California Seismic Imaging Project: The California state legislature passed a bill
 after the Shoreline Report authorizing PG&E to collect boat load of new seismic imaging
 data. This report is essentially a data dump of that work, and it has the bulk of what I would like
 you all to look at.
- 4. LTSP: This is an old PG&E report (1991) that may also be useful as background.
- NTTF DCCP PSHA Review: This is the actual new seismic hazard study that we are
 reviewing. We will need to cross reference the conclusions about faults (do they exist, their
 geometry, slip rate, length and area, etc.) based on seismic imaging to the data in the CCCSIP
 report.
- 6. **Diablo Canyon ISFSR SER**: This was our review of the site back in early 2000's for the Independent Spent Fuel Storage Installation (ISFSI). May be useful as background information.
- Figure: is a folder I use to put in various figures and some of my Diablo Presentations and related images.

For reference: http://www.pge.com/en/safety/systemworks/dcpp/seismicsafety/index.page

This link gets you to most of these reports on line.

Work Scope:

I have five progressive tasks in mind.

1. Look through the CCCSIP documents and develop a summary (catalog) of all the seismic imaging data that's there. Identify the who, what and where and assess its quality and possible usefulness to the PSHA. I think we can do this relatively quickly. We can even bring on a temp/student if available and willing to work on this. NRC wants to be able to say that they are familiar with all the data and have looked it over as part of the review. I would like to have a very quick deliverable on this (couple of pages?) relatively soon.

- Identify which data in the CCCSIP report is actually relied on to develop conclusions in the new PSHA. Assess the validity of the structural/seismic interpretations from the quality of the seismic imaging data. This may take a bit longer than task 1, but I hope we can do this relatively quickly.
- 3. Identify potential faults in the data sets that may have been overlooked by the PSHA technical team. I am **not** suggesting we identify any vague targets, but if you see images that in your view (and based on your experience) are very likely significant faults, we should tag them and assess their potential to influence the seismic hazard at the site.
- 4. For those critical data sets identified in task 2, complete a technical review of the data and the interpretations. This will be included in our write up for the overall PSHA assessment.
- 5. Review the 3D data collected in the Irish Hills to reassess the blind thrust fault model (I think it is now referred to as the San Luis Range Thrust).

I'll walk you all through this again next week and provide some more background on the PSHA and how we can assess whether fault sources can be important to the PSHA next week.

Thanks,

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

From:John Stamatakos

Sent:12 May 2015 20:11:18 +0000 To:Debashis Basu;Kaushik Das Subject:Diablo Matlab work

OK, I put everything in S:\John Stamatakos\Diablo Files

It includes chapter 8 from the PG&E report, all the figures that uses these PDFs and CDFs in the analysis, the email from George and Osvaldo helping with the formula, and my Excel Spread sheet.

The question is, can we code up MATLAB to make these distribution?

Thanks

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

From:John Stamatakos

Sent:29 Apr 2015 19:45:20 +0000

To:Giacinto, Joseph (Joseph.Giacinto@nrc.gov);Plaza-Toledo, Meralis (Meralis.Plaza-

Toledo@nrc.gov)

Subject:Diablo SSC

I had a good call with the San Antonio folk. I can meet after the Columbia meeting to talk through some of the early observations.

Thanks,

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

Informal review of The Central Coastal California Seismic Imaging Project (CCCSIP) report (Pacific Gas and Electric Company)

By

GED

April 2015

The Central Coastal California Seismic Imaging Project (CCCSIP) report was produced by the Pacific Gas and Electric Company (PG&E) in response to a 2008 recommendation by the California Energy Commission (CEC). The California Energy Commission's 2008 report "An Assessment of California's Nuclear Power Plants: AB 1632 Report", also known as the "AB 1632 Report", recommended that Pacific Gas and Electric perform a series of geophysical investigations to explore fault zones near the Diablo Canyon Power Plant (DCPP). A primary goal of the investigations was to improve understanding of the seismic risk to the Diablo Canyon Power Plant, specifically:

- Hosgri Fault Zone slip rate
- Hosgri Fault Zone dip
- Hosgri–San Simeon fault zone step-over (i.e., are these faults linked so that will rupture in unison?)
- Los Osos fault zone slip rate
- · Los Osos fault zone dip
- Los Osos fault zone sense of slip
- Hosgri-Shoreline fault zone rupture (i.e., are these faults linked so that will rupture in unison?)
- Shoreline fault zone slip rate
- · Shoreline fault zone southern extent
- Shoreline fault zone segmentation

These issues were chosen because of their importance in choosing seismic source parameters used to model the seismic hazard for the Diablo Canyon Power Plant, and because of the uncertainty associated with them. Hazard is expressed as probability of ground motion acceleration exceeding 2 g at the key frequency of 5 hertz.

Three areas of study were specifically prescribed by the AB1632 report:

- (1) PG&E should use three-dimensional geophysical seismic reflection mapping and other advanced techniques to explore fault zones near Diablo Canyon.
- (2) As ground motion models are refined to account for a greater understanding of the motion near an earthquake rupture, it will be important for PG&E to consider whether the models indicate larger than expected seismic hazards at Diablo Canyon and if so, whether the plant was built with sufficient design margins to continue operating reliably after experiencing these large ground motions.

(3) PG&E should assess the implications of a San Simeon-type earthquake beneath Diablo Canyon. This assessment should include expected ground motions and vulnerability assessments for safety-related and non-safety related plant systems and components that might be sensitive to long period motions in the near field of an earthquake rupture.

A range of data is presented and analyzed in the Central Coastal California Seismic Imaging Project report, most of it collected between 2009 and 2014, but including and drawing upon a variety of work performed over the previous 30 years. Work incorporated in the report was performed by PG&E, its contractors, and by the United States Geological Survey. The report is organized into the following sections:

Marine seismic reflection surveys (including analysis of natural seismicity data)

Chapters 2 and 4 – 2D/3D low-energy seismic surveying (LESS) to map the Hosgri, Shoreline and Point Buchon fault zones and associated folding west, northwest and north of Diablo Canyon Power Plant. Chapter 4 includes older, deep-penetration seismic data to investigate linkage between Hosgri and San Simeon fault zones and folding offshore and south of the Los Osos fault zone.

Important conclusions, chapter 2:

- "The main structural elements mapped in the study area are the Hosgri fault zone (HFZ), the
 Point Buchon fault zone, and a prominent syncline that deforms Tertiary strata in the southern
 two thirds of the study area."
- "The Hosgri fault zone consists of numerous fault strands and is the best imaged and most continuous and complex fault zone in the region."
- "... the local style of faulting changes along strike of the Hosgri fault zone. Graben A, bounded by
 right-stepping strands of the Hosgri fault zone in the north, indicates extensional strike slip
 faulting. A single fault strand characterizes the fault zone in the center of the study area.
 Numerous, relatively short strands fan out to the southeast and are associated with folds in the
 south, indicating compressional strike-slip faulting."
- "The Point Buchon fault zone, northwest of the central segment of the Shoreline fault zone, is a northwest-trending fault that disrupts Tertiary strata east of the HFZ"
- "... the Point Buchon fault zone may connect to the central segment of the Shoreline fault zone and associated structures"
- "Graben B is associated with the northern end of the Point Buchon fault zone"
- "...the structural relationship between the two grabens [A and B] and structures within Estero Bay to the north of the study area needs to be further evaluated"
- Because "the 3D/2D data are restricted to the shallow subsurface, the mapped surficial faults
 cannot be confidently extended to the earthquake hypocentral depths. Therefore, no conclusion
 can be made in regard to these faults being the source of the earthquakes that constitute the
 northern Shoreline seismicity sublineament"

Important conclusions, chapter 4:

- "...we were unable to observe any clear evidence in the seismic-reflection data for a recent fault
 connecting the San Simeon fault zone with the Hosgri fault zone. Our interpretations do not
 preclude the existence of a fault at depth or the possibility of a future rupture along this fault at
 depth, including propagation to the surface."
- "...we map the newly named Half Graben fault zone, a series of faults along which a half graben
 has formed, down-dropped on the east and tilted to the west ... The half graben is narrow in the
 north... To the south, the half graben widens considerably and appears to end near ... the Los
 Osos fault zone"

Chapter 3 – 2D/3D low-energy seismic surveying (LESS) to identify the southern extent, geometry, connectivity, and slip rate of the Shoreline fault, and the slip rate on the Hosgri fault zone. Older deep penetration data are also used.

Important conclusions:

- "Piercing points identified for constraining offsets along the Shoreline, Oceano, and Hosgri fault zones were identified ... buried paleochannels and paleoshorelines (paleostrandlines) were the best geomorphic features to use in evaluating offsets."
- "These studies reveal a more complex [Hosgri] fault zone than had previously been mapped".
- "...strands of the Hosgri fault zone [in the Estero Bay area] are generally steeply dipping to vertical..."
- "...sense of vertical separation across the Hosgri fault zone [in the Estero Bay area] is dominantly down to the west..."
- "Channel offsets and their interpreted ages yield a preferred lateral slip rate for the Hosgri fault
 zone in Estero Bay of approximately 1.6 ± 0.8 mm/yr within a high (90%) confidence interval.
 Accounting for uncertainties in ages and offset estimates, the range in lateral slip rate is
 between approximately 0.2 mm/yr and 3.6 mm/yr."
- [In the Point Sal Area] "The new mapping ... shows that from south to north, the Hosgri fault
 zone splits from a single strand with little or no vertical separation to multiple splays with
 substantial vertical and dextral shear, which converge to form a single strand once more. ... with
 transtension in the south and transpression in the north. There is an approximate 6-degree
 change in the strike of the Hosgri fault zone..."
- "Channel Complex F provides the preferred piercing points for estimating slip rates on the Hosgri fault zone in the Point Sal area."
- "a minimum estimated slip rate of 0.39 mm/yr (1.4 Ma at 550 m minimum offset) and a
 maximum estimated slip rate of 5.07 mm/yr (138 ka at 700 m maximum offset) is calculated for
 the Hosgri fault zone at Point Sal"

Chapter 5 – Deployment and monitoring of ocean bottom seismographs (OBS)

Important conclusions:

 "offshore events close to but outside the ocean bottom seismographs stations will have improved depth control; however, these events are still subject to uncertainty, particularly with regard to the focal mechanisms."

Chapter 6 – Characterization of the Hosgri fault zone using primarily post 1988 seismic reflection data but also some gravity and magnetic surveys. A 3D high-energy seismic survey (HESS) was proposed by PG&E, however, the California Coastal Commission denied PG&E's application due to concerns about the environmental impact of these studies.

Important conclusions:

- "Earlier models ... that identified the Hosgri fault zone as a major thrust fault underlying the
 Coast Ranges are not supported by the (older) high-energy marine 2D seismic-reflection data
 acquired during the Long Term Seismic Program (LTSP); nor are they supported by potential field
 and seismicity data collected during the Long Term Seismic Program Update and Central Coastal
 California Seismic Imaging Project [that's this one] program."
- "Geologic observation, seismicity data, and geophysical data all demonstrate that the Hosgri
 fault zone is a right-lateral strike-slip fault that dips steeply (75°-90°) northeast to a depth of
 12–14 km in the vicinity of the Diablo Canyon power plant."
- "evidence for recent fault rupture between the Hosgri and San Simeon fault zones is not well
 imaged in some locations, [although] the data do not preclude the existence of fault linkage at
 seismogenic depths"
- "Chapter 13 presents a ground-motion hazard sensitivity analysis for the linkage of the Hosgri and San Simeon faults, and a combined rupture of the Hosgri–San Simeon and Shoreline faults"

Land seismic surveys

Chapter 7 – Description of the Geologic Mapping Project conducted by PG&E and also reported separately, well data from Honolulu-Tidewater #1, and introduction of natural seismicity, gravity and magnetic data, although the primary data presented in the chapter is 2D accelerated weight-drop (AWD) and a small vibro-seis 3D(?) volume of seismic reflection data. Several cross sections are drawn and the Pismo Syncline is described. The purpose was to evaluate the geometry of the Los Osos, San Miguelito, and San Luis Bay faults, as well as illuminate the deeper structure of the Pismo Syncline and the Edna fault system within the central Irish Hills.

Important conclusions:

- "The Pismo syncline in the central and southern Irish Hills is the deformed remnant of a Neogene extensional basin."
- The basin was bounded on the north by the Edna fault zone(s), fairly large basin bounding
 normal faults. The southern margin of the basin (now the southern limb of the Pismo Syncline)
 was formed by several smaller north-dipping normal faults, which have been inverted to reverse
 faults during synclinal folding. Many of these faults are "blind", i.e. are not exposed at the
 surface and are interpreted from seismic data.

- Folds are mappable at the surface.
- The overall interpretation is one of a negative flower structure that formed during a transtensional phase of slip, and that was later inverted during transpressional slip.
- · All faults are interpreted as steeply dipping.

Chapter 8 – 3D seismic reflection survey confined to an onshore area around the Diablo Canyon Power Plant about 3 x 5 km ("Phase 1"), and a small shoreline strip southeast of the power plant about 3 km long by 0.5 km wide including the Rattlesnake fault at the shoreline ("Phase 2"). Data collected and analyzed by Fugro. Detailed geologic map of the area around the power plant. The goal was to identify structures that might be significant to seismic hazard analysis of the power plant, and provide input data for ground motion modeling at the power plant site.

Important conclusions:

- "... folding in buried reflector packages consistent with out-of-syncline parasitic folding that discordantly detached and shortened Obispo volcaniclastic strata off of stiffer, relatively undeformed diabase bodies... folding event is old and no longer active, and took place during the compressional uplift event that inverted the ancestral Pismo Basin into the deeply eroded Pismo syncline."
- "Despite differences in elevation between time-correlated uplifted terraces, the terraces
 themselves remain horizontal, indicating that the style of late Quaternary deformation of the
 western Irish Hills is characterized by rigid block uplift with little or no rotation."
- ...[in Phase 1 area] "no throughgoing steep or vertical reflector truncations were observed that
 would indicate the presence of a significant steep fault offset. ... Any throughgoing faulting in
 the reflective depth range of 0 to 0.3 km would have to follow shallow to flat unconformities."
- [The updated surface mapping] "shows steep, generally north dipping Obispo volcaniclastic strata exposed along Discharge Cove. The tomography indicates that these steeply dipping strata are underlain by a shallowly north-dipping diabase intrusive. Future efforts that would consider the construction of a stratigraphic cross section through the Phase 1 area must be very wary of using only the surface dip data, and should honor the nearly flat-lying subsurface velocity structure as well."
- "Three lineaments mapped on the bedrock surface beneath the marine terrace sediments in the Phase 2 area merit investigation as potential faults. In order to directly examine the potential fault plane, ground-based investigations of the bedrock platform surface and the overlying Quaternary sediments would be required"

Chapter 9 – Results of Geologic Mapping Project, intended to help interpretation of onshore seismic reflection data. Data presented includes previously published and unpublished geologic maps plus new data collected in this study. There is a section dedicated to the Los Osos fault zone. One conclusion is: "new mapping in the vicinity of the Edna, Los Osos, San Luis Bay, San Miguelito, and Shoreline fault zones does not introduce any new hard constraints on fault location, dip, slip direction, or slip rate". Data presented in this chapter is also used in chapters 7 and 8.

Appendices contain daily field reports, photographs, sample catalogue, an Arc GIS catalogue of shapefiles and other information relating to data acquisition and geologic mapping in the Irish Hills, and a compilation of (primarily) stratigraphic data from 18 of 34 wells (26 oil and 8 hydrogeologic).

Important conclusions:

- "Edna and San Miguelito fault zones—minor changes to the geologic units adjacent to the faults."
- "Los Osos fault zone—minor changes to the geologic units adjacent to the fault zone, and changes to the depiction of the fault zone along the northern margin of the Irish Hills (including removal of the concealed, northwest-trending fault across southern Morro Bay)."
- "Shoreline fault zone—minor changes to the geologic units and bedrock faults adjacent to the fault zone for the reaches opposite Olson Hill and the Diablo Canyon power plant."
- "San Luis Bay fault zone—minor changes to the geology adjacent to the fault zone along the
 outer coast from Olson Hill to Rattlesnake Creek, and the addition of a generalized, concealed,
 and locally queried trace in San Luis Obispo Bay and on the outer coast between the Rattlesnake
 fault and the Olson Hill deformation zone."

Geotechnical studies

Chapter 10 – provides a 3D shear-wave velocity (V_s) model for the Diablo Canyon power plant foundation area. Both 3D acoustic compressional-wave velocity (V_P) models and one-dimensional V_{s^-} depth profiles constrained by surface-wave dispersion were developed within the Diablo Canyon power plant site.

Important conclusions:

- There is significant spatial variability in V_{s-30} [shear-wave velocity in the top 30 meters]
 throughout the Diablo Canyon power plant site due to variations in near surface geology.
- The shear-wave-velocity model is used as input into the Site Conditions Evaluation report in Chapter 11.

Chapter 11 – Site conditions evaluation as relevant to the modeling of ground motion at the Diablo Canyon power plant site.

Chapter 12 – Addresses testimony from Dr. Douglas Hamilton concerning two postulated faults: the Diablo Cove and the San Luis Range/Inferred Offshore faults. In addition to using selected data from Hamilton, a variety of other PG&E reports, and published literature, this chapter uses data from chapters 2, 4, 7, 8, and 9 in Central Coastal California Seismic Imaging Project (this) report.

Important conclusions: Essentially they conclude that the Diablo Cove fault is a non-issue, and that the San Luis Range/Inferred Offshore fault – although not there – will be accounted for in their new seismic source characterization [hmmm].

- "We conclude that the Diablo Cove fault does not represent a seismic hazard to the Diablo
 Canyon power plant, and there is no basis for considering the Diablo Cove fault as proposed by
 Hamilton ... to be either a fault displacement hazard or a seismic source of strong ground
 motions. We make this conclusion based on the following key points:
- Trench and excavation mapping conducted prior to construction of the Diablo Canyon power
 plant documented that the fault zone is discontinuous, is associated with minimal offset, and
 does not displace marine terrace deposits that are 120 ka. Thus, the faulting where observed
 directly is minor and inactive in the late Pleistocene.
- Geologic mapping and interpretation of multibeam echo sounder imagery do not support connecting the Diablo Cove fault offshore to the Shoreline fault zone.
- There is no basis for correlating seismicity with the Diablo Cove fault based on an evaluation of microearthquake locations and consideration of their location uncertainty.
- The short length of the Diablo Cove fault zone—probably less than half a kilometer—is not
 consistent with a down-dip width of several kilometers that would extend the fault to
 seismogenic depths.
- Structural analysis of geologic data and high-resolution 3D land seismic data at the Diablo
 Canyon power plant supports an interpretation, shared by the original mappers of the faults,
 that the faulting is related to shallow fold deformation and shortening that predates the late
 Quaternary and probably dates to the Miocene or Pliocene. The faulting may or may not be
 related to a Miocene diabase intrusion imaged directly north of the north-dipping Diablo Cove
 fault at shallow depths. Based on this interpretation, the fault extends to only a few tens to
 hundreds of meters depth."
- We conclude that there is no clear evidence in the available data to support the presence of [the San Luis Range/Inferred Offshore thrust fault], and there is evidence that precludes its presence. Accordingly, there is no basis for considering the San Luis Range/Inferred Offshore thrust to be a seismic hazard to the Diablo Canyon power plant as proposed by Hamilton. We make this conclusion based on the following key points:
- Analyses of multibeam echo sounder bathymetry data and seismic-reflection data do not
 support the interpreted uplift rate boundary across the San Luis Range/Inferred Offshore thrust
 fault proposed by Hamilton. Instead, interpretations of the data are consistent with a very low
 or negligible change in uplift rate where the San Luis Range/Inferred Offshore thrust fault is
 interpreted to impinge on the Shoreline fault zone and where the SLRF is interpreted to diverge
 from the Shoreline fault zone south of Point Buchon. Interpretations of coastal marine terrace
 data and offshore marine terraces are consistent with uplift rate boundaries that instead
 coincide with other structures considered by PG&E in past seismic hazard analyses.
- We disagree with the assertion by Dr. Hamilton that the San Luis Range/Inferred Offshore thrust fault interpretation is required to fit the observed pattern of coastal terrace uplift and instead suggest the observed pattern of coastal uplift may be matched by several proposed fault geometries, including those proposed by PG&E in past seismic hazard analyses.

- We disagree with the assertion by Dr. Hamilton that the seismicity data beneath the Irish Hills show a clear alignment supporting the San Luis Range/Inferred Offshore thrust fault at depth.
 The seismicity data can be interpreted in different ways to support many different fault models.
- Interpretation of land seismic-reflection data do not show evidence for a gently to moderately dipping San Luis Range/Inferred Offshore thrust fault beneath the southern Irish Hills in the general location proposed by Hamilton. Instead, interpretations of the seismic-reflection data show steeply north-dipping structures down to approximately 7 km depth or deeper that coincide with recognized faults (the Irish Canyon and San Luis Bay) at the surface. The interpretation of these steeply dipping structures to depth precludes the presence of the San Luis Range/Inferred Offshore thrust fault.
- Although the specific San Luis Range/Inferred Offshore thrust fault interpretation by Hamilton is not well supported by the available data, and by no means can be held up as a unique or preferred interpretation, the general solution of a primary, north- or north-northeast-dipping fault beneath the Irish Hills is consistent with several observations, and is a possible fault model that should be considered for seismic hazard analysis to the Diablo Canyon power plant. We note that the interpretations by Hamilton are being considered for evaluation and integration with other available data following the Senior Seismic Hazard Analysis Committee Level 3 process. The Senior Seismic Hazard Analysis Committee program for the Diablo Canyon power plant, which is being performed under regulatory review by the NRC, is creating a new seismic source characterization model.

Chapter 13 – Evaluation of sensitivity of the deterministic ground motions that were presented in the PG&E Shoreline Fault Zone Report (2011) to the seismic source characterizations for the Shoreline and Hosgri faults, using new ground motion models developed by the Pacific Earthquake Engineering Research (PEER) center as part of their "Next Generation Attenuation" program.

Important conclusion:

 "For all the cases considered in this sensitivity study, the 84th percentile ground motions for the power-block and turbine-building foundation levels are bounded by the 1977 Hosgri spectrum."

[In other words, their former analysis is not affected by any of the new data/interpretations.]

Chapter 14 – The findings and conclusions of the Central Coastal California Seismic Imaging Project report [this one].

Important conclusion:

 "These studies confirm previous analyses that the plant and its major components are designed to withstand—and perform their safety functions during and after—a major seismic event."

From:John Stamatakos

Sent:13 Apr 2015 15:00:17 +0000

To:Miriam R. Juckett

Subject:DiabloCanyonPowerPlant - seismic risk data survey April 2015 Attachments:DiabloCanyonPowerPlant - seismic risk data survey April 2015.docx

Can you look this over quickly?

I want to hand out at today's meeting.

J

Sarah Wigginton

From:Sarah Wigginton
Sent:8 Apr 2015 19:21:56 -0500
To:Ronald McGinnis;David Ferrill
Cc:Alan Morris
Subject:Document Catalogue
All,

Here is a link to the completed portion of the Document Catalogue for Diablo Canyon. Z:\Diablo Canyon\Document Catalog COMPLETE.xlsx

I have about 300 more pages to go in the very last PDF, but I'll be doing that work in a separate excel file (\\REGIOS\Demps\Diablo Canyon\Diablo Canyon\Document Catalogue IN PROGRESS.xlsx) so it won't interfere with any work you all do on the completed portion.

Best, Sarah

Sarah Wigginton

Department of Earth, Material, and Planetary Sciences Geosciences and Engineering Division Southwest Research Institute 6220 Culebra Road, San Antonio, TX 78238, USA

Osvaldo Pensado

From:Osvaldo Pensado

Sent:30 Apr 2015 18:22:54 -0500

To:John Stamatakos

Subject:Function for excel

Okay John.

What is the charge number?

Doing your problem in Mathematica is quite simple. In Excel ... not so much. I give you instructions to get the trapezoidal function in Excel.

For the trapezoidal function for the offset:

a = 15

b=26

c=35

d = 43

p is a random number uniformly sampled between 0 an 1. It can be sampled with Excel using p=Rand().

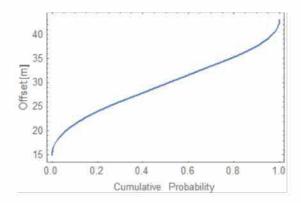
Apply it to randomly sampled values of p=Rand() in Excel.

The formula is a big sausage with nested if-then statements. At least it is a closed formula. There is a high chance to make a typographical error, though.

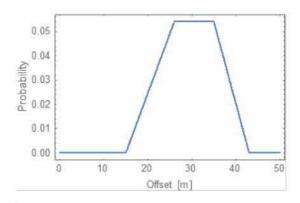
You should consider programming the formula in a macro.

$$\begin{aligned} & \text{trapezCDFInv}[p_, a_, b_, c_, d_] \coloneqq \text{If}[0 \le p \ \& \ p \\ & < \frac{b-a}{-a-b+c+d}, a + \sqrt{a^2p-b^2p-acp+bcp-adp+bdp}, \\ & \text{ElseIf}[\frac{b-a}{-a-b+c+d} \le p \ \& \ p < \frac{a+b-2c}{a+b-c-d}, \frac{1}{2}(a+b-ap-bp+cp+dp), \\ & \text{ElseIf}[\frac{a+b-2c}{a+b-c-d} \le p \ \& \ p \\ & \le 1, d-\sqrt{ac+bc-c^2-ad-bd+d^2-acp-bcp+c^2p+adp+bdp-d^2p}]]] \end{aligned}$$

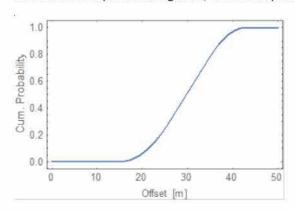
This is the plot of the trapezCDFInv function



I derived the formula from the following trapezoid:



This is the CDF: parabola segment, followed by a straight line, ending in another parabola segment.



I felt like programming the formula in Excel for you, but I changed my mind when I saw the sausage. I can do the Monte Carlo in no time in Mathematica. I do not feel like touching the sausage.

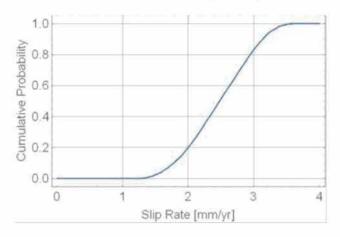
For a Triangular function the formula to use is

```
cdfTriangInv[p_, a_, b_, c_]: = If[p 
 \leq (b-a)/(c-a), a + \text{Sqrt}[(b-a)*(c-a)*p], c - \text{Sqrt}[(c-a)*(c-b)*(1-p)];
again, p=Rand()
```

To give you an idea on how simple the problem is in Mathematica, this would be the Latin hypercube sampling program (which will be better than random sampling you will do in Excel):

And the slip rate is

Plot[CDF[d1, x], {x, 0,4}, Frame \rightarrow True, BaseStyle \rightarrow 14, GridLines \rightarrow Automatic, FrameLabel \rightarrow {"Slip Rate [mm/yr]", "Cumulative Probability"}]



Dr. Osvaldo Pensado

Group Manager, Risk Analysis and Performance Assessment Geosciences and Engineering Division (210) 522-6084 opensado@swri.org Sent:29 Apr 2015 16:07:18 +0000

To: Violeta Gonzales

Subject:FW: Diablo Canyon

Are you familiar with the bridge line procedure for phone calls?

From: John Stamatakos

Sent: Wednesday, April 29, 2015 11:06 AM

To: Ronald McGinnis

Subject: RE: Diablo Canyon

We have one we use for management meetings .. ask Violet.

From: Ronald McGinnis

Sent: Wednesday, April 29, 2015 12:05 PM

To: John Stamatakos

Subject: RE: Diablo Canyon

I have no idea. Never used one. I will ask.

From: John Stamatakos

Sent: Wednesday, April 29, 2015 11:04 AM

To: Ronald McGinnis

Subject: RE: Diablo Canyon

Ronnie, do we have a bridge line we can use?

John

From: Ronald McGinnis

Sent: Wednesday, April 29, 2015 10:37 AM

To: John Stamatakos

Subject: RE: Diablo Canyon

Sounds good.

From: John Stamatakos

Sent: Wednesday, April 29, 2015 9:35 AM

To: Ronald McGinnis

Subject: RE: Diablo Canyon

Office ... or we may use a bridge if I want to bring in NRC.

From: Ronald McGinnis

Sent: Wednesday, April 29, 2015 10:33 AM

To: John Stamatakos

Subject: RE: Diablo Canyon

We will call you. Office or cell?

From: John Stamatakos

Sent: Wednesday, April 29, 2015 9:16 AM

To: Ronald McGinnis

Subject: RE: Diablo Canyon

OK

From: Ronald McGinnis

Sent: Wednesday, April 29, 2015 10:00 AM

To: John Stamatakos Subject: RE: Diablo Canyon

John,

How about 2:00 our time?

-Ronny

From: Ronald McGinnis

Sent: Tuesday, April 28, 2015 1:55 PM

To: John Stamatakos Subject: RE: Diablo Canyon

Should work. I will get a time and let you know.

From: John Stamatakos

Sent: Tuesday, April 28, 2015 1:53 PM

To: Ronald McGinnis

Subject: RE: Diablo Canyon

I am in a Diablo meeting right now. We should have a call tomorrow.

I'll have to look at my schedule but could you ask your folks so we can set up a good time?

John

From: Ronald McGinnis

Sent: Tuesday, April 28, 2015 1:35 PM

To: John Stamatakos Subject: RE: Diablo Canyon

John,

We just got back in the office from two weeks of travel. David and I are in the office this week and then gone again next week. How did the meeting with NRC go? I got your voicemail asking about the GIS file but I didn't get it until yesterday.

Do we have the go ahead for Phase 2? If so, we may want to have a phone call this week to go over the details.

Thanks, Ronny

From: John Stamatakos

Sent: Friday, April 10, 2015 3:04 PM

To: Ronald McGinnis

Cc: David Ferrill; Alan Morris (b)(6); Kevin Smart; Sarah Wigginton; Miriam R. Juckett

Subject: RE: Diablo Canyon

I mean Ronny ... sorry I know better

From: John Stamatakos

Sent: Friday, April 10, 2015 4:02 PM

To: Ronald McGinnis

Cc: David Ferrill; Alan Morris (alanmrrs0@gmail.com); Kevin Smart; Sarah Wigginton; Miriam R. Juckett

Subject: RE: Diablo Canyon

Thanks Ronnie,

Outstanding job. I am very pleased with the progress so far.

john

From: Ronald McGinnis

Sent: Friday, April 10, 2015 3:58 PM

To: John Stamatakos

Cc: David Ferrill; Alan Morris (b)(6); Kevin Smart; Sarah Wigginton

Subject: RE: Diablo Canyon

John,

We are not quite finished with the data quality tab in the spreadsheet so that will have to continue, but all the data has been reviewed and is represented by a row in the following linked spreadsheet.

Y:\Diablo Canyon\Diablo Canyon\Document Catalog COMPLETE.xlsx

Also, we are working on an ArcGIS project that helps to organize the seismic data. It should be finished by COB today. That link is at Y:\Diablo Canyon\Diablo Canyon\Diablo Canyon\Diablo Canyon March 2015.mxd

The review document is at T:\Diablo Canyon\Diablo Canyon\CNWRA report April 2015\DiabloCanyonPowerPlant - seismic risk data survey April 2015.docx

All the rest of the files are in the Diablo Canyon folder on regios.

Let us know if you have any questions.

-Ronny

From: John Stamatakos

Sent: Friday, April 10, 2015 2:48 PM

To: Ronald McGinnis Subject: Diablo Canyon

Can I review all the files so I can present at NRC on Monday?

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

Sent:27 Mar 2015 20:19:55 +0000

To:Alan Morris; Alan Morris

Subject:FW: Diablo Canyon Review Not sure why you weren't copied...

From: John Stamatakos

Sent: Friday, March 27, 2015 3:01 PM

To: Ronald McGinnis; David Ferrill; Amy Minor; Kevin Smart

Cc: Miriam R. Juckett

Subject: Diablo Canyon Review

I've place most of my Diablo Canyon files on the DEMPS server (Demps\regios).

There are a series of reports that Pacific Gas & Electric (POG&E) produced over the last few years.

- Shoreline and RIL: The Shoreline report was submitted by PG&E in 2011 and we (with NRC review if in 2012). The Regulatory Information Letter (RIL 12-01) is that review. This report and review focused on the Shoreline fault and potential implications to the Licensing Basis for the plant. But the reports offer some good general background information. Other files in this folder are related to the Shoreline Report and the RIL.
- DCPP Shoreline and Thrust Fault Allegation: In addition to the Shoreline Report, NRC had us look at an allegation made by a former PG&E consultant about other possible faults and the plant. Alan helped me on one of the allegations (possible blind thrust beneath the plant site).
- Central Coastal California Seismic Imaging Project: The California state legislature passed a bill
 after the Shoreline Report authorizing PG&E to collect boat load of new seismic imaging
 data. This report is essentially a data dump of that work, and it has the bulk of what I would like
 you all to look at.
- 4. LTSP: This is an old PG&E report (1991) that may also be useful as background.
- NTTF DCCP PSHA Review: This is the actual new seismic hazard study that we are
 reviewing. We will need to cross reference the conclusions about faults (do they exist, their
 geometry, slip rate, length and area, etc.) based on seismic imaging to the data in the CCCSIP
 report.
- Diablo Canyon ISFSR SER: This was our review of the site back in early 2000's for the Independent Spent Fuel Storage Installation (ISFSI). May be useful as background information.
- 7. **Figure**: is a folder I use to put in various figures and some of my Diablo Presentations and related images.

For reference: http://www.pge.com/en/safety/systemworks/dcpp/seismicsafety/index.page

This link gets you to most of these reports on line.

Work Scope:

I have five progressive tasks in mind.

 Look through the CCCSIP documents and develop a summary (catalog) of all the seismic imaging data that's there. Identify the who, what and where and assess its quality and possible

- usefulness to the PSHA. I think we can do this relatively quickly. We can even bring on a temp/student if available and willing to work on this. NRC wants to be able to say that they are familiar with all the data and have looked it over as part of the review. I would like to have a very quick deliverable on this (couple of pages?) relatively soon.
- Identify which data in the CCCSIP report is actually relied on to develop conclusions in the new PSHA. Assess the validity of the structural/seismic interpretations from the quality of the seismic imaging data. This may take a bit longer than task 1, but I hope we can do this relatively quickly.
- 3. Identify potential faults in the data sets that may have been overlooked by the PSHA technical team. I am **not** suggesting we identify any vague targets, but if you see images that in your view (and based on your experience) are very likely significant faults, we should tag them and assess their potential to influence the seismic hazard at the site.
- 4. For those critical data sets identified in task 2, complete a technical review of the data and the interpretations. This will be included in our write up for the overall PSHA assessment.
- 5. Review the 3D data collected in the Irish Hills to reassess the blind thrust fault model (I think it is now referred to as the San Luis Range Thrust).

I'll walk you all through this again next week and provide some more background on the PSHA and how we can assess whether fault sources can be important to the PSHA next week.

Thanks,

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

Sent:28 Apr 2015 18:56:06 +0000

To:David Ferrill;Alan Morris;Kevin Smart;Sarah Wigginton

Subject:FW: Diablo Canyon

Is there a particular time that works for you all? I am good any time.

From: John Stamatakos

Sent: Tuesday, April 28, 2015 1:53 PM

To: Ronald McGinnis

Subject: RE: Diablo Canyon

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From: John Stamatakos

Sent: Friday, April 10, 2015 3:04 PM

To: Ronald McGinnis

Cc: David Ferrill; Alan Morris (b)(6)); Kevin Smart; Sarah Wigginton; Miriam R. Juckett

Subject: RE: Diablo Canyon

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Sent: Friday, April 10, 2015 4:02 PM

To: Ronald McGinnis

Cc: David Ferrill; Alan Morris (b)(6)); Kevin Smart; Sarah Wigginton; Miriam R. Juckett

Subject: RE: Diablo Canyon

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The review document is at T:\Diablo Canyon\Diablo Canyon\CNWRA report April 2015\DiabloCanyonPowerPlant - seismic risk data survey April 2015.docx

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-Ronny

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Sent: Friday, April 10, 2015 2:48 PM

To: Ronald McGinnis Subject: Diablo Canyon

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John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

From:John Stamatakos

Sent:22 Apr 2015 02:20:23 +0000

To:Miriam R. Juckett

Subject:FW: diablo scenario events

From: Munson, Clifford [mailto:Clifford.Munson@nrc.gov]

Sent: Tuesday, April 21, 2015 11:46 AM

To: Ake, Jon; John Stamatakos; Graizer, Vladimir

Cc: Heeszel, David

Subject: diablo scenario events

John,

Would you come up with some plausible scenario events for Hosgri in terms of the parameters listed below (as a spreadsheet?). I coded the SWUS GMM for T=1 sec. There are 31 median models each with a unique set of 10 coefficients. I just read in their electronic file as a 31 by 10 matrix to avoid typing errors. I also coded up the total sigma (3 branches with 2 coefficients for each branch).

The input parameters are:

- 1. Magnitude (mag)
- 2. Depth to top of rupture (ztor) in km
- 3. Rupture distance (rrup) in km
- 4. Joyner-Boore distance (rjb) in km
- 5. Fault dip angle (dip) in degrees
- 6. Down-dip rupture width (ddrw) in km
- 7. Horizontal distance from top of rupture measured perpendicular to strike (Rx) in km
- 8. Fault type (REV,NRM, or SS) depending on rake angle

I will proceed to code T=0.1 sec and maybe some more periods if I have time.

I would like to verify our results somehow before we merge these codes with Roland's.

Thanks, Cliff

From:John Stamatakos

Sent:22 Apr 2015 02:21:53 +0000

To (b)(6)

Subject:FW: diablo scenario events

From: Munson, Clifford [mailto:Clifford.Munson@nrc.gov]

Sent: Tuesday, April 21, 2015 11:46 AM

To: Ake, Jon; John Stamatakos; Graizer, Vladimir

Cc: Heeszel, David

Subject: diablo scenario events

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- 8. Fault type (REV,NRM, or SS) depending on rake angle

I will proceed to code T=0.1 sec and maybe some more periods if I have time.

I would like to verify our results somehow before we merge these codes with Roland's.

Thanks, Cliff

From:John Stamatakos

Sent:4 May 2015 18:01:22 +0000

To:Stovall, Scott (Scott.Stovall@nrc.gov)

Subject:FW: Diablo SSC

Attachments: Diablo Canyon Seismic Source Characterization Review 1.pdf

From: John Stamatakos

Sent: Monday, May 4, 2015 9:37 AM
To: Graizer, Vladimir (Vladimir.Graizer@nrc.gov)

Subject: FW: Diablo SSC

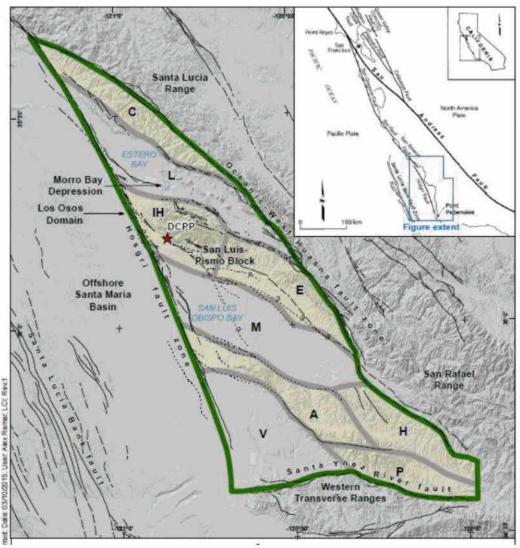
From: John Stamatakos [mailto (b)(6)
Sent: Monday, May 4, 2015 9:33 AM

To: John Stamatakos Subject: Diablo SSC

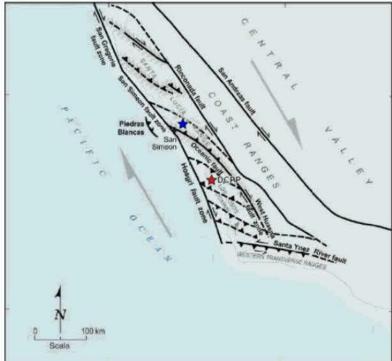
DIABLO CANYON SEISMIC SOURCE CHARACTERIZATION REVIEW

John Stamatakos 5/4/2015

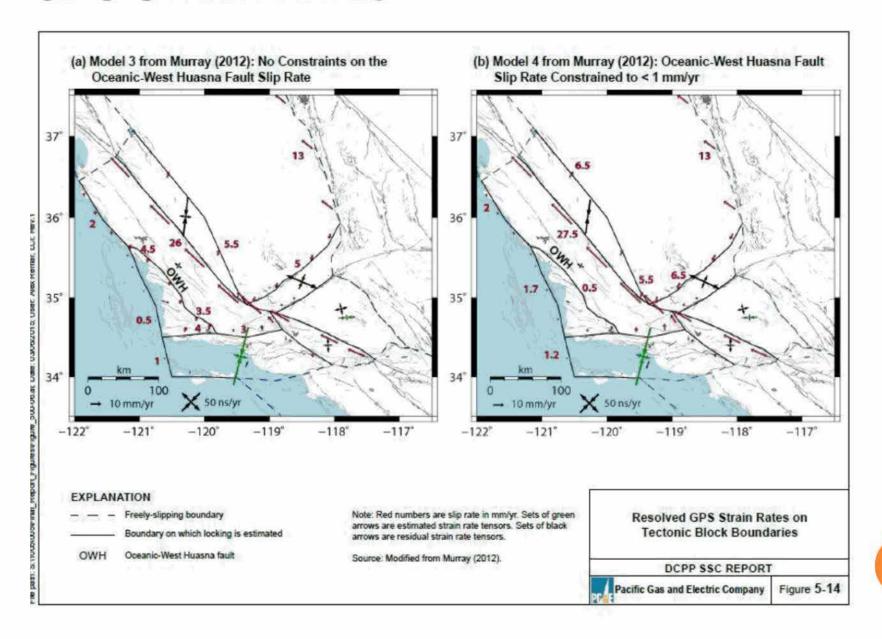
CONTEMPORARY TECTONIC SETTING



Dextral strike-slip plate boundary with transpression

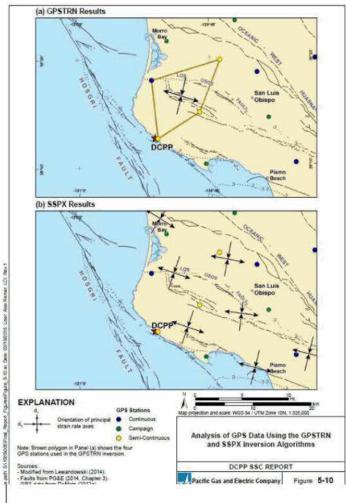


GPS STRAIN RATES



Fault Heave Rates UCERF3_final_GPS_edited.gps, relative to P523 Santa Yriez (West) 120"45" EXPLANATION Heave Rate Components* R = right-lateral L = left-lateral Low-angle thrust plate High-angle thrust P = compressional (perpendicular to strike) Dextral * All rates in mm/a. Sinistral High-angle normal GPS Strain Rates from the NeoKinema Model Low-angle normal in South-Central Coastal California Change in horizontal velocity across fault (mm/a) Note: Fault widths are scaled by slip (heave) rate. DCPP \$\$C REPORT Sense of slip is coded by color. Source: Modified from Bird (2012). Pacific Gas and Electric Company Figure 5-15

MORE STRAINS



FAULT SOURCES

- Geometry
- Faulting Style (SS, Reverse, Composite)
- Ruptures and Rupture Segments
- Slip Rate
- Slip Rate Allocation (on ruptures)
- Magnitude Distribution Models
- Time Dependency

^{*}Areal Sources and Distant Fault Sources ... another day

Time Dependency Model (Equivalent Poisson Ratio)		Fault Geometry Model	Rupture Model	Slip Rate Allocation Model (mm/yr)	Magnitude Distribution Model		
					Magnitude PDF	M _{max}	M _{char}
						8.5 [0.1]	7.3
		1100	H85-01	4.00	WAACY	/	[0.2]
	1.9	H90	H00-U1	1.23	Contract and Contract	8.1	7.1
	[0.25]	[0.2]		[0.185]	[0.8]	[0.5]	[0.5]
				/		7.8	6.8
	/	LINE	H85-02	0.40		[0.4]	[0.3]
Hosgri Source	[0.5]	[0.6]	1103-02	0.40		-	
				[0.630]			
				\		8.5	_
					Truncated	[0.1]	
	0.3	H75	H85-07	0.13	Exponential	8.1	N/A
	[0.25]	[0.2]		[0.185]	[0.2]	[0.5]	
						7.8	-
				0.067		[0.4]	6.8
	4.0	01/		[0.185]	Characteristic		[0.2]
	1.6 [0.25]	OV	SW-01	0.018	Earthquake	N/A	6.5
	[0.25]	[0.4]		[0.630]	[1.0]		[0.5]
		/		0.005			6.3
01.00		/		[0.185]			[0.3]
SLBP	1.1	SW	SW-04				
Jources	[0.5]	[0.4]					
			SW-05	0.164			6.4 (main)
			LANCETTA A	[0.185]	Simplified	N/A	[1.0]
	0.3	\ NE	SW-06	0.087	Maximum Magnitude	IN/A	
	[0.25]	[0.2]		[0.630]	[1.0]		6.3 (splay)
				0.046			[1.0]
				[0.185]			
			SW-10				
					Logic Tree S	structure for	the Primary

Notes: In the example tree, rupture source H85-02 is a longer *linked* rupture source, so the WAACY and truncated exponential magnitude PDF models are considered. Rupture source SW-01 is a *characteristic* rupture source, so only the Youngs and Coppersmith (1985) characteristic earthquake magnitude PDF is considered. Rupture source SW-06 is a splay rupture source, so only the simplified maximum magnitude earthquake magnitude PDF model is

Logic Tree Structure for the Primary and Connected Fault Sources

DCPP SSC REPORT

PGGE Pacific Gas and Electric Company

Figure

6-1

FAULT GEOMETRY MODELS (FGM)

- Three Hosgri FGMs
- Three San Luis-Pismo Block (SLPB) FGMs

Table 6-4. Fault Geometry Models (FGMs) and Logic Tree Combinations

	SLPB FGMs				
Hosgri FGMs	Outward-Vergent (OV)	Southwest-Vergent (SW)	Northeast-Vergent (NE)		
Hosgri 90 (H90)	H90/ OV	H90/ SW	H90/ NE		
Hosgri 85 (H85)	H85/ OV	H85/ SW	H85/ NE		
Hosgri 75 (H75)	H75/ OV	H75/ SW	H75/ NE		

- About 40 rupture segments
 - Three sets of rupture segments (for the three SLPB FGMs)

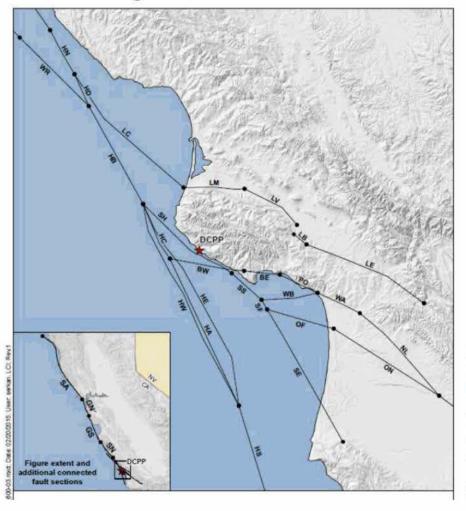
Figure extent and additional connected fault sections

RUPTURE SEGMENTS

Outward-Vergent

MORE RUPTURE SEGMENTS

SW-Vergent



NE-Vergent



EXAMPLE: HOSGRI FAULT RUPTURE MODELS

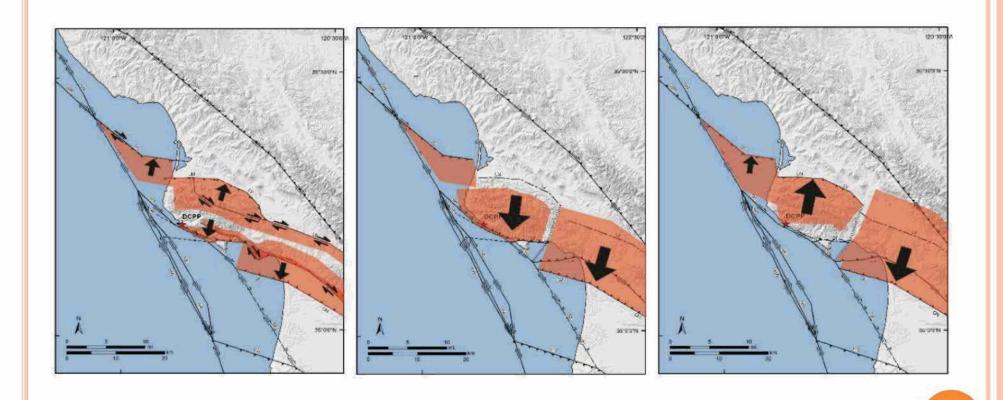
Table 9-3. Hosgri Fault Rupture Model

Rupture Source Number	Туре	Description	Fault Sections ¹ (closest section to the DCPP in bold)	Sense of Slip
H-01	Linked	Hosgri (Central trace) to MTJ²	HS+HA+HC+HB+HD+ HN+SI+SN+GS+GN+S A	Strike slip
H-02	Linked	Hosgri (West trace) to MTJ	HS+HW+HB+HD+HN+ SI+SN+GS+GN+SA	Strike slip
H-03	Linked	Hosgri (East trace) to MTJ	(East HS+HE+HB+HD+HN+S Strike	
H-04	Complex	Hosgri (Central trace) with Piedras Blancas	HS+ HA +HC+HB+WR (primary fault); PB (secondary fault)	Primary = strike slip Secondary = reverse
H-05	Splay	Splay Shoreline with HS+HA+HC HN+SI+SN (main fault) SE+SS+SH		Strike slip
H-063	Linked	Hosgri north of the Shoreline fault intersection	HB+HD+HN+SI+SN+G S+GN+SA	Strike slip
H-073	Linked	Hosgrinorth of the Los Osos fault intersection	HN+SI+SN+GS+GN+S A	Strike slip
H-08 ³	Characteristic	Piedras Blancas	РВ	Reverse

¹ Two-letter codes are explained in Table 6-5 and on Plate 9-1.
² MTJ = Mendocino Triple Junction

³ Same down dip geometry is used for all three HosgriFGMs.

THREE SLPM FGMs

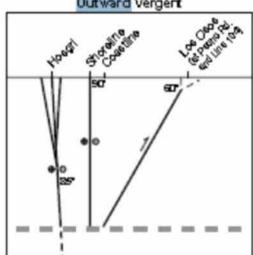


THREE SLPB FGMs

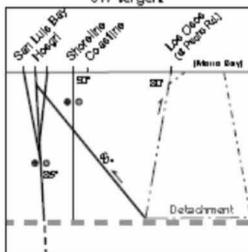
Parameter Values, Los Osos Fault

	Outward Vergent	SW Wargent	NE Wengent	1		We ighted
Model	Weight 0.4	Weight: 0.4	Weight 0.2	Pa.	TEX.	mean
Los Osos	IC+LM+LV+LE	LC+UM+UM-U	IC+UM+U+U		muz	me ry
Dip	60	20	50	20	20	66
Dip Direction	WZ	SW	ZW			
Sty & of faulting	RVP-O	R	k			
Depth to to p	1	1	1	1	1	1
Width	13	11	14	11	14	12 A

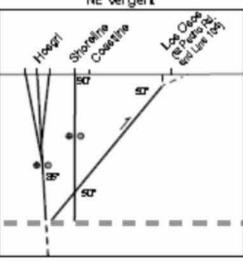




SW Vergent



NE Vergent



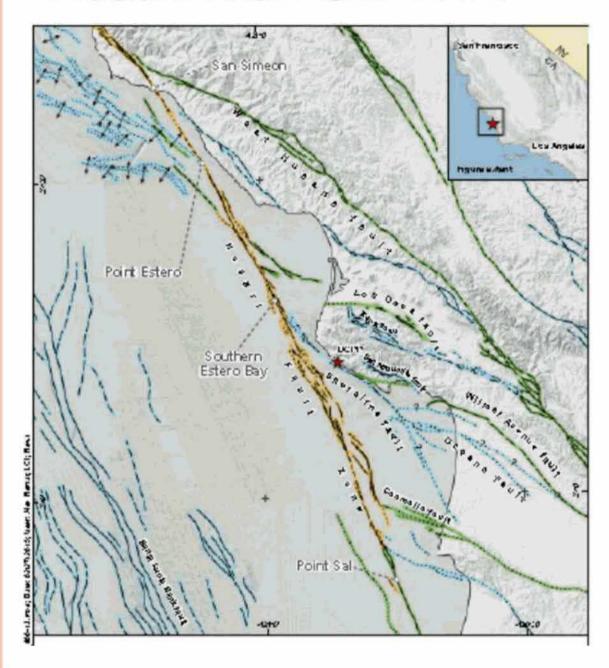
Note: Cross section D-D'shown to like trate Lill section of Los Osos taxit, the closest section to the DCPP.

Lo I O I o I Pault Parameter Value I

CCPP \$ \$C REPORT

Racific Gas and Electric Company | Fig. R. 7-29

HOSGRI FAULT SLIP RATE

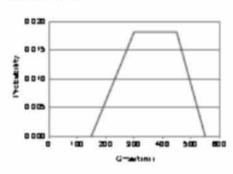


Slip Rate determined from four points

- San Simeon
- · Point Estero
- Estero Bay
- Pont Sal

SLIP RATE ESTIMATES

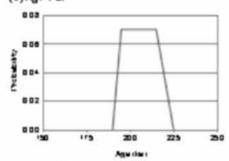




(b) Justification for Offset PDF

//aine	Omet(m)	Biti
шh.	150	Uncertainty in the graphed on of the terrace touch edge and the stage and sure of the patient earlier of patients and present during terrace to make the maken.
Pretined	300	Cured meaning of the perception who will at the HIL
Prete med	450	Apparent precing gord of set and presence of socured area! headland
max.	990	Uncertainty in the projection of the territors back, edge and the aftergrand are of the galesteed and present during less towns formation.

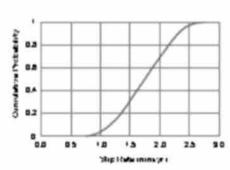
(c) Age PDF



(d) Justification for Age PDF

Value	Age (Na)	Biti
Mh.	190	Youngest substage higher and within MIS-1 (Campton, 2011)
Preferred	196	hand MS fage of he
Pretend	215	busco (Hanson and Letts, 1924)
Max.	225	Orderal autorisings highward within MIS (15 condison 2011)

(+) SIID Rate COF



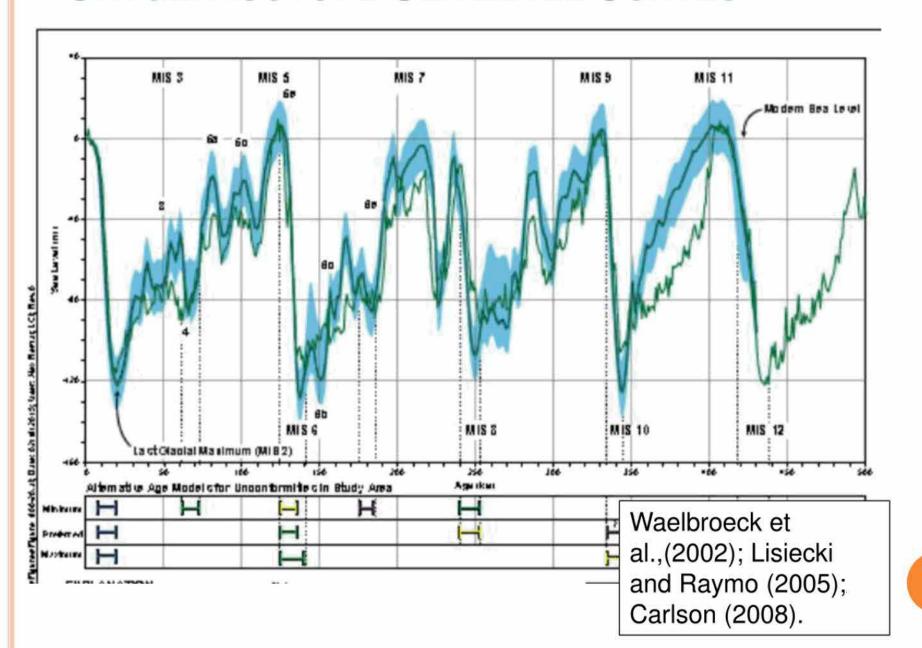
(f) Summar; Statutes

Cumula 1 w Probabilit:	Slip Rate (mm/;r)
80.0	1.0
D.1	1.2
02	1.4
0.5	1.8
8.0	2.2
0.9	2.3
0.95	2.4
Mh.	0.7
Mac.	2.8
Mean	1.8

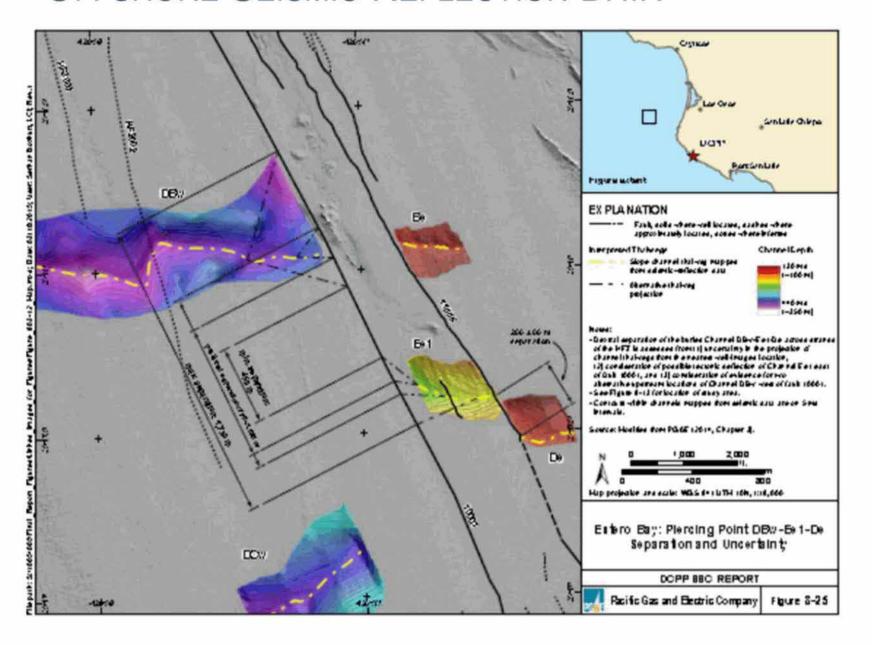
Slip Rates estimates are derived from probability distribution functions (triangle or trapezoidal distributions) for measured slip and estimated of offset age

We are developing an Excel spreadsheet to test variations In these models.

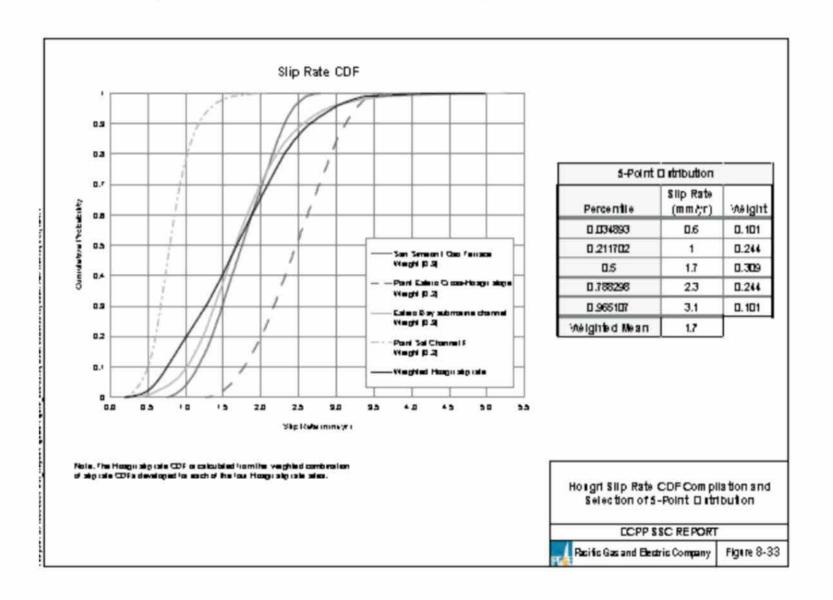
OXYGEN ISOTOPE SEA LEVEL CURVES



SLIP BASED ON OFFSET MARKERS IMAGED IN OFFSHORE SEISMIC REFLECTION DATA



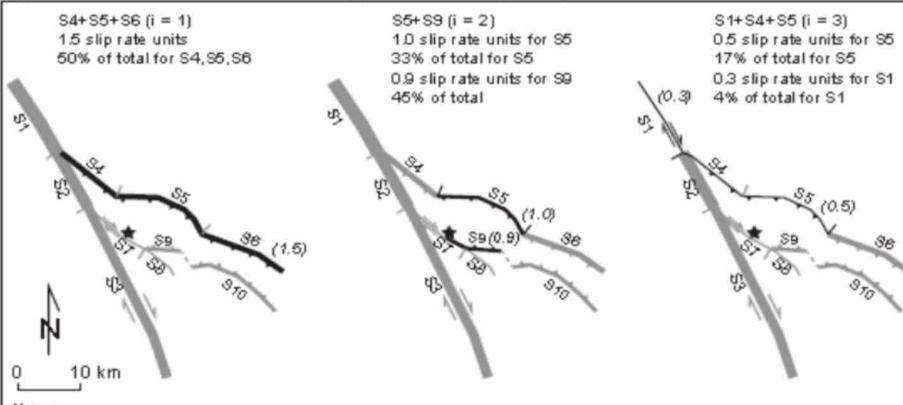
MEAN CDF FOR HOSGRI SLIP RATE



SLIP RATE ALLOCATION MODELS

- o "A Slip Rate Allocation Model describes the slip rate allocated to individual rupture sources in a single Rupture Model. Accordingly, there is one Slip Rate Allocation Model for the Hosgri Rupture Model (that applies to all three Hosgri FGMs) and three Slip Rate Allocation Models for the SLPB Rupture Models—one each for the OV, SW, and NE Rupture Models."
- "The Slip Rate Allocation Model creates a slip rate for each rupture source such that, when the contributions from all rupture sources including a particular fault are summed, the combined slip rate equals the target slip rate budget for that particular fault for that particular Rupture Model."

(b) Slip Rate Allocation Methodology for Mean Slip Rate, Fault Section S5



Notes:

- Black lines indicate fault rupture.
- i value designates each rupture source involving fault section S5. The sum of the slip rates in all three scenarios equals the target mean slip rate for fault section S5 (see equation 9-1).

EXPLANATION



Site



Fault sections: strike-slip (left), reverse (right)



Fault section slip rate, with the value in parentheses, and the width of the line proportional to the slip rate.



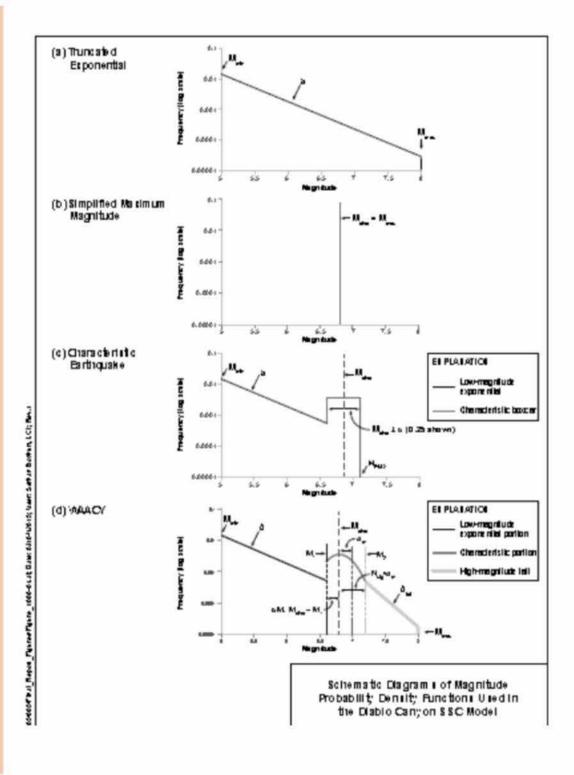
Fault section IDs and section boundary

Slip Rate Allocation Model Concept

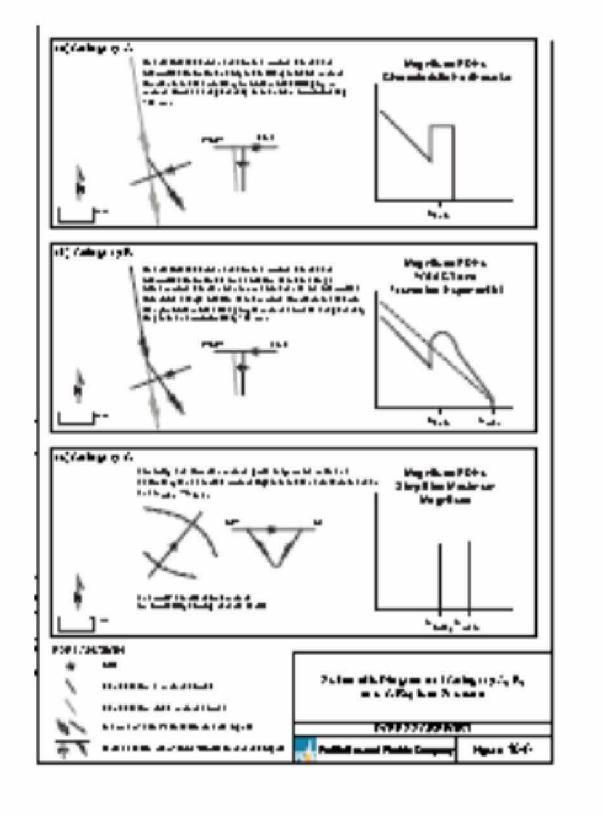
DCPP SSC REPORT

Pacific Gas and Electric Company

Figure 9-9



MAGNITUDE DISTRIBUTION MODELS



EACH RUPTURE
SOURCE
ASSIGNED TO
ONE OF THREE
MDMs

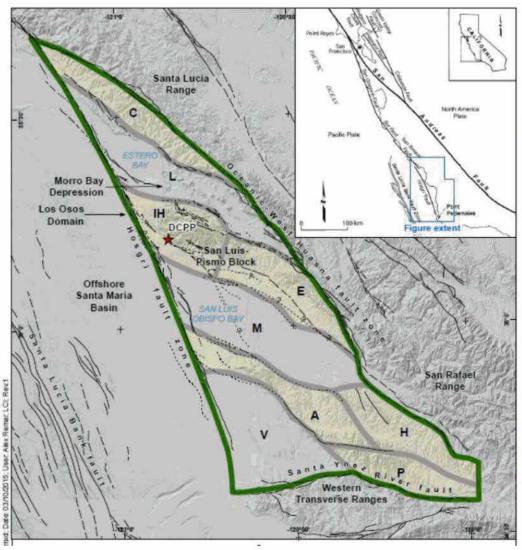
TIME DEPENDENCY MODEL

For another time

DIABLO CANYON SEISMIC SOURCE CHARACTERIZATION REVIEW

John Stamatakos 5/4/2015

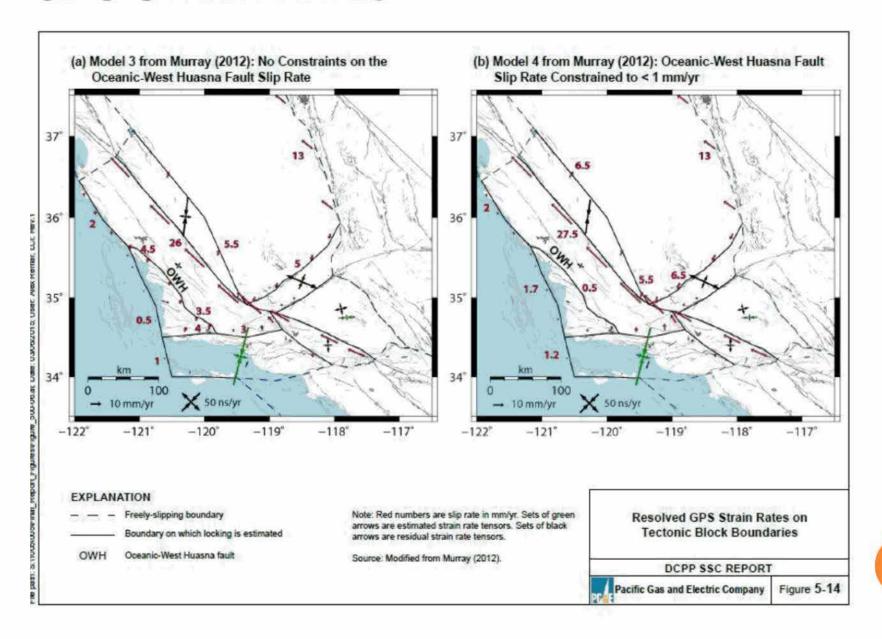
CONTEMPORARY TECTONIC SETTING



Dextral strike-slip plate boundary with transpression

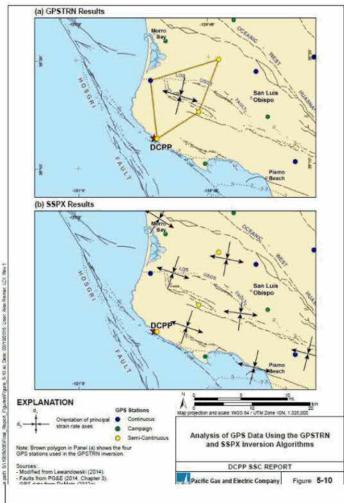


GPS STRAIN RATES



Fault Heave Rates UCERF3_final_GPS_edited.gps, relative to P523 Santa Yriez (West) 120"45" EXPLANATION Heave Rate Components* R = right-lateral L = left-lateral Low-angle thrust plate High-angle thrust P = compressional (perpendicular to strike) Dextral * All rates in mm/a. Sinistral High-angle normal GPS Strain Rates from the NeoKinema Model Low-angle normal in South-Central Coastal California Change in horizontal velocity across fault (mm/a) Note: Fault widths are scaled by slip (heave) rate. DCPP \$\$C REPORT Sense of slip is coded by color. Source: Modified from Bird (2012). Pacific Gas and Electric Company Figure 5-15

MORE STRAINS



FAULT SOURCES

- Geometry
- Faulting Style (SS, Reverse, Composite)
- Ruptures and Rupture Segments
- Slip Rate
- Slip Rate Allocation (on ruptures)
- Magnitude Distribution Models
- Time Dependency

^{*}Areal Sources and Distant Fault Sources ... another day

Time	Dependency Model	Fault Geometry	Rupture	Slip Rate Allocation	Magnit	ude Distribution	n Model
(Equi	valent Poisson Ratio)	Model	Model	Model (mm/yr)	Magnitude PDF	M _{max}	M _{char}
						8.5 [0.1]	7.3
		1100	H85-01	4.00	WAACY	/	[0.2]
	1.9	H90	100-01	1.23	CONTROL # 407/27/20	8.1	7.1
	[0.25]	[0.2]		[0.185]	[0.8]	[0.5]	[0.5]
		/		/-		7.8	6.8
		1105	H85-02	0.40		[0.4]	[0.3]
Hosgri Source	1.3	H85	1103-02	0.40	(
Source	[0.5]	[0.6]		[0.630]		7027.524	
	\			1	\	8.5	-
					Truncated	[0.1]	
	0.3	H75	H85-07	0.13	Exponential	8.1	N/A
	[0.25]	[0.2]		[0.185]	[0.2]	[0.5]	
						7.8	_
				0.067		[0.4]	6.8
				[0.185]	Characteristic		[0.2]
	1.6 [0.25]	OV	SW-01	0.018	Earthquake	N/A	6.5
	[0.20]	[0.4]		[0.630]	[1.0]		[0.5]
		/		0.005			6.3
			A	[0.185]			[0.3]
SLBP	1.1	SW	SW-04				• 0000
ources	[0.5]	[0.4]					
		\	SW-05	0.164			6.4 (main)
			5/550/TD8/8/	[0.185]	Simplified	N/A	[1.0]
	0.3	\ NE	SW-06	0.087	Maximum Magnitude	N/A	
	[0.25]	[0.2]		[0.630]	[1.0]		6.3 (splay)
				0.046			[1.0]
				[0.185]			
			SW-10				
						N o D	
					Logic Tree S	structure for	the Primary

Notes: In the example tree, rupture source H85-02 is a longer *linked* rupture source, so the WAACY and truncated exponential magnitude PDF models are considered. Rupture source SW-01 is a *characteristic* rupture source, so only the Youngs and Coppersmith (1985) characteristic earthquake magnitude PDF is considered. Rupture source SW-06 is a splay rupture source, so only the simplified maximum magnitude earthquake magnitude PDF model is

Logic Tree Structure for the Primary and Connected Fault Sources

DCPP SSC REPORT

PGGE Pacific Gas and Electric Company

Figure

6-1

FAULT GEOMETRY MODELS (FGM)

- Three Hosgri FGMs
- Three San Luis-Pismo Block (SLPB) FGMs

Table 6-4. Fault Geometry Models (FGMs) and Logic Tree Combinations

	SLPB FGMs				
Hosgri FGMs	Outward-Vergent (OV)	Southwest-Vergent (SW)	Northeast-Vergent (NE)		
Hosgri 90 (H90)	H90/ OV	H90/ SW	H90/ NE		
Hosgri 85 (H85)	H85/ OV	H85/ SW	H85/ NE		
Hosgri 75 (H75)	H75/ OV	H75/ SW	H75/ NE		

- About 40 rupture segments
 - Three sets of rupture segments (for the three SLPB FGMs)

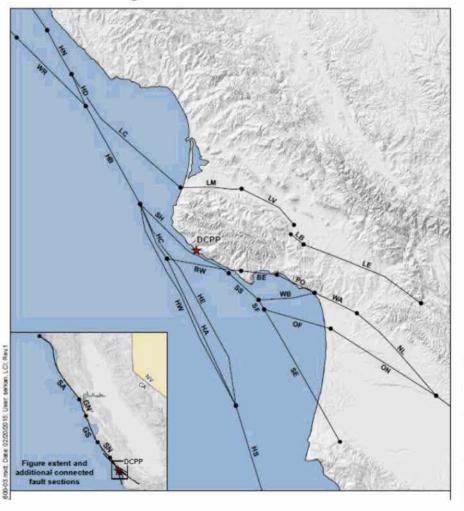
Figure extent and additional connected fault sections

RUPTURE SEGMENTS

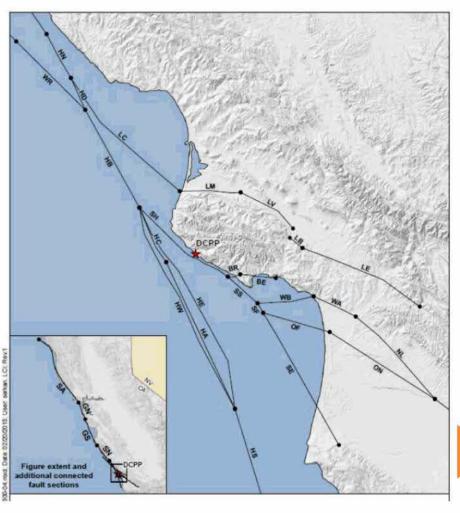
Outward-Vergent

MORE RUPTURE SEGMENTS

SW-Vergent



NE-Vergent



EXAMPLE: HOSGRI FAULT RUPTURE MODELS

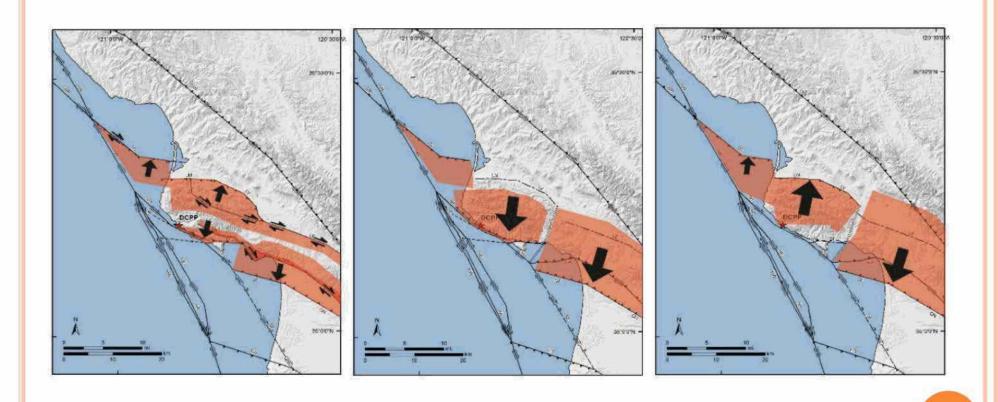
Table 9-3. Hosgri Fault Rupture Model

Rupture Source Number	Туре	Description	Fault Sections ¹ (closest section to the DCPP in bold)	Sense of Slip
H-01	Linked	Hosgri (Central trace) to MTJ²	HS+HA+HC+HB+HD+ HN+SI+SN+GS+GN+S A	Strike slip
H-02	Linked	Hosgri (West trace) to MTJ	HS+HW+HB+HD+HN+ SI+SN+GS+GN+SA	Strike slip
H-03	Linked	Hosgri (East trace) to MTJ	(East HS+HE+HB+HD+HN+S Strike	
H-04	Complex	Hosgri (Central trace) with Piedras Blancas	HS+ HA +HC+HB+WR (primary fault); PB (secondary fault)	Primary = strike slip Secondary = reverse
H-05	Splay	Splay Shoreline with HS+HA+HC HN+SI+SN (main fault) SE+SS+SH		Strike slip
H-063	Linked	Hosgri north of the Shoreline fault intersection	HB+HD+HN+SI+SN+G S+GN+SA	Strike slip
H-073	Linked	Hosgrinorth of the Los Osos fault intersection	HN+SI+SN+GS+GN+S A	Strike slip
H-08 ³	Characteristic	Piedras Blancas	РВ	Reverse

¹ Two-letter codes are explained in Table 6-5 and on Plate 9-1.
² MTJ = Mendocino Triple Junction

³ Same down dip geometry is used for all three HosgriFGMs.

THREE SLPM FGMs

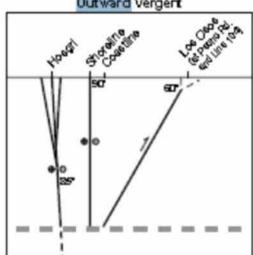


THREE SLPB FGMs

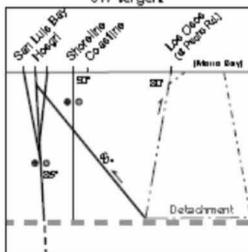
Parameter Values, Los Osos Fault

	Outward Vergent	SW Wargent	NE Wengent	1		We ighted
Model	Weight 0.4	Weight: 0.4	Weight 0.2	Pa.	TEX.	mean
Los Osos	IC+LM+LV+LE	LC+UM+UM-U	IC+UM+U+U		muz	me ry
Dip	60	20	50	20	20	66
Dip Direction	WZ	SW	ZW			
Sty & of faulting	RVP-O	R	k			
Depth to to p	1	1	1	1	1	1
Width	13	11	14	11	14	12 A

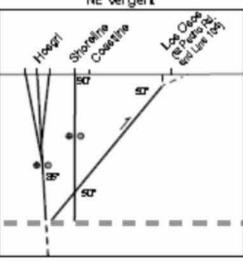




SW Vergent



NE Vergent



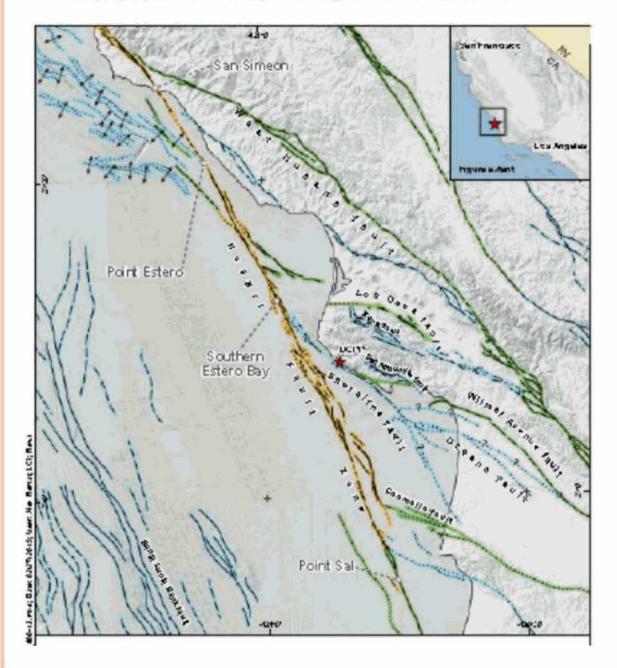
Note: Cross section D-D'shown to like trate Lill section of Los Osos taxit, the closest section to the DCPP.

Lo I O I o I Pault Parameter Value I

CCPP \$ \$C REPORT

Racific Gas and Electric Company | Fig. R. 7-29

HOSGRI FAULT SLIP RATE

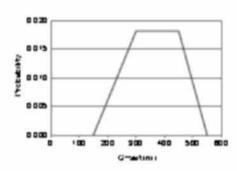


Slip Rate determined from four points

- San Simeon
- · Point Estero
- Estero Bay
- Pont Sal

SLIP RATE ESTIMATES

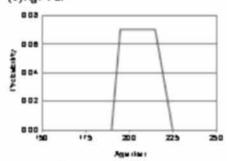




(b) Justification for Offset PDF

/ains	Omet(m)	Biti
Шħ.	150	Uncertainty in the graphed on of the terraion touch usign and the stops and sure of the patient author of patients and terraints are to make the motion.
Pre's med	300	Cuted migration of Iva pm ong partison who mis of the MFL
Prete med	450	Apparent precing gord of set and presence of socured area! headland
max.	980	Uncertainty in the projection of the territors back, edge and the strong and aure of the galestread and present during territors formation.

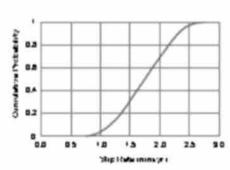
(c) Age PDF



(d) Justification for Age PDF

Value	Age (Na)	Biti
Mh.	190	Youngest substage highwished within MIS-1 (Campion, 2011)
Preferred	196	hand MIS I age of the
Pretend	215	busco (Hanson and Letts, 1924)
Itac.	225	Orderal autorisings highward within MIS (15 condison 2011)

(+) SIID Rate COF



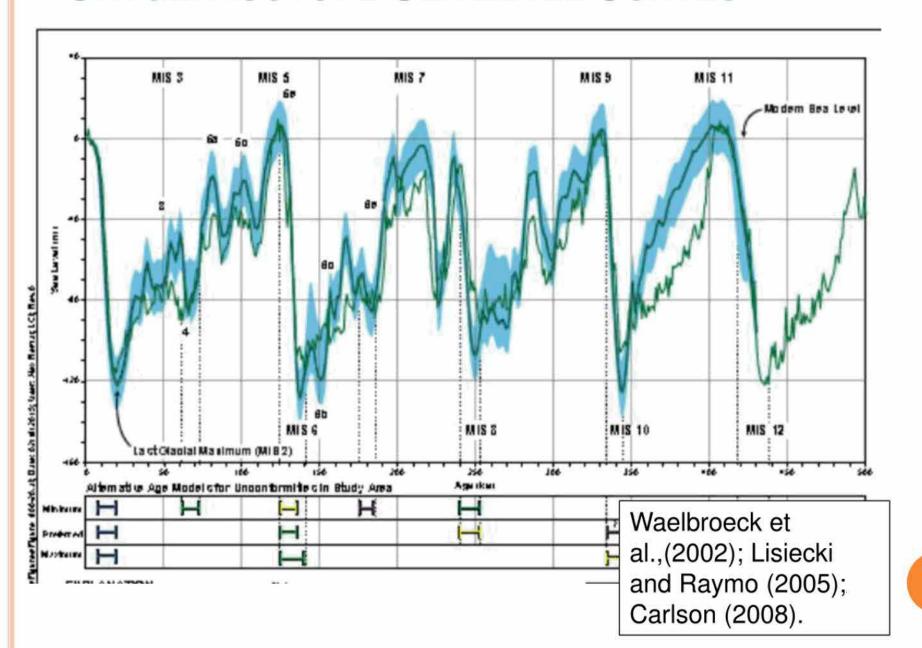
(f)Summar; Statutics

Cumula 1 w Probability	Slip Rate (mm/;r)
0.05	1.0
D.1	1.2
02	1.4
0.5	1.8
0.8	2.2
0.9	2.3
0.95	2.4
Mh.	7.0
Mac.	2.8
Mean	1.8

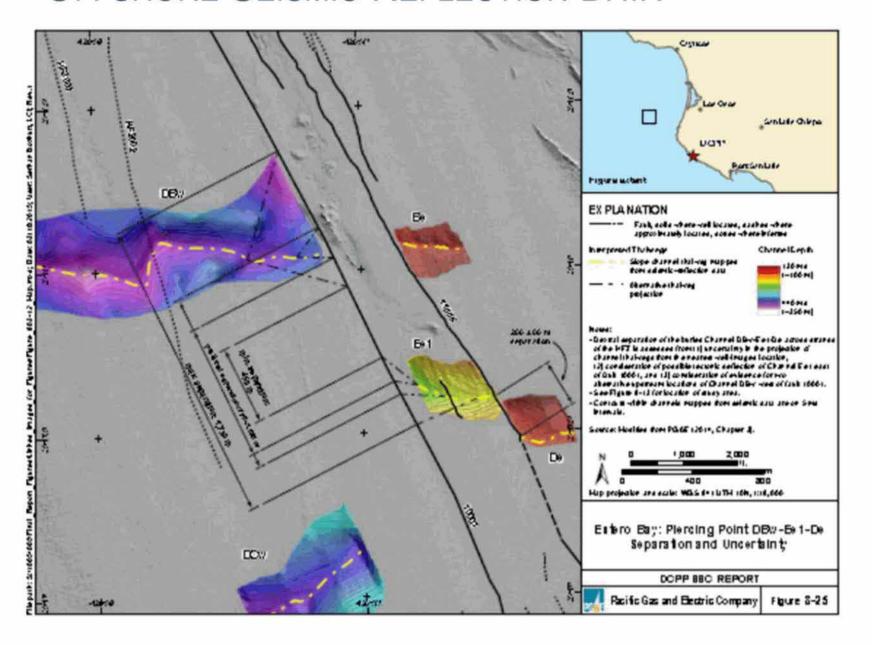
Slip Rates estimates are derived from probability distribution functions (triangle or trapezoidal distributions) for measured slip and estimated of offset age

We are developing an Excel spreadsheet to test variations In these models.

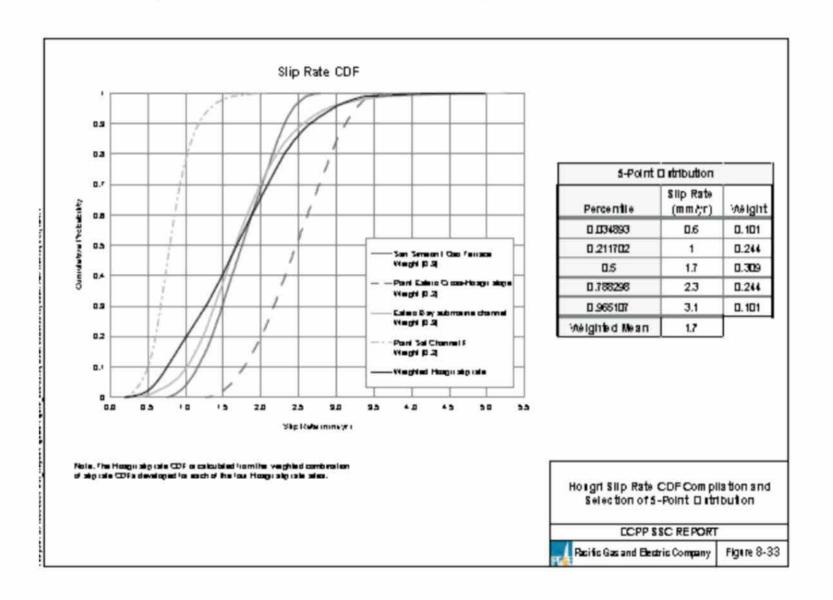
OXYGEN ISOTOPE SEA LEVEL CURVES



SLIP BASED ON OFFSET MARKERS IMAGED IN OFFSHORE SEISMIC REFLECTION DATA



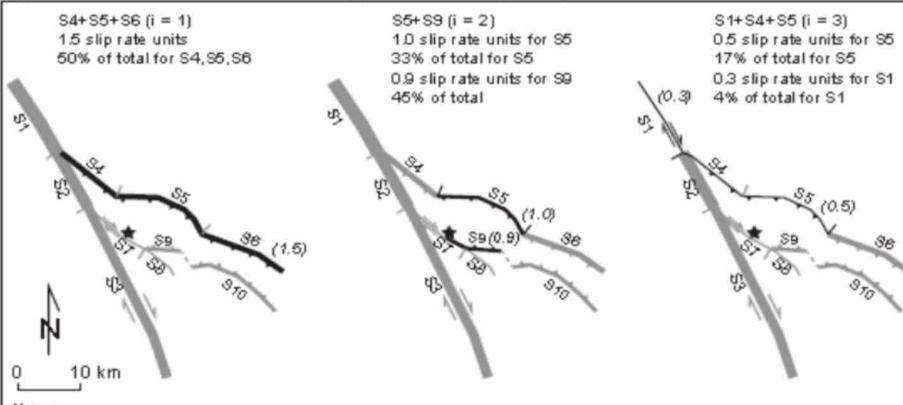
MEAN CDF FOR HOSGRI SLIP RATE



SLIP RATE ALLOCATION MODELS

- o "A Slip Rate Allocation Model describes the slip rate allocated to individual rupture sources in a single Rupture Model. Accordingly, there is one Slip Rate Allocation Model for the Hosgri Rupture Model (that applies to all three Hosgri FGMs) and three Slip Rate Allocation Models for the SLPB Rupture Models—one each for the OV, SW, and NE Rupture Models."
- "The Slip Rate Allocation Model creates a slip rate for each rupture source such that, when the contributions from all rupture sources including a particular fault are summed, the combined slip rate equals the target slip rate budget for that particular fault for that particular Rupture Model."

(b) Slip Rate Allocation Methodology for Mean Slip Rate, Fault Section S5



Notes:

- Black lines indicate fault rupture.
- i value designates each rupture source involving fault section S5. The sum of the slip rates in all three scenarios equals the target mean slip rate for fault section S5 (see equation 9-1).

EXPLANATION



Site



Fault sections: strike-slip (left), reverse (right)



Fault section slip rate, with the value in parentheses, and the width of the line proportional to the slip rate.



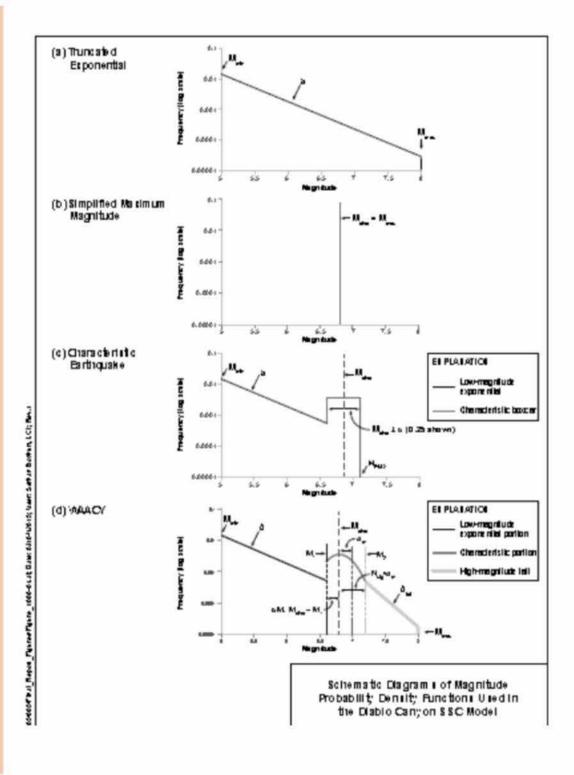
Fault section IDs and section boundary

Slip Rate Allocation Model Concept

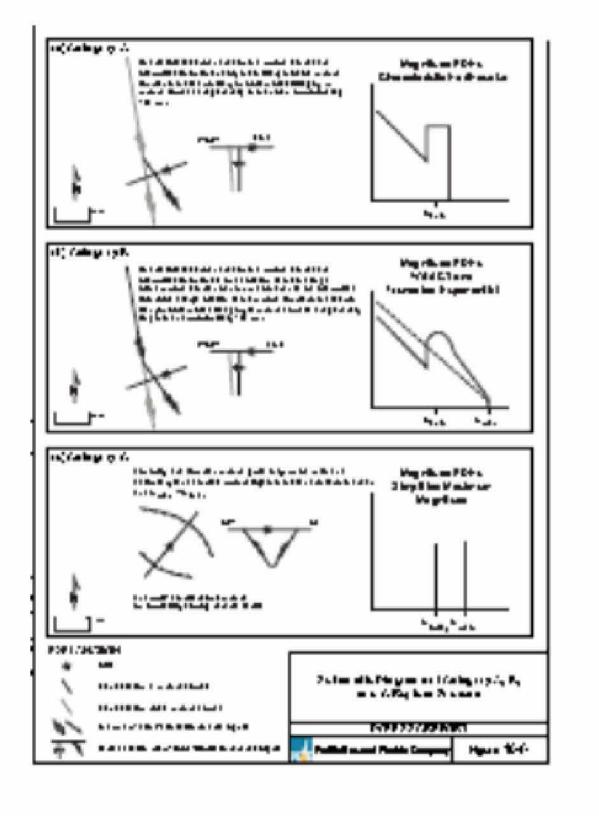
DCPP SSC REPORT

Pacific Gas and Electric Company

Figure 9-9



MAGNITUDE DISTRIBUTION MODELS



EACH RUPTURE
SOURCE
ASSIGNED TO
ONE OF THREE
MDMs

TIME DEPENDENCY MODEL

For another time

John Stamatakos

From:John Stamatakos

Sent:4 May 2015 18:03:37 +0000

To:Giacinto, Joseph (Joseph.Giacinto@nrc.gov); 'Miriam R. Juckett'

Subject:FW: Diablo SSC

Attachments: Diablo Canyon Seismic Source Characterization Review 1.pdf

From: John Stamatakos

Sent: Monday, May 4, 2015 2:01 PM **To:** Stovall, Scott (Scott.Stovall@nrc.gov)

Subject: FW: Diablo SSC

From: John Stamatakos

Sent: Monday, May 4, 2015 9:37 AM

To: Graizer, Vladimir (Vladimir.Graizer@nrc.gov)

Subject: FW: Diablo SSC

From: John Stamatakos [mailto:john.stamatakos@gmail.com]

Sent: Monday, May 4, 2015 9:33 AM

To: John Stamatakos Subject: Diablo SSC

John Stamatakos

From:John Stamatakos

Sent:6 Apr 2015 19:45:53 +0000

To:Ake, Jon (Jon.Ake@nrc.gov); Munson, Clifford (Clifford.Munson@nrc.gov); Graizer,

Vladimir (Vladimir.Graizer@nrc.gov)

Subject:FW: Password for Secured PDF Files

From one of my staff working on the Diablo SSC reports.

John

From: Sarah Wigginton

Sent: Monday, April 6, 2015 3:31 PM

To: John Stamatakos **Cc:** Ronald McGinnis

Subject: Password for Secured PDF Files

John,

I'm working on finishing up the Diablo Canyon Document Catalog and I've noticed that some of PDF files are "secured" so I am unable to copy any of the material (titles, sources, etc.). Working with an unsecured version would greatly speed up the process of cataloging the figures!

Would it be possible to get my hands on a password for the "DCPP SSC Report Rev A"?

Best, Sarah

Sarah Wigginton

Department of Earth, Material, and Planetary Sciences Geosciences and Engineering Division Southwest Research Institute 6220 Culebra Road, San Antonio, TX 78238, USA

John Stamatakos

From:John Stamatakos

Sent:4 May 2015 12:40:07 +0000

To:John Stamatakos

Subject:FW: PG&E: Diablo Canyon Public Meeting on April 28 Attachments:NRC Public Meeting 4-28 Seismic Final.pdf

From: John Stamatakos

Sent: Monday, May 4, 2015 8:39 AM

To: John Stamatakos

Subject: FW: PG&E: Diablo Canyon Public Meeting on April 28

From: DiFrancesco, Nicholas [mailto:Nicholas.DiFrancesco@nrc.gov]

Sent: Sunday, April 26, 2015 10:42 PM

To: Munson, Clifford; Ake, Jon; John Stamatakos; Brittain Hill; Graizer, Vladimir

Cc: Jackson, Diane; Shams, Mohamed; Vega, Frankie; Walker, Wayne; Alexander, Ryan; Moreno, Angel; Uselding, Lara; Burnell, Scott; Kock, Andrea; Scott Flanders; Maier, Bill; Roth(OGC), David; Lindell, Joseph; Uttal, Susan; Markley, Michael; Lingam, Siva; Hipschman, Thomas; Wyman, Stephen

Subject: PG&E: Diablo Canyon Public Meeting on April 28

Folks.

Attached are the PG&E slides in support of the Tuesday public meeting. NRC slides will be available tomorrow morning.

Please forward to those I may have missed.

Thanks.

Nick

From: Jahangir, Nozar [mailto:NxJ1@pge.com]

Sent: Sunday, April 26, 2015 7:58 PM

To: DiFrancesco, Nicholas; Soenen, Philippe R

Cc: Strickland, Jearl

Subject: Diablo Canyon Public Meeting on April 28

Philippe;

Attached is the DCPP presentation for the subject meeting. I will also take 30 hardcopies with me, as well. I will be travelling on Monday and will be in Rockville on Monday night.

We also need the Web access number and passcode for Technical PG&E staff that will be calling in support of the presentation.

Thanks

Nozar Jahangir P.E.

Manager, Technical Services
Diablo Canyon Seismic Engineering
805-545-6512
(cell)

nx₁1@pge.com

From: DiFrancesco, Nicholas [mailto:Nicholas.DiFrancesco@nrc.gov]

Sent: Thursday, April 23, 2015 10:33 AM

To: Soenen, Philippe R

Cc: Jahangir, Nozar; Vega, Frankie; Shams, Mohamed; Jackson, Diane

Subject: NRC Technical Focus Areas for Support of Public Meeting on April 28

Mr. Soenen,

In support of the public meeting scheduled for April 28, 2015, the NRC staff would like to gain additional technical understanding in several areas to support productive public meeting discussions. In addition to providing a general overview of the SSC and GMC SSHAC Reports and March 2015 50.54(f) response for DCPP, please provide additional clarification on the following topics.

Seismic Source Characterization

- Summarize the key data used to constrain the slip rate of the Hosgri fault, including associated uncertainties.
- 2. Clarify how elements of the thrust/reverse interpretation for the San Luis Range Thrust are incorporated into the SSC.
- 3. Clarify how the rupture models are derived from the fault source geometry models.
- 4. Summarize the methodology used to define the equivalent Poisson rates.

Ground Motion Characterization

- Provide additional detail on the criteria used for the selection of the candidate ground motion prediction equations (GMPEs) for development of the common form median ground motion models for DCPP. Specifically, please elaborate on the basis for including GMPEs based on datasets other than NGA-West2.
- Provide additional detail on development of the common functional form used to fit the
 candidate GMPEs. Specifically, please discuss how model parameters such as depth to
 Vs=1 km/s and 2.5 km/s (which are present in some of the candidate GMPEs) are
 accounted for in the functional form.

- 3. Provide additional detail on the approach for weighting the selected common form models as well as the criteria used to verify the physicality of the final models.
- Provide additional detail on how the continuous distribution for total sigma (σ_{SS}) was developed by combining the between-event and within-event aleatory variabilities.

Site Response

- 1. Section <u>2.3.2.1</u> of the 50.54(f) submittal states that shear modulus and damping curves are not directly applicable to DCPP since analytical modeling is not used and that non-linear site effects are implicitly included in the empirical GMPEs for Vs30=760 m/s. However, the NGA-West2 database has a limited amount of data for sites with Vs30 near 760 m/s and for earthquakes with magnitudes and source-to-site distances similar to those dominating the hazard for DCPP. Please provide additional information on how these limitations in the NGA-West2 database are accounted for in the site response model for DCPP.

Please let me know if you have any questions on the above focus areas.

Thanks,

Nick DiFrancesco

Senior Project Manager - Seismic Reevaluation Activities U.S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation Japan Lesson Learned Project Division nicholas.difrancesco@nrc.gov | Tel: (301) 415-1115

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To learn more, please visit http://www.pge.com/about/company/privacy/customer/

Hill, Brittain

From:Hill, Brittain

Sent:18 Mar 2015 13:47:22 -0400 To:John Stamatakos;Miriam R. Juckett

Subject:FW: Plan updated!

Some updates added recently for WUS topics, and current status of different plants (Regional

sections at end)

Britt

From: Gibson, Lauren

Sent: Wednesday, May 21, 2014 2:41 PM

To: DiFrancesco, Nicholas; Burnell, Scott; Hill, Brittain

Subject: Plan updated!

Thank you for your help. The ADAMS version of the Communication Plan has been updated. I've sent it to the State Liaison Officer Program contact.

View ADAMS P8 Properties ML14083A619

Open ADAMS P8 Document (5/21/2014, Communication Plan for Seismic Hazard Re-Evaluation Submittals in Response to NTTF Recommendation 2.1, Seismic)

Lauren

Sent:9 Apr 2015 20:50:07 +0000

To:David Ferrill;Sarah Wigginton;Kevin Smart;Alan Morris;Alan Morris

(b)(6)

Subject:FW: Work in progress...

FYI.

Many thanks Sarah!!

From: Ronald McGinnis

Sent: Thursday, April 09, 2015 3:49 PM

To: John Stamatakos **Cc:** Miriam R. Juckett

Subject: RE: Work in progress...

John,

Thanks John. I will send you the link to the spreadsheet and an ArcGIS project tomorrow.

David, Alan, and I are on travel May 4-8. The calendar shows Kevin and Sarah being here.

I will pass along your thanks.

-Ronny

From: John Stamatakos

Sent: Thursday, April 09, 2015 3:43 PM

To: Ronald McGinnis Cc: Miriam R. Juckett

Subject: RE: Work in progress...

I have looked it over and I think it's a good summary. I don't have any changes now. I have not seen the data catalog, but sounds like you are working on it. I would like to have them tomorrow, so I can go through them and present them to the NRC team on Monday.

Tell the team, especially Sarah, many thanks from me.

Also, it looks like one of the NRC seismologists, Jon Ake, may be in San Antonio for a kickoff of another project in early May (4-6). Are you around then?

John

Sent: Thursday, April 9, 2015 4:29 PM To: John Stamatakos Cc: Alan Morris; David Ferrill; Sarah Wigginton; Alan Morris Subject: RE: Work in progress); Kevin Smart			
John,			
Have you had a chance to look at the document Alan sent? If you get a chance can you let us know what you think and if any changes are needed? Just so you are aware, Kevin and Alan are leading a field seminar in Death Valley and Owens Valley returning Thursday of next week. David and I are leading one all next week to West Texas. The week after that (April 20-24) we al will be in the field in West Texas (including Sarah).			
Sarah finished the data catalog and I am going through it now evaluating the data quality. There are 1300 rows!!			
David, Sarah, and I are all in tomorrow if we need to discuss anything.			
Thanks,			
Ronny			

Ronald N. McGinnis			
rmcginnis@swri.org			
Senior Research Scientist			
Department of Earth, Material, and Planetary Sciences Southwest Research Institute			
6220 Culebra Road			
San Antonio, Texas 78238-5166			
Office: 210-522-5825			
Mobile: (b)(6)			

From: Alan Morris

From: Ronald McGinnis

Sent: Monday, April 06, 2015 3:06 PM To: Ronald McGinnis; David Ferrill; Sarah Wigginton; Kevin Smart

Cc: John Stamatakos

Subject: RE: Work in progress...

OK, it's 8 pages, and maybe too long, but for some reason these reports are always prolix.

Is this what we need?

Does it need pruning?

Does it need analysis?

Does it need anything?

Alan

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http://3dstress.swri.org/

From: Alan Morris

Sent: Friday, April 03, 2015 4:51 PM

To: Ronald McGinnis; David Ferrill; Sarah Wigginton; Kevin Smart

Cc: John Stamatakos

Subject: Work in progress...

T:\Diablo Canyon\Diablo Canyon\CNWRA report April 2015\DiabloCanyonPowerPlant - seismic risk data survey April 2015.docx

I was planning to cycle back through adding important conclusions for every chapter, but any of us could do that...

Chapter 1 is very useful in giving summaries of the data and goals for each of the subsequent chapters.

For the tornado diagram, equations 1-1 and 1-2 in chapter 13 are the key.

Gotta check posters for next week...

Happy Easter

Alan

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BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Pacific Gas and Electric)	
Company for Compliance Review of Utility)	
Owned Generation Operations, Electric Energy)	
Resource Recovery Account Entries, Contract)	Application 15-02-023
Administration, Economic Dispatch of Electric)	(Filed February 27, 2015)
Resources, Utility Retained Generation Fuel)	
Procurement, and Other Activities for the Period)	
January 1 through December 31, 2013.)	
(U 39 E))	
	_)	

ALLIANCE FOR NUCLEAR RESPONSIBILITY'S PROTEST

Date: April 3, 2015

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I. INTRODUCTION.

Pursuant to Rule 2.6 of the Rules of Practice and Procedure of the California Public

Utilities Commission ("Commission" or "CPUC"), the Alliance for Nuclear Responsibility

("A4NR") files its Protest to a portion of the 2014 Energy Resource Recovery Account

Compliance ("ERRA Compliance") application filed by the Pacific Gas and Electric Company

("PG&E"). A4NR objects to PG&E's recovery of certain balances recorded in the Diablo Canyon

Seismic Studies Balancing Account ("DCSSBA") for 2014 costs which fail to comply with D.12-09
008 and D.10-08-003 and, consequently, were not reasonably incurred. Additionally, D.14-08
032 directed PG&E to transfer funding for its Long Term Seismic Program ("LTSP"), including the

Senior Seismic Hazard Analysis Committee ("SSHAC") process, to the DCSSBA effective January

1, 2014, subject to reasonableness review in the ERRA Compliance process. A4NR protests

recovery of certain LTSP amounts as well.

A4NR's Protest focuses on PG&E's continued evasion of the Independent Peer Review Panel ("IPRP") established by the Commission to assist in the oversight of the ratepayer-funded AB 1632 seismic studies. The legal and factual grounds for the 2014 Protest are similar to those cited in A4NR's protest of PG&E's still-pending 2013 ERRA Compliance application, A.14-02-008, broadened to include the LTSP to the extent that non-compliant avoidance of IPRP review has contaminated core assumptions used in PG&E's SSHAC reports. Sadly, the 2013 evidence cited in A4NR's opening and reply briefs in A.14-02-008 has been augmented by increasingly brazen defiance by PG&E of D.12-09-008 and D.10-08-003, as outlined herein.

1

¹ D.14-08-032, OP 29 a. The Commission stated, "We find this disposition to be a reasonable approach to improving oversight of the LTSP costs," (Id., p. 411) and, "We find this disposition to be a reasonable approach to assure the proper integration of Assembly Bill (AB) 1632 seismic studies with the LTSP and the SSHAC process." (Id., p. 412)

II. CHERRY-PEEVEY EMAILS REVEAL POST-FUKUSHIMA PR PLOY.

A4NR's Protest coincidentally follows the recent revelation of unreported ex parte communications in 2011 between PG&E Vice President Brian Cherry and Commission President Michael Peevey concerning PG&E's A.10-01-022, which sought ratepayer funding for the relicensing of the Diablo Canyon Nuclear Power Plant ("DCNPP"). Five days after the Fukushima accident, ALJ Robert Barnett had taken the A.10-01-022 evidentiary hearing scheduled for April 13, 2011 off calendar. On April 11, 2011 – just one month after the Japanese meltdown -- PG&E ceremoniously announced it would accelerate completion of the AB 1632 seismic studies and requested the U.S. Nuclear Regulatory Commission ("NRC") "to delay final action on the utility's on-going license renewal application until PG&E submits the findings."

That same day, Mr. Cherry and President Peevey had the following exchange:³

From: Cherry, Brian K [mailto:BKC7@pge.com]

Sent: Mon 4/11/2011 2:49 PM

To: Peevey, Michael R.

Subject: FW: Diablo Canyon License Renewal

Attached is the letter mentioned in the press release.

From: Peevey, Michael R. [mailto:michael.peevey@cpuc.ca.gov]

Sent: Monday, April 11, 2011 4:34 PM

To: Cherry, Brian K

Subject: RE: Diablo Canyon License Renewal

Very good. Prudent thing to do and should reduce some fears, concerns.

ftp://ftp2.cpuc.ca.gov/PG&E20150130ResponseToA1312012Ruling/2011/04/SB GT&S 0001262.pdf

² "PG&E Commits to Finishing 3-D Seismic Studies Related to Diablo Canyon Before Seeking Final Issuance of Renewed Licenses," news release from PG&E External Communications, April 11, 2011. The release quoted John Conway, Senior Vice President of Energy Supply and Chief Nuclear Officer: "We recognize that many in the public have called for this research to be completed before the NRC renews the plant's licenses," said Conway. "We are being responsive to this concern by seeking to expeditiously complete the 3-D seismic studies and provide those findings to the commission and other interested parties so that they may have added assurance of the plant's seismic integrity."

³ Accessible at

From: Cherry, Brian K [mailto:BKC7@pge.com]

Sent: Mon 4/11/2011 4:47 PM To: Peevey, Michael R.

Subject: RE: Diablo Canyon License Renewal

...and resurrect our application and get it back on track?

From: Peevey, Michael R. [mailto:michael.peevey@cpuc.ca.gov]

Sent: Monday, April 11, 2011 5:04 PM

To: Cherry, Brian K

Subject: RE: Diablo Canyon License Renewal

Yep. I will have Carol talk to Barnett.

From: Cherry, Brian K [mailto:BKC7@pge.com]

Sent: Mon 4/11/2011 5:05 PM To: Peevey, Michael R.

Subject: RE: Diablo Canyon License Renewal

Thanks. The sooner the better.

From: Peevey, Michael R. [mailto:michael.peevey@cpuc.ca.gov]

Sent: Monday, April 11, 2011 5:08 PM

To: Cherry, Brian K

Subject: RE: Diablo Canyon License Renewal

May.

From: Cherry, Brian K

Sent: 4/11/2011 5:09:40 PM

To: 'Peevey, Michael R.' (michael.peevey@cpuc.ca.gov)

Cc:

Bcc:

Subject: RE: Diablo Canyon License Renewal

Great. And thanks again.

III. AB 1632 PROGRAM'S REVIEW SAFEGUARDS WERE BREACHED.

A4NR relied upon the establishment of the IPRP by the Commission in D.10-08-003 to ensure that the AB 1632 studies were conducted as robust scientific inquiry and not as a public relations exercise. As ALI Barnett made clear in that proceeding:

And I say this, and I'll say it on the record, that part of this is because I don't want the Commission to be in a position of just accepting what the utilities tell us without looking at it. We've gotten in that position too many times, and I feel that the way to avoid that problem that we are just taking the utility at its word without the expertise to determine the reasonableness of that. That is why I think the IPRP is valuable, and why they should have an expert witness to review this stuff.⁴

The protocols for IPRP-PG&E interactions articulated in IPRP Report No. 2,⁵ repeated verbatim in IPRP Report No. 3,⁶ and reinforced by the admonition in D.12-09-008 ("We expect PG&E to

⁴ A.10-11-015 Transcript, p. 263.

⁵ IPRP Report No. 2, September 7, 2011, pp. 8 – 9: "The IPRP expects that:

[•] PG&E will provide its study plans and draft completed study findings to the IPRP for review. These include studies summarized in CPUC Decision 10-08-003 including off-shore, on-shore, and ocean bottom studies, and seismic studies recommended in the AB 1632 Report.

[•] The IPRP, coordinated by the California Geological Survey (CGS), will review and provide comments on PG&E's study plans. The goal will be, if possible, to provide comments within 30 days of receipt.

[•] The IPRP, coordinated by the CGS, will review and provide comments on PG&E's draft completed study findings to the CPUC. The goal will be to provide comments as promptly as possible.

[•] PG&E will review and, if possible, within 30 days incorporate the IPRP's recommendations and comments in PG&E's revised study plans and revised completed study findings and prepare for the IPRP a 'Response to Comments' for the IPRP to document scientifically why PG&E accepted or rejected the IPRP's comments.

[•] PG&E and the IPRP will participate in quarterly meetings/briefings to review the status of PG&E's seismic studies, any changes in the study plans, and any preliminary study findings.

[•] PG&E and the IPRP will prepare a master schedule incorporating the major milestones for the IPRP's review process and will include these milestones in PG&E's monthly progress reports and schedule to the NRC and the Atomic Safety and Licensing Board.

[•] The CPUC and CEC will address any major scientific or technical issues that have not been resolved informally between the IPRP and PG&E. CPUC Decision 10-08-003 states that, 'Should a dispute arise it should be resolved informally but if that is not attainable the Commission has authority to halt the associated rate recovery.' In addition, the CEC may report on any seismic issues and updates through its IEPR process. However, we anticipate that any major scientific or technical issue that may arise can be addressed and resolved informally.

The quarterly briefings/meetings mentioned above will allow PG&E to report on its progress and help facilitate a productive informal exchange of scientific viewpoints."

continue to meet with the IPRP to present and review changes to the seismic study plans, to provide process updates to the IPRP regarding implementation of the studies, and to receive IPRP comments."⁷), offered at least theoretical protection from the PG&E misconduct which surfaced in 2013 and worsened in 2014.

IV. PG&E SENT 'FINAL' REPORT TO THE NRC WITH NO IRPR REVIEW.

PG&E submitted what it labeled the "final" AB 1632 report to the NRC on September 10, 2014, six days after the evidentiary hearing in A.14-02-008, and without providing even a draft of the submittal to the IPRP. As the Director of PG&E's Geosciences Department explained at the A.14-02-008 hearing, PG&E had decided that the IPRP was only entitled to receive "finalized" results of the studies after PG&E had issued a "final" report to the U.S. Nuclear Regulatory Commission. 10

As described in the evidentiary record of A.14-02-008, the extensive criticism of PG&E's ground motion assumptions at the July 11, 2013 IPRP meeting, followed by the eviscerating IPRP Report No. 6, appears to have significantly chilled relations between PG&E and the IPRP.

One month after publication of IPRP Report No. 6, PG&E regulatory affairs personnel were complaining to CPUC staff about self-initiated reports by the IPRP and questioning whether the IPRP could be "decommissioned" after submittal of the "final" report. 11

⁶ IPRP Report No. 3, April 6, 2012, pp. 8 – 9.

⁷ D.12-09-008, p. 16.

⁸ Richard Klimczak, PG&E, A.14-02-008 Transcript, p. 139, ln. 16; p. 141, ln. 14.

⁹ *Id.*, p. 140, ln. 21; p. 141, ln. 22.; p. 142, ln. 7.

¹⁰ *Id.*, p. 140, ln. 25.

¹¹ A4NR Opening Brief, A.14-02-008, pp. 27 – 29 citing three internal PG&E emails dated September 16, 2013.

It had taken more than six months of repeated requests by IPRP chair Chris Wills to obtain PG&E's documentation of its V_s measurements at the DCNPP plant site, and his efforts established that PG&E's V_s assumptions had a 50% greater impact on the seismic hazard calculation than the slip rate on the Hosgri Fault, previously labeled the top uncertainty in the PG&E model. And IPRP Report No. 6 was unsparing in its criticism of PG&E's assumptions:

- To prioritize the main targets of the AB 1632 onshore and offshore geophysical studies, the IPRP earlier asked PG&E for sensitivity analyses of the probabilistic hazards. PG&E's 2011 response ranked uncertainty in the slip rate of the Hosgri Fault as clearly the most significant, with a "calculated ground motion hazard that varies by a factor of nearly 2." 12
- Changing PG&E's base case ground motion characterization of V_{s30} of 1200 m/s to a generic site with a V_{s30} of 760 m/s ("more consistent with other soft rock sites in California" 13) "increases the hazard by more than a factor of 3" 14 and changing PG&E's assumed site condition to a generic site with a V_{s30} of 1000 m/s "increases hazard by a factor of 2." 15
- "Compared to traditional approaches, the PG&E method resulted in lower ground motion hazard estimates, particularly in the spectral period range important to [Diablo Canyon] ... " In contrast, "(a) lower $V_{\rm S30}$ brings the estimated ground motion hazards beyond the original design level when used in typical, state-of-the-practice seismic hazard analysis..." ¹⁶
- The IPRP questioned whether PG&E's approach adequately captured shear wave velocities at different depths beneath the plant: "With only three profiles, it is unlikely that one of them represents the lowest velocity material underlying the plant. Some of the variability seen in the 1978 data may reflect poor quality of the V_S measurements made 35 years ago. Interpretations of that data, however, appear to include unconservative assumptions of velocity in boreholes where no velocity was recorded..." 17

¹² IPRP Report No. 6, p. 17.

¹³ *Id.*, p. 3.

¹⁴ *Id.,* p. 18.

¹⁵ Id.

¹⁶ *Id.*, p. 3.

¹⁷ *Id.*, p. 6.

- Nor was newer data from the ISFSI¹⁸ site without problem: "these two profiles do not give consistent V_s measurements at given depths. Considerable variability exists at some depth ranges ... they do not help constrain the lower bound or range of velocity at the plant site." ¹⁹
- "A complete consideration of site conditions across the plant footprint requires additional V_s measurements using modern technology to constrain the uncertainty and yield more reliable site V_s values."²⁰

V. PG&E's 2014 'FINAL' REPORT STONEWALLED IPRP 2013 CRITIQUE.

Despite written assurances to the CPUC staff in response to IPRP Report No. 6 that "PG&E understands the scientific findings and will conduct the further studies noted," and internal acknowledgment within PG&E's Geosciences Department that "The recommended tasks described in the conclusion are reasonable and we plan to address them as part of our own updated site response evaluation," the so-called "final" report submitted to the NRC on September 10, 2014 is willfully unresponsive. As summarized in the IPRP's belated review of the ground motion chapters of the 2014 "final" AB 1632 report:

- IPRP Report No. 6 noted that ' V_s data at the DCPP site indicate significant variability /uncertainty' and that <u>PG&E's estimates "appear to include unconservative</u> <u>assumptions of velocity in boreholes'</u>. IPRP recommended additional studies to determine the V_s beneath DCPP and the variability of V_s .²³ (emphasis added)
- IPRP Report No. 6 recommended that PG&E 'demonstrate that the low site amplification seen at the DCPP site is due to site effects, not specific to the azimuths and distances traveled by the recorded ground motions at the site from the two earthquakes used'

¹⁸ "ISFSI" is an acronym for Independent Spent Fuel Storage Installation.

¹⁹ IPRP Report No. 6, pp. 6 – 7.

²⁰ Id., p. 6

²¹ A4NR Opening Brief, A.14-02-008, p. 30, citing PG&E's October 10, 2013 written response to IPRP Report No. 6.

²² A4NR Opening Brief, A.14-02-008, p. 31, citing September 9, 2013 email from Dr. Norman Abrahamson to Richard Klimczak.

²³ IPRP Report No. 9, pp. 2-3.

and 'justify the adequacy of using only two earthquakes to characterize site amplification'. ²⁴ (emphasis added)

- In response, PG&E confirmed in a letter to CPUC (PG&E, 2013) that it would conduct further studies to improve the quantification of site conditions and amplification. These studies would: (1) use new data from on-land exploration geophysics surveys to develop a 3D model of shear wave velocity beneath the plant site; (2) analyze broad band ground motion data and ground motions from small earthquakes to better quantify site-specific amplification terms; and (3) evaluate site amplification using analytical approaches in which seismic waves are propagated through a velocity model. The CCCSIP report addressed the first study as discussed in detail in the remainder of this IPRP report, <u>but</u> not the second and third studies.²⁵ (emphasis added)
- The high-resolution tomographic model of the area near DCPP presented in the CCCSIP report shows details of the variation in interpreted velocity. Important elements of this detailed model include: relatively low near-surface velocities in areas with remaining natural soil; relatively high near-surface velocities underlying much of the plant itself; highly variable estimates of V_{S30}; and irregularly shaped subsurface regions interpreted to have high velocity.²⁶
- While each of these features of the tomographic model may represent improved understanding of the 'site conditions' at DCPP and may lead to decreased uncertainty in seismic hazard estimates, PG&E has not confirmed the uncertainties in these velocity estimates. Moreover, the CCCSIP report has an extensive discussion of the difficulty of gaining accurate tomographic results at shallow depths, given the constrained source-receiver locations. ²⁷ (emphasis added)
- Differences between V_S profiles measured in 1978 and profiles derived from the tomographic model may reflect poor data or poor resolution in the 1978 profiles. If the 1978 downhole velocity surveys represent 'ground truth', however, it appears that the tomographic model does not show some shallow high velocity layers up to 50' thick or low velocity layers up to 100' thick. The lack of correspondence between measured V_S

²⁴ *Id.*, p. 3.

²⁵ Id. The "final" AB 1632 Report is also referred to as the "CCCSIP" report, an acronym for Central Coastal California Seismic Imaging Project.

²⁶ Id., p. 4.

²⁷ Id.

profiles and V_S profiles estimated from the tomographic model suggests significant uncertainty remains in estimates of "site conditions" at DCPP. ²⁸ (emphasis added)

- The IPRP cannot determine if these differences reflect poor data or analysis in one or both measurements of VS or if both surveys are essentially correct, but have differing levels of spatial resolution. <u>Certainly, the differences between VS profiles from the</u> <u>tomographic model and previously measured VS profiles should have been addressed</u> <u>in the CCCSIP report.</u> ²⁹ (emphasis added)
- For the DCPP site, the use of single station sigma with site-specific term appears to be the key factor that brings the deterministic spectra below the original design spectra.³⁰ (emphasis added)
- While the single station sigma assumption and especially the site term have a significant effect on hazard, the site term is based on the observations of only two earthquakes.³¹ As described in IPRP Report No. 6, the IPRP is not convinced that the 'site term' reflects some property of the site that would affect all earthquakes recorded at DCPP. The alternative hypothesis that additional factors related to the particular source or paths of those two earthquakes remains at least as plausible.³² (emphasis added)
- The CCCSIP report does not include any additional studies to address this issue. The 3D site response analyses proposed by PG&E will not address whether single station sigma model is more reasonable than the ergodic assumption, nor will it reduce uncertainty in the site specific term that is calculated based on two recorded earthquakes.³³ (emphasis added)
- Figure 6 compares deterministic spectra for the CCCSIP sensitivity scenario assuming linked co-seismic rupture of the Shoreline, Hosgri, and San Simeon Faults (M7.3). It shows that deterministic ground motion increases across the spectrum as magnitude for the Shoreline Fault rupture increases from 6.7 to 7.3. This figure also shows increased ground motion as V_s 30 decreases from 1200 m/s [at the power block foundation level] to

²⁸ *Id.*, p. 5.

²⁹ *Id.*, pp. 5 – 6.

³⁰ *Id.*, p. 12.

³¹ The NRC staff noted this same limitation in its 2012 assessment of PG&E's single-station-sigma adjustment at DCNPP, observing, "Generally a larger number of earthquakes would be needed to develop confidence in the correction factor." RIL 12-01, p. 59.

³² IPRP Report No. 9, p. 12.

³³ Id.

760 m/s. More significantly, the figure shows, once again, that the most influential factor affecting deterministic ground motion estimates is the single station sigma assumption and the site term. ³⁴ (emphasis added)

- The 3D response analysis cannot, however, address issues associated with the sitespecific term. IPRP previously expressed its concern regarding the adequacy of using only
 two earthquakes in estimating the site-specific term and made recommendations to gain
 confidence in the PG&E site-specific approach, including analyzing broad band ground
 motion data and ground motions from small earthquakes to better quantify the sitespecific term. PG&E has not addressed these recommendations. (emphasis added)
- The "site term" based on two recorded earthquakes may represent other factors, rather than site conditions. <u>IPRP is not convinced that this factor is adequately constrained for</u> <u>use in ground motion calculations</u>.³⁶ (emphasis added)

The IPRP, impeded from performing its duties by PG&E's extended embargo from mid-2013 until the AB 1632 report was "finalized" in September 2014, was also critical of certain aspects of PG&E's seismic source characterization when it eventually gained access to the document. IPRP Report No. 8 is particularly pointed in its assessment of PG&E's analysis of onshore faults:

- The IPRP is not convinced that the interpretations of the down-dip extensions of faults are well constrained, even in the case of well-documented surface faults. Similarly, faults interpreted from the seismic sections, but not corroborated by surface mapping, (e.g. faults interpreted between the San Miguelito and Edna faults) are possible, but are by no means unique interpretations of the data. Overall, the IPRP is not convinced that projections of faults beyond the very shallow subsurface represented unique interpretations of the data. (emphasis added))
- Projections of faults to depth in 'basement' rocks of the Franciscan complex appear to be even more problematic. As discussed at the IPRP meeting on November 17, 2014, the Franciscan complex is known to be a mixture of different rock types pervasively

³⁴ Id.

³⁵ *Id.*, p. 15.

³⁶ Id.

³⁷ IPRP Report No. 8, p. 5.

sheared at a variety of scales and is not expected to produce reflectors that are extensive over broad areas. The majority of seismic sections, (e.g. AWD line 150 as presented on Chapter 7, Figure 5-25) show prominent, continuous reflectors at relatively great depths in material that is assumed to be bedrock of the Franciscan complex.³⁸ (emphasis added)

- Most deep reflectors shown on Figure 5-25, and in many other sections are arranged in groups of concave-upward, gently curved reflectors. These reflectors are interpreted in the CCCSIP report as representing geological structure. The IPRP, however, regards this pattern of concave-upward sets of reflectors as difficult to explain geologically, but not difficult to envision as artifacts from the data processing. If the continuous reflectors in Franciscan complex bedrock are artifacts of data processing, rather than representing geologic structure, then the seismic reflection surveys provide no constraint on the down-dip geometry of faults in the Franciscan Complex.
- The Los Osos fault, in particular, is entirely within Franciscan Complex rocks from very shallow depths. If the reflection surveys do not show real geologic structure along the down-dip extension of this fault, then dip of the fault remains essentially unconstrained.⁴⁰ (emphasis added)
- Since the Franciscan complex is known to be a mixture of different rock types
 pervasively sheared at a variety of scales, continuous, gently dipping layers are not
 expected. The overall arrangement of the gently dipping 'reflectors' also raises
 questions that are not addressed in the report. In several sections, the arrangement of
 reflectors does not resemble a cross-section of folded or faulted rock. The pattern of
 concave-upward sets of reflectors seen in many sections does not have an obvious
 geological explanation, leading the IPRP to question whether they represent real
 geologic structure. 41 (emphasis added)
- Even if all reflectors shown in the seismic sections are images of geologic features, the interpretations of various faults are inconsistent and not unique: 1) In many cases, faults are interpreted based on a series of truncated reflectors, but are shown to pass through other reflectors that are not truncated; 2) In some seismic sections, it appears that additional faults are permitted by the data. It is not clear how the stated interpretation methodology allowed the interpretation team to draw some faults and not others; and 3) Alternate interpretations of the dip of most faults are possible. 42 (emphasis added)

³⁸ *Id.*, p. 6.

³⁹ Id.

⁴⁰ Id.

⁴¹ *Id.,* p. 7.

⁴² *Id.*, pp. 7 – 8.

- This concern applies to the dip of the Los Osos fault. Alternate dips, including relatively low-angle dips, of the Los Osos fault appear to be possible through sections 138-149 and 150 as shown on Figures 5-24 and 5-25 of the CCCSIP report. The reduction in uncertainty in seismic hazard depicted on the 'tornado diagram' for dip of the Los Osos fault appears to be based on the CCCSIP report conclusion that the new data precludes low-angle dips. The IPRP does not concur that low-angle dips are precluded by this new data and therefore does not believe that these studies have resulted in reduced uncertainty in seismic hazard related to this parameter. ⁴³ (emphasis added).
- Although surface faults recognized to date appear to be consistent with strike-slip faulting on the Shoreline fault, rather than thrusting on the SLRF, the possibility of thrust faults in the subsurface is not ruled out by on-land seismic survey data. The interpretation of the ONSIP data is far from unique and allows one to interpret a low angle reverse fault at the proposed location, contrary to what is stated in the CCCSIP report (p.70 Figure 6-54). The CCCSIP interpretation criteria are not clearly defined and do not appear consistent in terms of selections made when seismic reflections are truncated.⁴⁴ (emphasis added)

IPRP Report No. 8 emphasizes the curtailed nature of its after-the-fact review, ⁴⁵ and points out that proper evaluation of PG&E's seismic data acquisition and processing would require the retention of outside consulting services – an authority expressly granted to the IPRP by D.10-08-003 ⁴⁶ and D.12-09-008, ⁴⁷ and first promised at the IPRP's initial meeting on August 31, 2010, ⁴⁸ but still unfulfilled as of the date of this Protest. Unsurprisingly, it was the very fear of this predictable IPRP focus on data acquisition and processing that dominated PG&E management's 2013 internal "risk" evaluation of a scenario labeled "IPRP Review":

⁴³ *Id.*, p. 8.

⁴⁴ Id., p. 10.

⁴⁵ "IPRP review of the tectonic model is based on the CCCSIP report and presentation. The IPRP has not had time, to review the seismic data processing in detail." IPRP Report No. 8, p. 7.

⁴⁶ D.10-08-003, p. 11.

⁴⁷ D.12-09-008, p. 23.

⁴⁸ IPRP Report No. 1, p. 5.

IPRP recommends additional processing of data or interpretations after their review of project results. The project results and conclusions are to be provided to the Independent Peer Review Panel (IPRP) as a condition of authorized CPUC funding for this project. They could recommend additional processing methods be applied or other interpretation techniques be utilized. The IPRP make-up does not have members who are experienced in processing and interpretation, but they could seek an independent review by others. (emphasis added)

IPRP Report No. 9 also describes more recent obstruction to its review of PG&E's ground motion assumptions:

Following the public meeting on January 8, 2015, the IPRP had a number of additional questions regarding the velocity model described in Chapter 10 and requested an additional meeting with PG&E. <u>PG&E declined to meet again with IPRP</u>. As a result, this report only covers aspects of those models described in the CCCSIP report and the public meeting. ⁵⁰ (emphasis added)

PG&E's successful strategy to circumvent meaningful IPRP review, originally formulated in 2013 and implemented as a reaction to the devastating IPRP Report No. 6, culminated with submittal of a deeply flawed "final" AB 1632 Report to the NRC in 2014. As of the date of this Protest, A4NR has had insufficient time to determine the degree to which adulterated assumptions from the inadequately reviewed AB 1632 Report have driven the conclusions of the LTSP's recent SSHAC Report. The cynical fashion in which PG&E's recent publicity offensive has invoked the hamstrung IPRP review to promote the rosy conclusions of the SSHAC Report leaves little room for doubt:

13

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⁴⁹ A4NR Opening Brief, A.14-02-008, p. 4, quoting a March 28, 2013 submittal to PG&E's Executive Project Committee by Ed Halpin, Jeff Summy, and Richard Klimczak.

⁵⁰ IPRP Report No. 9, p. 2.

- Independent experts also included an evaluation of the advanced seismic studies recently performed near Diablo Canyon, <u>as well as feedback on the research provided from a</u> <u>state-appointed independent peer review panel</u>.⁵¹ (emphasis added)
- Their work also utilized insight gained from the advanced seismic studies recently completed near Diablo Canyon. In addition, input on the advanced seismic studies provided by the California Public Utilities Commission's Independent Peer Review
 Panel was considered in the seismic hazard re-evaluation process. 52 (emphasis added)
- [This] work also included an evaluation of the advanced seismic studies recently
 performed near Diablo Canyon, as well as feedback on the research provided from a
 state-appointed independent peer review panel.⁵³ (emphasis added)

VI. DR. BLAKESLEE SPOTLIGHTS PG&E's DECEPTIVE PATTERN.

Leave it to the author of AB 1632, Dr. Sam Blakeslee, the former Exxon geophysicist who served as Republican Minority Leader of the California State Assembly, to assess the degree to which the \$64.25 million ratepayer-funded seismic studies have been subverted. As Dr. Blakeslee observed in December 3, 2014 testimony to the U.S. Senate Environment and Public Works Committee, over several decades PG&E has discovered more faults in close proximity to the plant, attributed greater capability to the faults which it has acknowledged, yet consistently proclaimed the seismic risk at the plant to be diminishing: "The potential earthquakes affecting the plant have increased with each major study. But what's equally striking is that the shaking

⁵¹ "Confirming Diablo Canyon Plant's Safety," Ed Halpin, Lompoc Record, March 14, 2015.

^{52 &}quot;Seismic and tsunami safety a priority for Diablo Canyon," Ed Halpin, San Luis Obispo Tribune, March 19, 2015.

⁵³ "Op/ed: PG&E exec answers critics, says Diablo Canyon is safe, secure," Ed Halpin, Pacific Coast Business Times, March 20, 2015.

predicted by PG&E for these increasing threats has systematically decreased as PG&E adopted less and less conservative analytical methodologies..." ⁵⁴

Dr. Blakeslee was especially critical of PG&E's debased "final" AB 1632 Report:

... in a seeming contradiction, rather than finding that larger or closer faults produce greater shaking and therefore a greater threat, PG&E argues in the Report that ground motion will be lower than the levels previously estimated. In other words, these newly discovered and re-interpreted faults are capable of producing shaking that exceeds the shaking from the Hosgri, yet that shaking threat would be much reduced from prior estimates.

Though discussed only in passing in the Report, the reason for this seeming contradiction is quite important when assessing whether or not the plant is safe or whether it is operating within its license conditions. The reason the earthquake threat purportedly went down when new faults were discovered is because the utility adopted significant changes to the methodology utilized for converting earthquakes (which occur at the fault) into ground motion (which occurs at the facility). This new methodology, which is less-conservative than the prior methodology, essentially "de-amplifies" the shaking estimated from any given earthquake relative to the prior methodology used during the licensing process. ⁵⁵

PG&E's "final" AB 1632 Report artfully avoids an apples-to-apples comparison which would isolate the influence of its continuously evolving ground motion prediction methodology. The charts on pages 13 – 15 of the Technical Summary, attached to this Protest as Appendix A, purport to contrast the spectra derived from the AB 1632 studies against the 1977 Hosgri evaluation and the 1991 LTSP analysis. Neglecting to reveal the radically different methods for predicting ground motions between cases has the same power of deception as assembling a financial spreadsheet mixing different vintages of dollars without disclosure. To the extent

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⁵⁴ Written Statement by Sam Blakeslee, Ph.D, to the Senate Committee on Environment and Public Works, December 3, 2014, p. 3. Dr. Blakeslee's complete statement is accessible at http://www.epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore id=42d07682-cad9-49f4-bbf1-fc9757f624c9

Id., p. 5.

that PG&E intended anyone to rely upon the misrepresentations-by-omission contained in these charts, and such reliance were to occur, the common law uses a certain f-word to describe such conduct.

VII. PG&E's POST-CCCSIP CONTEMPTUOUS DISCLOSURE.

Having successfully circumvented the IPRP before submitting its "final" report to the NRC, and choosing to absorb the criticism of IPRP Report No. 8 without response, the PG&E Geosciences Department could not resist engaging in its own form of end-zone dance at the January 8, 2015 meeting of the IPRP. With peculiar aplomb, Dr. Norman Abrahamson blithely distributed a new hazard sensitivity chart, attached to this Protest as Appendix B, and acknowledged that the six highest ranked uncertainties (each relating to earthquake-induced ground motions at the plant) had never before been presented to the IPRP. Despite admitting that PG&E's void of site-specific ground motion data dominates Diablo Canyon's probabilistic seismic hazard, Dr. Abrahamson nonchalantly suggested this deficiency be addressed in PG&E's 2025 update. There was no mention of the staggering difference in magnitude between the six newly identified uncertainties and the ones which had been selected for the AB 1632 studies. ⁵⁶

His unmistakable message: having feasted on a \$64.25 million authorization for ratepayer-funded studies, we never addressed the most significant issues or even told you what they were. But now we've run out the clock. Too bad, chumps.

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⁵⁶ Dr. Abrahamson's discussion of the new hazard sensitivity chart runs from 1:51:27 to 2:03:25 in the video of the January 8, 2015 IPRP meeting, accessible at http://youtu.be/hXu_vn5gxMU

VIII. TO LIVE OUTSIDE THE LAW YOU MUST BE HONEST.

The light-handed oversight previously afforded PG&E in the conduct of its AB 1632 studies appears to be a legacy of the Commission's discredited, pre-San Bruno voluntary compliance era. As Executive Director Paul Clanon memorably testified to a California Senate committee, "That can be characterized as 'self-reporting,' but a better way to look at it is creating a safety culture at the utility." He later explained that, in lieu of fines, "a better way to ensure safety is to make sure that a utility sees violations on its own has every incentive to report them." As Mr. Clanon told a post-explosion community meeting in San Bruno, fines might "discourage the utilities to come forward when they see a problem. A utility doesn't want their pipelines to be unsafe."

A4NR does not contend that PG&E <u>wants</u> DCNPP to be seismically unsafe. Rather, the accumulated record of PG&E's performance of its AB 1632 seismic studies documents a furtive, thumb-on-the-scale approach designed primarily to quell public apprehension and forestall pressure to close the plant. PG&E has received special dispensation from the NRC since October 12, 2012 to defer application of the Double Design Earthquake ("DDE") standard to the Shoreline Fault until submittal of the DCNPP SSHAC analysis -- despite the NRC's acknowledgment that "using the DDE as the basis of comparison will most likely result in the Shoreline fault and the Hosgri earthquake being reported as having greater ground motion"

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⁵⁷ "PG&E Hammered Over Safety Issues," San Mateo Times, October 19, 2010.

⁵⁸ "State's gas pipeline inspections found to lag," San Francisco Chronicle, November 14, 2010.

⁵⁹ "San Bruno blast victims skeptical of PUC oversight," San Francisco Chronicle, December 8, 2010.

than the plant's Safe Shutdown Earthquake. ⁶⁰ This remarkable prediction was repeated by Dr. Cliff Munson, an NRC seismologist, in testimony to a June 19, 2013 California Energy Commission workshop. ⁶¹ The indifference with which California state agencies have, at least publicly, accepted this revelation has been alarming but the financial bottom line is undeniable: significant seismic retrofit requirements seem likely to be required. ⁶²

A4NR does not expect the CPUC to involve itself in questions of the seismic licensing basis of DCNPP or the prudence of the manner in which the NRC has addressed the seismic licensing basis issue. ⁶³ Instead, A4NR expects the Commission to be diligent in its application of traditional ratemaking authority to protect California's economic interest and electricity reliability interest in accurately understanding the seismic challenges facing the plant. The Commission would be derelict in meeting this responsibility by relying exclusively on PG&E's good faith or commitment to scientific objectivity.

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⁶⁰ Letter to Edward D. Halpin from Joseph M. Sebrosky, NRC Senior Project Manager for Plant Licensing Branch IV, Division of Operating Reactor Licensing, Office of Nuclear Reactor Regulation, October 12, 2012, accessible at http://pbadupws.nrc.gov/docs/ML1207/ML120730106.pdf

⁶¹ Lead Commissioner Workshop on California Nuclear Power Plant Issues, Docket No.13-IEP-1J, June 19, 2013, Transcript, p. 89, accessible at http://www.energy.ca.gov/2013 energypolicy/documents/2013-06-19 workshop/2013-06-19 nuclear workshop transcript.pdf

The severity of any such requirement is suggested by PG&E's 2012 submittal to the NRC of a 331-page list of DCNPP deviations from the "new plant" criteria Dr. Munson testified will be applied: ""The thing I want to emphasize is that the hazard evaluations are based on current practices for new reactors." Id., p. 81. PG&E's 331-page list of deviations is accessible at http://pbadupws.nrc.gov/docs/ML1134/ML11342A238.pdf

⁶³ The Union of Concerned Scientists reported in 2013 that, of the 100 reactors currently operating in the U.S., the two at Diablo Canyon top the NRC's list as being most likely to experience an earthquake larger than they are designed to withstand, using NRC data to calculate the probability of such an event as more than 10 times greater than the nuclear fleet average. "Seismic Shift: Diablo Canyon Literally and Figuratively on Shaky Ground," Union of Concerned Scientists, November 2013, p. 7, accessible at

http://www.ucsusa.org/sites/default/files/legacy/assets/documents/nuclear_power/diablo-canyon-earthquakerisk.pdf

PG&E is the only NRC power plant licensee in the history of the commercial nuclear power industry to face criminal indictment for safety-related violations by the U.S. Department of Justice. While the 27 safety-related felony counts in PG&E's federal grand jury indictment are focused on the company's gas division, it strains credulity to believe that DCNPP has been somehow immunized from the corporate culture rot that recently prompted Commission President Michael Picker to acknowledge during a California Senate oversight hearing that, "I think there's a very clear case that in some places, the utility did divert dollars that we approved for safety purposes for executive compensation." And the obstruction of justice felony count which leads PG&E's federal indictment emphatically addresses management as a whole:

"On or about September 10, 2010, and continuing through on or about September 30, 2011, in the Northern District of California, the defendant, PACIFIC GAS AND ELECTRIC COMPANY, did corruptly influence, obstruct, and impede, and did endeavor to influence, obstruct, and impede the due and proper administration of the law under which a pending proceeding was being had before a department and agency of the United States ..." 65 (emphasis added)

Although perhaps not a matter of familiarity to utility regulators, the term "RAP sheet" is derived from the Federal Bureau of Investigation's Record of Arrests and Prosecutions.

Actual conviction is not a prerequisite. A4NR is unaware of any other California electric utility with a RAP sheet. While PG&E is certainly entitled to its day(s) in court to defend itself from the federal charges, its status as a criminal defendant and the nature of its alleged crimes should

⁶⁴ President Picker's statement is at 36:56 of the video of the March 25, 2015 oversight hearing conducted by the California Senate Committee on Energy, Utilities and Communications, accessible at http://calchannel.granicus.com/MediaPlayer.php?view_id=7&clip_id=2682

⁶⁵ United States of America v. Pacific Gas and Electric Company, United States District Court for the Northern District of California, Case 3:14-cr-00175-THE, Superseding Indictment, July 29, 2014, p. 18.

discourage the Commission from extending any presumption of veracity to the representations in PG&E's AB 1632 Report without corroboration by the most rigorous scrutiny.

IX. WHY A4NR PROTESTS.

Building upon key decisions made and implemented by PG&E in 2013, the utility intensified its efforts in 2014 to subvert what was originally conceived by the Commission as a robust re-evaluation of DCNPP's seismic setting. If PG&E is allowed to recover the costs of such subterfuge, the effect on A4NR and all PG&E customers will be electricity rates rendered both unreasonable and unjust by Commission reward of unmistakable perfidy. The consequences for A4NR members (and others) living in communities near the plant stemming from unknowing acceptance of PG&E's defective seismic analysis could, in some circumstances, be much worse than that – with incalculable financial impact on California.

A4NR requests evidentiary hearings and will conduct discovery and sponsor testimony elaborating on the facts contained in this Protest, as well as the extent to which PG&E's LTSP and SSHAC expenditures in 2014 were similarly tainted. Assuming timely responsiveness by PG&E to legitimate discovery requests, A4NR has no objection to the schedule proposed in PG&E's application.

The undersigned will be the A4NR's principal contact in this proceeding, but A4NR also asks that the following two individuals be placed in the "information only" category of the Service List:

Rochelle Becker rochelle@a4nr.org David Weisman david@a4nr.org

Respectfully submitted,

By: /s/ John L. Geesman

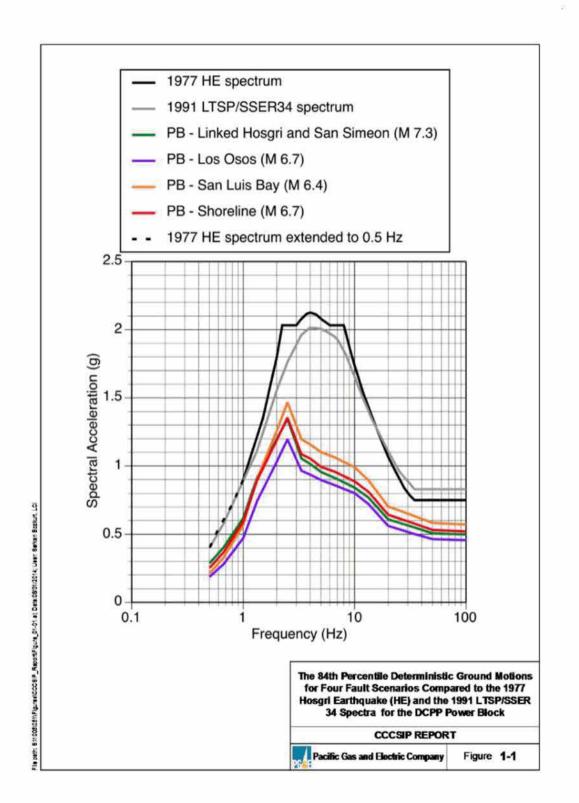
JOHN L. GEESMAN DICKSON GEESMAN LLP

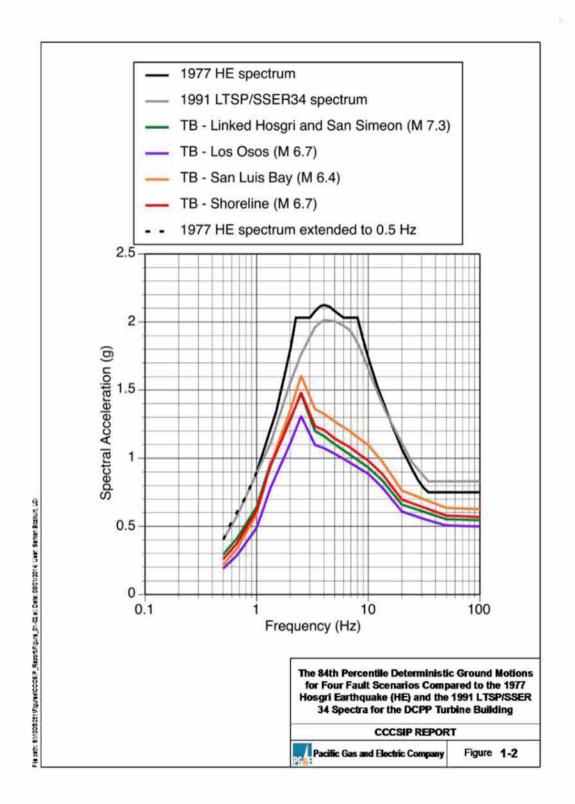
Date: April 3, 2015 Attorney for

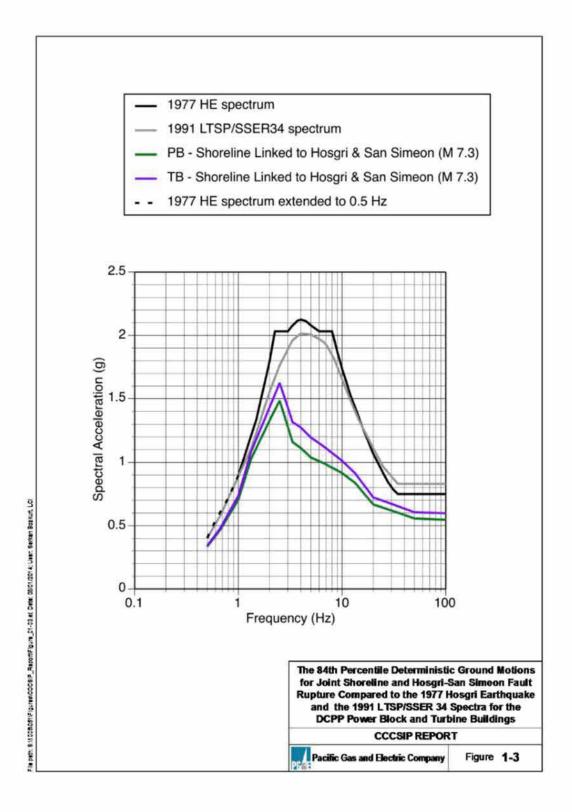
ALLIANCE FOR NUCLEAR RESPONSIBILITY

APPENDIX A

PG&E SPECTRA CHARTS FROM CCCSIP REPORT.



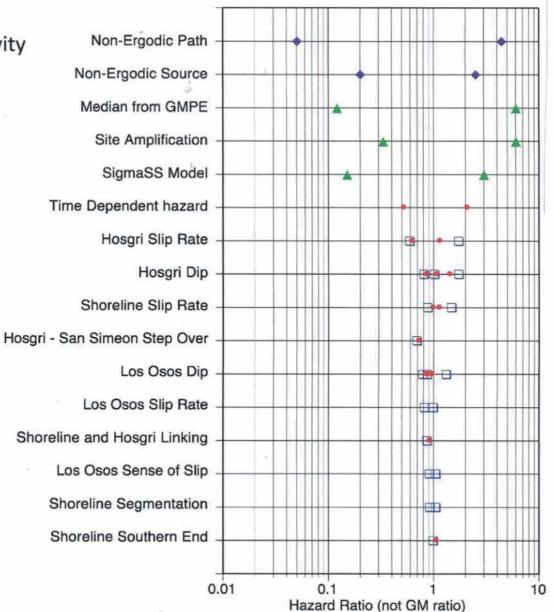




APPENDIX B

PG&E LATE-DISTRIBUTED HAZARD CHART

Hazard Sensitivity 5 Hz, PSA = 2g



- SSC 2011
- SSC 2014
- ▲ GMC 2014
- Non-Ergodic GMC

From:John Stamatakos

Sent:12 May 2015 20:14:25 +0000

To:Miriam R. Juckett

Subject:FW: Written concerns - April 28th, 2015 webcast meeting with PG&E

Attachments: IPRP Report No 6-1.pdf, IPRP Report No 8.pdf, IPRP Report No 9-1.pdf, 040315

A4NR Protest-023.pdf, 051215 Rochelle Becker-NRC staff.pdf Attachments are already publicly available as ML15134A258.

From: Rochelle Becker [mailto:rochellea4nr@gmail.com]

Sent: Tuesday, May 12, 2015 4:09 PM

To: njd2@nrc.gov

Cc: Markley, Michael; Richard.Plasse@nrc.gov; Michael.Wentzel@nrc.gov; Wayne.Walker@nrc.gov; Ryan.Alexander@nrc.gov; Thomas Hipschman; Bill Maier; Yong.Li@nrc.gov; Nilesh.Chokshi@nrc.gov; Jim.Xu@nrc.qov; Kamal.Manoly@nrc.qov; P.Y.Chen@nrc.qov; John.Burke@nrc.qov; Clifford.Munson@nrc.gov; Gerry Stirewalt; Timothy.Lupold@nrc.gov; John Stamatakos; Siva.Lingam@nrc.gov; Chris.Miller@nrc.gov; Bill.Dean@nrc.gov; Brian.Holian@nrc.gov; Marc.Dapas@nrc.gov; Michael.Johnson@nrc.gov; jon.ake@nrc.gov

Subject: Written concerns - April 28th, 2015 webcast meeting with PG&E

Dear Mr DiFrancesco,

Please see attached letter. There are four referenced attachments as pdf files as well.

Thank you Rochelle

Rochelle Becker, Executive Director Alliance for Nuclear Responsibility PO 1328 San Luis Obispo, CA 93406 www.a4nr.org

Jackson, Diane

From:Jackson, Diane

Sent:28 May 2015 09:43:04 -0400

To:Munson, Clifford

Cc:Graizer, Vladimir;John Stamatakos;Ake, Jon;Plaza-Toledo, Meralis;Giacinto, Joseph;Stovall,

Scott;Brittain Hill;Li, Yong

Subject:FYI: Reminder sent to Diablo for Information Request

Nick sent a reminder.

Diane

From: DiFrancesco, Nicholas

Sent: Thursday, May 28, 2015 9:16 AM

To: Philippe Soenen (Pns3@pge.com); Jahangir, Nozar

Cc: Michael Richardson (mjrm@pge.com); Strickland, Jearl; Shams, Mohamed; Jackson, Diane; Vega,

Frankie

Subject: Reminder on Diablo Information Request

Philippe, et, al

Just a reminder that the staff is interested in the following references to support NRC review:

- 1) Benchmark files for SWUS-DCPP median ground motion models.
- 2) ESTA 27 and 28 recordings of Parkfield and San Simeon earthquakes
 - a. Time histories
 - b. Response spectra
 - Response spectra adjusted for Vs30
- Engineering reports describing development of velocity profiles for stations ESTA 27 and 28.
- 4) Paper describing WAACY Magnitude PDF by Wooddell and others.

Please let me know when the references will be available.

Thanks,

Nick

Senior Project Manager - Seismic Reevaluation Activities U.S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation Japan Lesson Learned Project Division nicholas.difrancesco@nrc.gov | Tel: (301) 415-1115

From:John Stamatakos

Sent:29 Apr 2015 15:52:32 +0000

To:Giacinto, Joseph (Joseph.Giacinto@nrc.gov);Plaza-Toledo, Meralis (Meralis.Plaza-Toledo@nrc.gov)

Cc:Munson, Clifford (Clifford.Munson@nrc.gov);Ake, Jon (Jon.Ake@nrc.gov);Jackson, Diane (Diane.Jackson@nrc.gov);Stirewalt, Gerry (Gerry.Stirewalt@nrc.gov);Seber, Dogan (Dogan.Seber@nrc.gov);Miriam R. Juckett;Graizer, Vladimir (Vladimir.Graizer@nrc.gov);Hill, Brittain (Brittain.Hill@nrc.gov)

Subject: Hosgri Slip Rates

Joe and Meralis,

One of the more interesting, and more hazard sensitive, aspects of the Diablo canyon SSC is the Hosgri slip rate CDF. I suggest we focus our initial reviews on that aspect of the SSC. Dogan made a critical observation yesterday in our discussions, namely how can the lower tail of the CDF be justified. In thinking through the question last night I have a few suggestions.

- We should look at the seismic imaging data from the CCCSIP that PG&E uses to constrain the slip (interpretations of offset paleo-channels). There are 4 piercing points that PG&E uses to develop the composite slip rate CDF for the Hosgri fault. The slip rate data used for these 4 points is summarized in:
 - a. San Simeon/Oso Terrace Figure 8-16
 - b. Point Estero Cross-Hosgri Slope Figure 8-18
 - c. Estero Bay Submarine Channel Figure 8.28
 - d. Point Sal Channel F Figure 8.32

For each of these we should understand how the cumulative slip was determined (and uncertainty) and how the offset age was determined (and uncertainty).

- Age: For San Simeon, the age is based on the interpretation that the unconformity overlying
 the buried geomorphic featured tied to the Younger Dryas, so this one is rather
 straightforward. But the other three, especially Estero Bay and Point Sal, ages are based on
 interpretations of age ranges from the seal level curves. So we will need to understand how
 the TI team interpreted the offset parkers in terms of these curves and whether other
 interpretations outside the ones provided are permissible.
- 2. Slip: All the slip estimates are based on interpretations of the 2D and 3D seismic images and detailed sea floor bathymetry. I am going to ask my San Antonio team to look over these images from Chapter 8 of the SSC report to help us understand how the images were interpreted and to assess the overall quality of the interpretations. I am also interested in understanding whether the full range of uncertainty is included in the TI team's interpretations.

We could also ask Cliff and Jon to some sensitivity studies to constrain the limits of what we are looking for. I think it might be helpful here to know how far the current slip rate estimates would have to be different from those used in the study to move the hazard needle. For example, what if the TI team were off by a single Marine Oxygen Isotope Stage (MIS)? For most of these my very preliminary

guesstimate is that would correspond to about a 25% increase in the slip rates. Would such an increase in rates be significant?

I am going to have a call with my San Antonio team this afternoon, and would be happy to have you both on the call. Right now the call is set for 3:00 this afternoon, but it can adjusted to meet your schedules.

Thanks,

John.

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

jstamatakos@swri.org

From:John Stamatakos

Sent:10 Apr 2015 20:01:06 +0000

To:Graizer, Vladimir (Vladimir.Graizer@nrc.gov);Stirewalt, Gerry

 $(Gerry. Stirewalt@nrc.gov); Plaza-Toledo, Meralis (Meralis. Plaza-Toledo@nrc.gov); Miriam\ R.$

Juckett

Cc:Ake, Jon (Jon.Ake@nrc.gov);Hill, Brittain (Brittain.Hill@nrc.gov);Munson, Clifford (Clifford.Munson@nrc.gov);'lisa.walsch@nrc.gov';Li, Yong (Yong.Li@nrc.gov)

Subject: Monday Diablo Meeting

Vlad,

For Monday, I can walk everyone through the draft summary report we have on the seismic imagining data and searchable image table.

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

jstamatakos@swri.org

Sarah Wigginton

From:Sarah Wigginton Sent:6 Apr 2015 14:30:46 -0500 To:John Stamatakos Cc:Ronald McGinnis Subject:Password for Secured PDF Files John,

I'm working on finishing up the Diablo Canyon Document Catalog and I've noticed that some of PDF files are "secured" so I am unable to copy any of the material (titles, sources, etc.). Working with an unsecured version would greatly speed up the process of cataloging the figures!

Would it be possible to get my hands on a password for the "DCPP SSC Report Rev A"?

Best, Sarah

Sarah Wigginton

Department of Earth, Material, and Planetary Sciences Geosciences and Engineering Division Southwest Research Institute 6220 Culebra Road, San Antonio, TX 78238, USA

From:John Stamatakos

Sent:22 Apr 2015 02:17:55 +0000

To: 'Jackson, Diane'

Subject: RE: DCPP, Palo Verde, and Columbia Audit Information: SSHAC Documentation from

PPRP-IT Team

Ok thanks

I am working on some Diablo inputs for Cliff.

John

From: Jackson, Diane [mailto:Diane.Jackson@nrc.gov]

Sent: Tuesday, April 21, 2015 7:27 PM **To:** John Stamatakos; Spence, Jane

Subject: Re: DCPP, Palo Verde, and Columbia Audit Information: SSHAC Documentation from PPRP-IT

Team

Jane, any chance u can get these on a CD? John, no Columbia tomorrow. Diane

Sent from an NRC blackberry

Diane Jackson

(b)(6

From: John Stamatakos [mailto:jstam@swri.org]

Sent: Tuesday, April 21, 2015 04:25 PM

To: Munson, Clifford; DiFrancesco, Nicholas; Ake, Jon

Cc: Jackson, Diane; Shams, Mohamed; Vega, Frankie; Graizer, Vladimir; Hill, Brittain; Seber, Dogan;

Vega, Frankie; Stirewalt, Gerry

Subject: RE: DCPP, Palo Verde, and Columbia Audit Information: SSHAC Documentation from PPRP-IT

Team

I can't get to the NRC drive so I'll get copies I am at NRC.

Thanks

John

From: Munson, Clifford [mailto:Clifford.Munson@nrc.gov]

Sent: Tuesday, April 21, 2015 4:14 PM **To:** DiFrancesco, Nicholas; Ake, Jon

Cc: Jackson, Diane; Shams, Mohamed; Vega, Frankie; Graizer, Vladimir; John Stamatakos; Brittain Hill;

Seber, Dogan; Vega, Frankie; Gerry Stirewalt

Subject: RE: DCPP, Palo Verde, and Columbia Audit Information: SSHAC Documentation from PPRP-IT

Team

Importance: High

Nick.

We took a quick look at the contents of the information for DCPP and PVNGS. The DCPP folder contains the PPRP-TI correspondence and interactions on the source model and ground motion model SSHACs. However, the PVNGS only has the ground motion model SSHAC PPRP-TI team material and not for the Source model. Please let us know when we can get the source model PPRP-TI team documentation.

Thanks, Cliff

From: DiFrancesco, Nicholas

Sent: Tuesday, April 21, 2015 1:25 PM

To: Munson, Clifford; Ake, Jon

Cc: Jackson, Diane; Shams, Mohamed; Vega, Frankie; Graizer, Vladimir; John Stamatakos < jstam@swri.org > (jstam@swri.org); Hill, Brittain; Seber, Dogan; Vega, Frankie; Stirewalt, Gerry Subject: DCPP, Palo Verde, and Columbia Audit Information: SSHAC Documentation from PPRP-IT Team

Folks,

Please control distribution to the designated review team member for the following references.

Following your audit review, please advise if information reviewed should be docketed to support development of the hazard staff assessment or RAIs.

DC Audit Information

S:\Diablo Canyon R2.1 Seismic Information\SSHAC Documentation of PPRP-TI Team

Palo Verde Audit Information

S:\Palo Verde R2.1 Seismic Information\SSHAC Documentation of PPRP-TI Team

Columbia

Information is on ePortal (PM action to work through access controls). Also, licensee plans to work with PNNL to post information on public website.

Thanks, Nick

From: Soenen, Philippe R [mailto:PNS3@pge.com]

Sent: Tuesday, April 21, 2015 10:49 AM

To: DiFrancesco, Nicholas **Cc:** Jahangir, Nozar

Subject: DCPP information on Certrec

Nick.

We have uploaded the PPRP information onto Certrec IMS and granted access to Vladimir Grazier, John Stamatakos, and yourself. Here is how you get to the PPRP information in Certrec:

- · Login to ims.certrec.com
- · Click on "Inspections"
- Set status to "In Progress" and Plant to "Diablo Canyon"
- Click "Search" button.
- Click link to "Self-Assessment / Audit Review of PPRP Comments and TIT Resolution"
- Click on the "NRC Requests" tab
- Click on what you would like to see.

Please let me know if you have any questions.

Regards,

Philippe Soenen

Regulatory Services Office - 805.545.6984 Cell (b)(6)

PG&E is committed to protecting our customers' privacy.

To learn more, please visit http://www.pge.com/about/company/privacy/customer/

Alan Morris

From: Alan Morris

Sent:15 May 2015 19:06:33 +0000

To:John Stamatakos Cc:David Ferrill

Subject:RE: Diablo Canyon

Not the version I am looking at - did you place it somewhere other than on Regios?

Alan

Alan Morris

Department of Earth, Material, and Planetary Sciences Geosciences and Engineering Division

Southwest Research Institute

6220 Culebra Road, San Antonio, TX 78238, USA

Tel: 210.522.6743 Fax: 210.522.5155

Web page: http://www.swri.org/4org/d20/geosci/structur.htm

http://3dstress.swri.org/

From: John Stamatakos

Sent: Friday, May 15, 2015 2:03 PM

To: Alan Morris Cc: David Ferrill

Subject: RE: Diablo Canyon

I did unlock that one I think?

I do want to chat about this work next week when I am back in the office.

John

From: Alan Morris

Sent: Friday, May 15, 2015 1:50 PM

To: John Stamatakos Cc: David Ferrill

Subject: Diablo Canyon

John,

Did I understand you to have said that we might be able to see unlocked versions of some of the relevant documents?

If so, then I would like to be able to see all the parts of "NTTF DCCP PSHA Review", which seems to have some very good stuff in it, and it is not easy to read and annotate as it currently stands.

Thanks

Alan

Alan Morris
Department of Earth, Material, and Planetary Sciences
Geosciences and Engineering Division
Southwest Research Institute
6220 Culebra Road, San Antonio, TX 78238, USA

Tel: 210.522.6743 Fax: 210.522.5155

Web page: http://www.swri.org/4org/d20/geosci/structur.htm

http://3dstress.swri.org/

Alan Morris

From:Alan Morris

Sent:28 Apr 2015 19:49:58 +0000

To:Ronald McGinnis;David Ferrill;Kevin Smart;Sarah Wigginton

Subject: RE: Diablo Canyon After 9:30 am is good for me --Alan

Alan Morris

Department of Earth, Material, and Planetary Sciences

Geosciences and Engineering Division

Southwest Research Institute

6220 Culebra Road, San Antonio, TX 78238, USA

Tel: 210.522.6743 Fax: 210.522.5155

Web page: http://www.swri.org/4org/d20/geosci/structur.htm

http://3dstress.swri.org/

From: Ronald McGinnis

Sent: Tuesday, April 28, 2015 1:56 PM

To: David Ferrill; Alan Morris; Kevin Smart; Sarah Wigginton

Subject: FW: Diablo Canyon

Is there a particular time that works for you all? I am good any time.

From: John Stamatakos

Sent: Tuesday, April 28, 2015 1:53 PM

To: Ronald McGinnis

Subject: RE: Diablo Canyon

I am in a Diablo meeting right now. We should have a call tomorrow.

I'll have to look at my schedule but could you ask your folks so we can set up a good time?

John

From: Ronald McGinnis

Sent: Tuesday, April 28, 2015 1:35 PM

To: John Stamatakos Subject: RE: Diablo Canyon

John,

We just got back in the office from two weeks of travel. David and I are in the office this week and then gone again next week. How did the meeting with NRC go? I got your voicemail asking about the GIS file but I didn't get it until yesterday.

Do we have the go ahead for Phase 2? If so, we may want to have a phone call this week to go over the details.

Thanks, Ronny

From: John Stamatakos

Sent: Friday, April 10, 2015 3:04 PM

To: Ronald McGinnis

Cc: David Ferrill; Alan Morris (D)(G)); Kevin Smart; Sarah Wigginton; Miriam R. Juckett

Subject: RE: Diablo Canyon

I mean Ronny ... sorry I know better

From: John Stamatakos

Sent: Friday, April 10, 2015 4:02 PM

To: Ronald McGinnis

Cc: David Ferrill; Alan Morris (b)(6)); Kevin Smart; Sarah Wigginton; Miriam R. Juckett

Subject: RE: Diablo Canyon

Thanks Ronnie,

Outstanding job. I am very pleased with the progress so far.

john

From: Ronald McGinnis

Sent: Friday, April 10, 2015 3:58 PM

To: John Stamatakos

Cc: David Ferrill; Alan Morris ((b)(6)); Kevin Smart; Sarah Wigginton

Subject: RE: Diablo Canyon

John,

We are not quite finished with the data quality tab in the spreadsheet so that will have to continue, but all the data has been reviewed and is represented by a row in the following linked spreadsheet.

Y:\Diablo Canyon\Document Catalog COMPLETE.xlsx

Also, we are working on an ArcGIS project that helps to organize the seismic data. It should be finished by COB today. That link is at Y:\Diablo Canyon\Diablo Canyon\Diablo Canyon\Diablo Canyon March 2015.mxd

The review document is at T:\Diablo Canyon\Diablo Canyon\CNWRA report April 2015\DiabloCanyonPowerPlant - seismic risk data survey April 2015.docx

All the rest of the files are in the Diablo Canyon folder on regios.

Let us know if you have any questions.

-Ronny

From: John Stamatakos

Sent: Friday, April 10, 2015 2:48 PM

To: Ronald McGinnis Subject: Diablo Canyon

Can I review all the files so I can present at NRC on Monday?

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

jstamatakos@swri.org

From:John Stamatakos

Sent:29 Apr 2015 16:03:59 +0000

To:Ronald McGinnis Subject:RE: Diablo Canyon

Ronnie, do we have a bridge line we can use?

John

From: Ronald McGinnis

Sent: Wednesday, April 29, 2015 10:37 AM

To: John Stamatakos Subject: RE: Diablo Canyon

Sounds good.

From: John Stamatakos

Sent: Wednesday, April 29, 2015 9:35 AM

To: Ronald McGinnis

Subject: RE: Diablo Canyon

Office ... or we may use a bridge if I want to bring in NRC.

From: Ronald McGinnis

Sent: Wednesday, April 29, 2015 10:33 AM

To: John Stamatakos Subject: RE: Diablo Canyon

We will call you. Office or cell?

From: John Stamatakos

Sent: Wednesday, April 29, 2015 9:16 AM

To: Ronald McGinnis

Subject: RE: Diablo Canyon

OK

From: Ronald McGinnis

Sent: Wednesday, April 29, 2015 10:00 AM

To: John Stamatakos

Subject: RE: Diablo Canyon

John,

How about 2:00 our time?

-Ronny

From: Ronald McGinnis

Sent: Tuesday, April 28, 2015 1:55 PM

To: John Stamatakos Subject: RE: Diablo Canyon

Should work. I will get a time and let you know.

From: John Stamatakos

Sent: Tuesday, April 28, 2015 1:53 PM

To: Ronald McGinnis

Subject: RE: Diablo Canyon

I am in a Diablo meeting right now. We should have a call tomorrow.

I'll have to look at my schedule but could you ask your folks so we can set up a good time?

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Do we have the go ahead for Phase 2? If so, we may want to have a phone call this week to go over the details.

Thanks, Ronny

From: John Stamatakos

Sent: Friday, April 10, 2015 3:04 PM

To: Ronald McGinnis

Cc: David Ferrill; Alan Morris (b)(6)); Kevin Smart; Sarah Wigginton; Miriam R. Juckett

Subject: RE: Diablo Canyon

I mean Ronny ... sorry I know better

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To: Ronald McGinnis

Cc: David Ferrill; Alan Morris (0)(6)); Kevin Smart; Sarah Wigginton; Miriam R. Juckett

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To: John Stamatakos

Cc: David Ferrill; Alan Morris ((b)(6)); Kevin Smart; Sarah Wigginton

Subject: RE: Diablo Canyon

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The review document is at T:\Diablo Canyon\Diablo Canyon\CNWRA report April 2015\DiabloCanyonPowerPlant - seismic risk data survey April 2015.docx

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Let us know if you have any questions.

-Ronny

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Sent: Friday, April 10, 2015 2:48 PM

To: Ronald McGinnis Subject: Diablo Canyon

Can I review all the files so I can present at NRC on Monday?

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 jstamatakos@swri.org

From:John Stamatakos

Sent:15 May 2015 19:16:16 +0000

To:Alan Morris

Subject:RE: Diablo Canyon

No but III check again.

From: Alan Morris

Sent: Friday, May 15, 2015 3:07 PM

To: John Stamatakos **Cc:** David Ferrill

Subject: RE: Diablo Canyon

Not the version I am looking at - did you place it somewhere other than on Regios?

Alan

Alan Morris

Department of Earth, Material, and Planetary Sciences

Geosciences and Engineering Division

Southwest Research Institute

6220 Culebra Road, San Antonio, TX 78238, USA

Tel: 210.522.6743 Fax: 210.522.5155

Web page: http://www.swri.org/4org/d20/geosci/structur.htm

http://3dstress.swri.org/

From: John Stamatakos

Sent: Friday, May 15, 2015 2:03 PM

To: Alan Morris Cc: David Ferrill

Subject: RE: Diablo Canyon

I did unlock that one I think?

I do want to chat about this work next week when I am back in the office.

John

From: Alan Morris

Sent: Friday, May 15, 2015 1:50 PM

To: John Stamatakos Cc: David Ferrill Subject: Diablo Canyon

John,

Did I understand you to have said that we might be able to see unlocked versions of some of the relevant documents?

If so, then I would like to be able to see all the parts of "NTTF DCCP PSHA Review", which seems to have some very good stuff in it, and it is not easy to read and annotate as it currently stands.

Thanks Alan

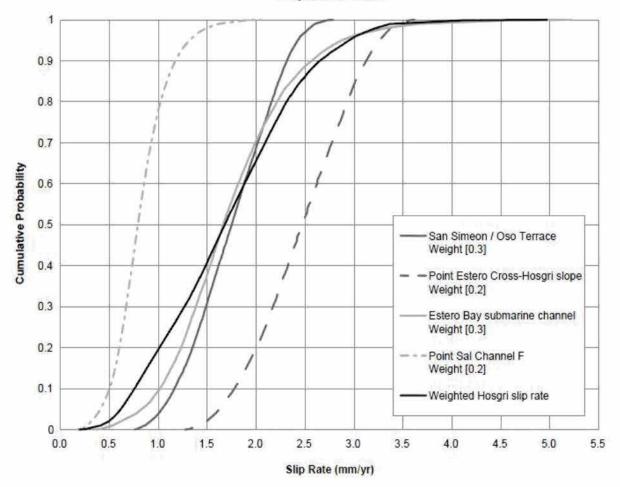
Alan Morris Department of Earth, Material, and Planetary Sciences Geosciences and Engineering Division Southwest Research Institute 6220 Culebra Road, San Antonio, TX 78238, USA

Tel: 210.522.6743 Fax: 210.522.5155

Web page: http://www.swri.org/4org/d20/geosci/structur.htm

http://3dstress.swri.org/

Slip Rate CDF



5-Point Distribution						
Percentile	Slip Rate (mm/yr)	Weight 0.101 0.244 0.309 0.244 0.101				
0.034893	0.6					
0.211702	1					
0.5	1.7					
0.788298	2.3					
0.965107	3.1					
Weighted Mean	1.7					

Note: The Hosgri slip rate CDF is calculated from the weighted combination of slip rate CDFs developed for each of the four Hosgri slip rate sites.

Hosgri Slip Rate CDF Compilation and Selection of 5-Point Distribution

DCPP SSC REPORT



Pacific Gas and Electric Company

Figure 8-33

From:John Stamatakos

Sent:29 Apr 2015 15:59:39 +0000

To:Ronald McGinnis; Alan Morris; David Ferrill; Kevin Smart; Sarah Wigginton

Cc:Miriam R. Juckett Subject:RE: Diablo Canyon

Attachments: Composite Hosgri SR PDF. JPG

Ronnie,

For the call this afternoon.

I want to look at the seismic imaging data from the CCCSIP that PG&E uses to constrain the slip (interpretations of offset paleo-channels) for the Hosgri Fault. There are 4 piercing points that PG&E uses to develop the composite slip rate CDF for the Hosgri fault. The slip rate data used for these 4 points is summarized in the SSC report in Chapter 8:

- San Simeon/Oso Terrace Figure 8-16
- b. Point Estero Cross-Hosgri Slope Figure 8-18
- c. Estero Bay Submarine Channel Figure 8.28
- d. Point Sal Channel F Figure 8.32

For each of these we should understand how the cumulative slip was determined (and uncertainty) and how the offset age was determined (and uncertainty).

- Age: For San Simeon, the age is based on the interpretation that the unconformity overlying the
 buried geomorphic featured tied to the Younger Dryas, so this one is rather
 straightforward. But the other three, especially Estero Bay and Point Sal, ages are based on
 interpretations of age ranges from the seal level curves. So we will need to understand how the
 TI team interpreted the offset parkers in terms of these curves and whether other
 interpretations outside the ones provided are permissible.
- Slip: All the slip estimates are based on interpretations of the 2D and 3D seismic images and detailed sea floor bathymetry. The summary figures from the CCCISP are also in Chapter 8 of the SSC Report.

Thanks,

John

FYI I replaced the locked DCPP SSC Report Rev A in the folder with an unlocked pdf version so search and rescue is much easier now.

From: Ronald McGinnis

Sent: Wednesday, April 29, 2015 10:00 AM

Sent:26 Mar 2015 15:35:53 +0000

To:David Ferrill;'Alan Morris'; Kevin Smart

Cc: Alan Morris

Subject: RE: Diablo Canyon data review for NRC

John is going to be here Tuesday morning. The plan is for Alan, Kevin (if you are here), and me to go over the project with him that morning and figure out a schedule. I am out most of the day on Wednesday for (b)(6) so Thursday may be the day we can spend the most time with John on this.

Unless David and Alan can do some on Wednesday while I am out.

-Ronny

From: Ronald McGinnis

Sent: Tuesday, March 24, 2015 9:08 AM **To:** David Ferrill; 'Alan Morris'; Kevin Smart

Cc: Alan Morris

Subject: RE: Diablo Canyon data review for NRC

Just got off the phone with John. We are set for next week April 1-2 (Wednesday and Thursday). I will get the conference room next to Violet reserved and I will get John set up on Regios so he can start loading data in advance of the meeting.

-Ronny

From: David Ferrill

Sent: Monday, March 23, 2015 10:12 PM **To:** 'Alan Morris'; Ronald McGinnis **Cc:** Alan Morris; Kevin Smart

Subject: RE: Diablo Canyon data review for NRC

Ronny,

This sounds like an interesting project!

Please let John know that I have been out of cell phone range for the last few days in Big Bend and just resurfaced today, and I did get his message and was planning to call him tomorrow morning.

I will be cleansing and having a colonoscopy Monday and Tuesday of next week, so those days are out for me. I expect/hope to be in on Wednesday and Thursday April 1-2, but will be taking off April 3rd for vacation. So, to me the best dates next week for meeting on this appear to by April 1-2, 2015.

David

From: Alan Morris [mailto: (b)(6)

Sent: Monday, March 23, 2015 9:58 PM

To: Ronald McGinnis

Cc: David Ferrill; Alan Morris; Kevin Smart

Subject: Re: Diablo Canyon data review for NRC

Alan
On Mon, Mar 23, 2015 at 10:47 AM, Ronald McGinnis rmcginnis@swri.org > wrote:
Guys,
I just got off the phone with John Stamatakos regarding a project that has been funded that he wants our help with. Diablo Canyon has acquired a very large seismic data set (2d, 3d over the plant site, extensive shallow seismic, and some off shore) something in the neighborhood of \$60 million worth of data. Some is newly acquired and all the new stuff has been merged with the old stuff.
There are 400 hours dedicated to this project. There would be two phases to this project. Phase I would be a high level review of the data and would be due in the next 45 days. Basically organize the data to see what they even have, perform a basic QA to see if the seismic is even useful, and provide a 2-3 page report outlining the data and our observations. Phase 2 would be full-scale characterization (PETREL model) pending that we can prove from Phase I that the data is useful.
John wants to come in next week to meet with us and look at the data for a couple days. Alan and David, can you offer two consecutive days that would work so I can let John know? I am available any day and Kevin said he could be available in the morning.
Hope the trip is going well.
Thanks,
Ronny

Ronald N. McGinnis

Next week is open, this week is not good for me, I am only planning to be in on Wednesday

rmcginnis@swri.org

Senior Research Scientist

Department of Earth, Material, and Planetary Sciences Southwest Research Institute

6220 Culebra Road

San Antonio, Texas 78238-5166

Office: 210-522-5825

Mobile: (b)(6)

From:John Stamatakos

Sent:1 Jun 2015 12:00:29 +0000

To: 'Munson, Clifford'

Subject:RE: Diablo Canyon Mtg - Topic for this week

Cliff,

I don't have anything to present this week. But wasn't the meeting moved to Wednesday?

John

From: Munson, Clifford [mailto:Clifford.Munson@nrc.gov]

Sent: Monday, June 1, 2015 7:47 AM

To: Ake, Jon; John Stamatakos; Graizer, Vladimir; Plaza-Toledo, Meralis; Stovall, Scott

Cc: Jackson, Diane

Subject: Diablo Canyon Mtg - Topic for this week

We will discuss magnitude recurrence and activity rates assuming constant seismic moment rate as opposed to constant seismicity. I have a presentation but it will probably not take more than half of our allotted time of 2 hrs. Does anyone else have something to present? I will get the projector and laptop.

Cliff

Munson, Clifford

From: Munson, Clifford

Sent:28 May 2015 11:40:45 -0400

To: John Stamatakos; Graizer, Vladimir; Stovall, Scott; Ake, Jon; Brittain Hill; Plaza-Toledo,

Meralis

Cc:Jackson, Diane;DiFrancesco, Nicholas

Subject:RE: Diablo Canyon RAI

Thanks John. They don't define site profiles in terms of the layering, properties, etc. because they do the empirical approach.

Cliff

From: John Stamatakos [mailto:jstam@swri.org]

Sent: Thursday, May 28, 2015 10:28 AM

To: Munson, Clifford; Graizer, Vladimir; Stovall, Scott; Ake, Jon; Hill, Brittain; Plaza-Toledo, Meralis

Cc: Jackson, Diane; DiFrancesco, Nicholas

Subject: RE: Diablo Canyon RAI

Cliff,

I have a comment/question in the RAI.

Thanks,

John

From: Munson, Clifford [mailto:Clifford.Munson@nrc.gov]

Sent: Thursday, May 28, 2015 9:21 AM

To: Graizer, Vladimir; Stovall, Scott; John Stamatakos; Ake, Jon; Brittain Hill; Plaza-Toledo, Meralis

Cc: Jackson, Diane; DiFrancesco, Nicholas

Subject: Diablo Canyon RAI

First draft of DCPP RAI on site response. Please take a look and let me know if you have any comments.

Thanks, Cliff Sent:27 Mar 2015 21:21:41 +0000

To:John Stamatakos

Subject:RE: Diablo Canyon Review

John,

Thank you. This is helpful. I assume you meant to send this to Alan instead of Amy so I forwarded it to him. Also, what is the charge number for this?

Have a good trip and see you Tuesday.

-Ronny

From: John Stamatakos

Sent: Friday, March 27, 2015 3:01 PM

To: Ronald McGinnis; David Ferrill; Amy Minor; Kevin Smart

Cc: Miriam R. Juckett

Subject: Diablo Canyon Review

I've place most of my Diablo Canyon files on the DEMPS server (Demps\regios).

There are a series of reports that Pacific Gas & Electric (POG&E) produced over the last few years.

- Shoreline and RIL: The Shoreline report was submitted by PG&E in 2011 and we (with NRC review if in 2012). The Regulatory Information Letter (RIL 12-01) is that review. This report and review focused on the Shoreline fault and potential implications to the Licensing Basis for the plant. But the reports offer some good general background information. Other files in this folder are related to the Shoreline Report and the RIL.
- 2. **DCPP Shoreline and Thrust Fault Allegation**: In addition to the Shoreline Report, NRC had us look at an allegation made by about other possible faults and the plant. Alan helped me on one of the allegations (possible blind thrust beneath the plant site).
- Central Coastal California Seismic Imaging Project: The California state legislature passed a bill
 after the Shoreline Report authorizing PG&E to collect boat load of new seismic imaging
 data. This report is essentially a data dump of that work, and it has the bulk of what I would like
 you all to look at.
- 4. LTSP: This is an old PG&E report (1991) that may also be useful as background.
- NTTF DCCP PSHA Review: This is the actual new seismic hazard study that we are
 reviewing. We will need to cross reference the conclusions about faults (do they exist, their
 geometry, slip rate, length and area, etc.) based on seismic imaging to the data in the CCCSIP
 report.
- 6. **Diablo Canyon ISFSR SER**: This was our review of the site back in early 2000's for the Independent Spent Fuel Storage Installation (ISFSI). May be useful as background information.
- 7. **Figure**: is a folder I use to put in various figures and some of my Diablo Presentations and related images.

For reference: http://www.pge.com/en/safety/systemworks/dcpp/seismicsafety/index.page

This link gets you to most of these reports on line.

Work Scope:

I have five progressive tasks in mind.

- Look through the CCCSIP documents and develop a summary (catalog) of all the seismic imaging data that's there. Identify the who, what and where and assess its quality and possible usefulness to the PSHA. I think we can do this relatively quickly. We can even bring on a temp/student if available and willing to work on this. NRC wants to be able to say that they are familiar with all the data and have looked it over as part of the review. I would like to have a very quick deliverable on this (couple of pages?) relatively soon.
- Identify which data in the CCCSIP report is actually relied on to develop conclusions in the new PSHA. Assess the validity of the structural/seismic interpretations from the quality of the seismic imaging data. This may take a bit longer than task 1, but I hope we can do this relatively quickly.
- 3. Identify potential faults in the data sets that may have been overlooked by the PSHA technical team. I am **not** suggesting we identify any vague targets, but if you see images that in your view (and based on your experience) are very likely significant faults, we should tag them and assess their potential to influence the seismic hazard at the site.
- 4. For those critical data sets identified in task 2, complete a technical review of the data and the interpretations. This will be included in our write up for the overall PSHA assessment.
- 5. Review the 3D data collected in the Irish Hills to reassess the blind thrust fault model (I think it is now referred to as the San Luis Range Thrust).

I'll walk you all through this again next week and provide some more background on the PSHA and how we can assess whether fault sources can be important to the PSHA next week.

Thanks,

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

jstamatakos@swri.org

Time Dependency Model		Fault Geometry Model	Rupture Model	Slip Rate Allocation Model (mm/yr)	Magnitude Distribution Model		
(Equivalent Poisson Ratio)	Magnitude PDF				M _{max}	Mohar	
	[0.25]	H90 [0.2]	H85-01	1.23	WAACY [0.8]	0.5 [0.1] 8.1 [0.5] 7.8 [0.4]	7.9 [0.2] 7.1 [0.5] 6.8 [0.3]
Hosgri Bource	1.3 [0.5]	[0.6]	H85-07	0.40	Truncated Exponential	8.5 [0.1] 8.1	N/A
	[0.25]	[0.2]		[0.185]	[0.2]	[0.5] 7.8 10.4	

Information (page 495/800) is duplicate.

From:John Stamatakos

Sent:21 Apr 2015 16:39:41 +0000

To: 'Munson, Clifford'

Subject:RE: diablo scenario events

Will do

From: Munson, Clifford [mailto:Clifford.Munson@nrc.gov]

Sent: Tuesday, April 21, 2015 11:46 AM

To: Ake, Jon; John Stamatakos; Graizer, Vladimir

Cc: Heeszel, David

Subject: diablo scenario events

John,

Would you come up with some plausible scenario events for Hosgri in terms of the parameters listed below (as a spreadsheet?). I coded the SWUS GMM for T=1 sec. There are 31 median models each with a unique set of 10 coefficients. I just read in their electronic file as a 31 by 10 matrix to avoid typing errors. I also coded up the total sigma (3 branches with 2 coefficients for each branch).

The input parameters are:

- 1. Magnitude (mag)
- 2. Depth to top of rupture (ztor) in km
- 3. Rupture distance (rrup) in km
- 4. Joyner-Boore distance (rjb) in km
- 5. Fault dip angle (dip) in degrees
- 6. Down-dip rupture width (ddrw) in km
- 7. Horizontal distance from top of rupture measured perpendicular to strike (Rx) in km
- 8. Fault type (REV,NRM, or SS) depending on rake angle

I will proceed to code T=0.1 sec and maybe some more periods if I have time.

I would like to verify our results somehow before we merge these codes with Roland's.

Thanks, Cliff From: Munson, Clifford [mailto:Clifford.Munson@nrc.gov]

Sent: Tuesday, April 21, 2015 11:46 AM

To: Ake, Jon; John Stamatakos; Graizer, Vladimir

Cc: Heeszel, David

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I will proceed to code T=0.1 sec and maybe some more periods if I have time.

I would like to verify our results somehow before we merge these codes with Roland's.

Thanks, Cliff

Osvaldo Pensado

From:Osvaldo Pensado

Sent:1 May 2015 09:28:17 -0500

To:John Stamatakos

Subject:RE: Function for excel

And you wanted to become a manager ... he, he ;)

From: John Stamatakos

Sent: Friday, May 01, 2015 9:26 AM

To: Osvaldo Pensado

Subject: RE: Function for excel

I think so. I am going to see if I can reproduce some of the Licensee results first. Right now I am knee deep in administryia.

John

From: Osvaldo Pensado

Sent: Friday, May 1, 2015 10:22 AM

To: John Stamatakos

Subject: RE: Function for excel

Will the closed form formula for the trapezoidal sampling help you?

From: John Stamatakos

Sent: Friday, May 01, 2015 9:13 AM

To: Osvaldo Pensado

Subject: RE: Function for excel

20.17752.01.012

Thanks so much

John

From: Osvaldo Pensado

Sent: Thursday, April 30, 2015 7:23 PM

To: John Stamatakos **Subject:** Function for excel

Okay John.

What is the charge number?

Doing your problem in Mathematica is quite simple. In Excel ... not so much. I give you instructions to get the trapezoidal function in Excel.

For the trapezoidal function for the offset:

a=15

b=26

c = 35

d=43

p is a random number uniformly sampled between 0 an 1. It can be sampled with Excel using p=Rand().

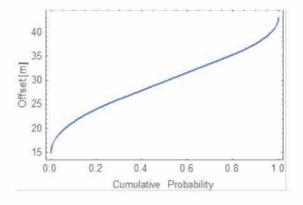
Apply it to randomly sampled values of p=Rand() in Excel.

The formula is a big sausage with nested if-then statements. At least it is a closed formula. There is a high chance to make a typographical error, though.

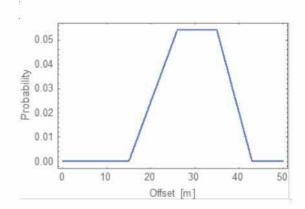
You should consider programming the formula in a macro.

$$\begin{aligned} & \text{trapezCDFInv}[p_, a_, b_, c_, d_] \coloneqq \text{If}[0 \le p \ \& \ p \\ & < \frac{b-a}{-a-b+c+d}, a + \sqrt{a^2p-b^2p-acp+bcp-adp+bdp}, \\ & \text{ElseIf}[\frac{b-a}{-a-b+c+d} \le p \ \& \ p < \frac{a+b-2c}{a+b-c-d}, \frac{1}{2}(a+b-ap-bp+cp+dp), \\ & \text{ElseIf}[\frac{a+b-2c}{a+b-c-d} \le p \ \& \ p \\ & \le 1, d-\sqrt{ac+bc-c^2-ad-bd+d^2-acp-bcp+c^2p+adp+bdp-d^2p}]]] \end{aligned}$$

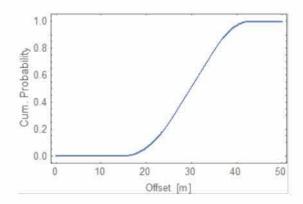
This is the plot of the trapezCDFInv function



I derived the formula from the following trapezoid:



This is the CDF: parabola segment, followed by a straight line, ending in another parabola segment.



I felt like programming the formula in Excel for you, but I changed my mind when I saw the sausage. I can do the Monte Carlo in no time in Mathematica. I do not feel like touching the sausage.

For a Triangular function the formula to use is

cdfTriangInv[p_, a_, b_, c_]: = If[
$$p \le (b-a)/(c-a)$$
, $a + \text{Sqrt}[(b-a)*(c-a)*p]$, $c - \text{Sqrt}[(c-a)*(c-b)*(1-p)]$]; again, p=Rand()

To give you an idea on how simple the problem is in Mathematica, this would be the Latin hypercube sampling program (which will be better than random sampling you will do in Excel):

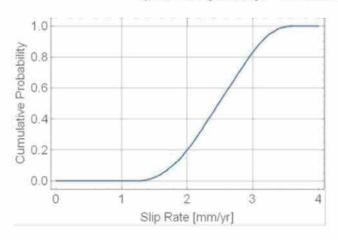
```
Return[piv2]];

pvec=shuffle[Table[i,{i,0,1,1.0/5000}]];
age1=cdfTriangInv[#,11.5, 12, 12.5]&/@ pvec;
pvec=shuffle[pvec];

offset1=trapezCDFInv[#,15, 26, 35, 43]&/@ pvec;
d1=EmpiricalDistribution[offset1/age1];
```

And the slip rate is

 $Plot[CDF[d1, x], \{x, 0, 4\}, Frame \rightarrow True, BaseStyle \rightarrow 14, GridLines \rightarrow Automatic, FrameLabel \rightarrow {"Slip Rate [mm/yr]", "Cumulative Probability"}]$



Dr. Osvaldo Pensado
Group Manager, Risk Analysis and Performance Assessment
Geosciences and Engineering Division
(210) 522-6084
opensado@swri.org

George Adams

From:George Adams

Sent:1 May 2015 16:11:37 -0500

To:John Stamatakos

Subject:RE: Function for excel Attachments:CDFINV.xlsm John,

I developed the spreadsheet attached with the macro written in Visual Basic (and shown below). Please let me know if this is what you needed or if an addition to it is needed.

George

Option Explicit

Function getTrapezCDFInv(p As Double, a As Double, b As Double, c As Double, d As Double) As Double On Error GoTo errhandler

```
getTrapezCDFInv = 0#

If 0 <= p And p < ((b - a) / (-a - b + c + d)) Then
    getTrapezCDFInv = a + Sqr(a ^ 2 * p - b ^ 2 * p - a * c * p + b * c * p - a * d * p + b * d * p)

Elself ((b - a) / (-a - b + c + d)) <= p And p < ((a + b - 2 * c) / (a + b - c - d)) Then
    getTrapezCDFInv = 0.5 * (a + b - a * p - b * p + c * p + d * p)

Elself ((a + b - 2 * c) / (a + b - c - d)) <= p And p <= 1 Then
    getTrapezCDFInv = d - Sqr(a * c + b * c - c ^ 2 - a * d - b * d + d ^ 2 - a * c * p - b * c * p + c ^ 2 * p + a * d * p + b * d * p - d ^ 2 * p)

Else
    getTrapezCDFInv = -999
End If

Exit Function
errhandler:
MsgBox "Error in getTrapezCDFInv: " & a & b & c & d</pre>
```

End Function

Function getTriangCDFInv(p As Double, a As Double, b As Double, c As Double) As Double On Error GoTo errhandler

```
getTriangCDFInv = 0#

If p \le ((b - a) / (c - a)) Then
getTriangCDFInv = a + Sqr((b - a) * (c - a) * p)

ElseIf p \le 1 Then
getTriangCDFInv = c - Sqr((c - a) * (c - b) * (1 - p))
```

```
Else
getTriangCDFInv = -999
End If
```

Exit Function errhandler:

MsgBox "Error in getTriangCDFInv: " & a & b & c

End Function

From: John Stamatakos

Sent: Friday, May 01, 2015 2:05 PM

To: George Adams

Subject: FW: Function for excel

20.17752.01.012 is the charge number

See attached plot

From: Osvaldo Pensado

Sent: Thursday, April 30, 2015 7:23 PM

To: John Stamatakos **Subject:** Function for excel

Okay John.

What is the charge number?

Doing your problem in Mathematica is quite simple. In Excel ... not so much. I give you instructions to get the trapezoidal function in Excel.

For the trapezoidal function for the offset:

a=15

b=26

c=35

d=43

p is a random number uniformly sampled between 0 an 1. It can be sampled with Excel using p=Rand().

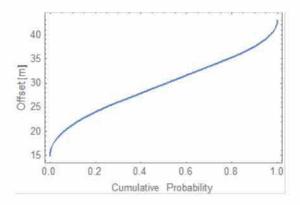
Apply it to randomly sampled values of p=Rand() in Excel.

The formula is a big sausage with nested if-then statements. At least it is a closed formula. There is a high chance to make a typographical error, though.

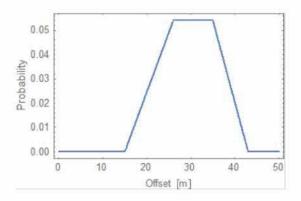
You should consider programming the formula in a macro.

$$\begin{aligned} & \text{trapezCDFInv}[p_, a_b_, c_d_] \coloneqq \text{If}[0 \le p \ \& \ p \\ & < \frac{b-a}{-a-b+c+d}, a + \sqrt{a^2p-b^2p-acp+bcp-adp+bdp}, \\ & \text{ElseIf}[\frac{b-a}{-a-b+c+d} \le p \ \& \ p < \frac{a+b-2c}{a+b-c-d}, \frac{1}{2}(a+b-ap-bp+cp+dp), \\ & \text{ElseIf}[\frac{a+b-2c}{a+b-c-d} \le p \ \& \ p \\ & \le 1, d-\sqrt{ac+bc-c^2-ad-bd+d^2-acp-bcp+c^2p+adp+bdp-d^2p}]]] \end{aligned}$$

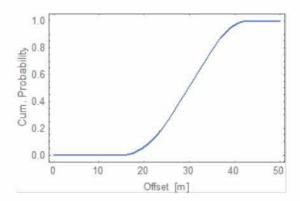
This is the plot of the trapezCDFInv function



I derived the formula from the following trapezoid:



This is the CDF: parabola segment, followed by a straight line, ending in another parabola segment.



I felt like programming the formula in Excel for you, but I changed my mind when I saw the sausage. I can do the Monte Carlo in no time in Mathematica. I do not feel like touching the sausage.

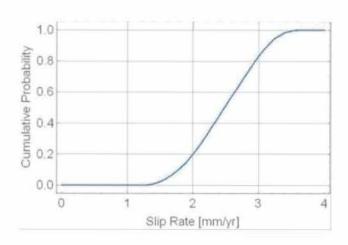
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To give you an idea on how simple the problem is in Mathematica, this would be the Latin hypercube sampling program (which will be better than random sampling you will do in Excel):

And the slip rate is

```
 \begin{aligned} & \text{Plot}[\text{CDF}[\text{d1},x],\{x,0,\!4\},\text{Frame} \rightarrow \text{True},\text{BaseStyle} \rightarrow \text{14},\text{GridLines} \rightarrow \text{Automatic},\text{FrameLabel} \\ & \rightarrow \{\text{"Slip Rate [mm/yr]"},\text{"Cumulative Probability"}\}] \end{aligned}
```



Dr. Osvaldo Pensado Group Manager, Risk Analysis and Performance Assessment Geosciences and Engineering Division (210) 522-6084 opensado@swri.org

John Stamatakos

From:John Stamatakos

Sent:29 Apr 2015 16:25:39 +0000

To: 'Giacinto, Joseph'

Subject: RE: Hosgri Slip Rates

Ok thanks

From: Giacinto, Joseph [mailto:Joseph.Giacinto@nrc.gov]

Sent: Wednesday, April 29, 2015 12:06 PM **To:** John Stamatakos; Plaza-Toledo, Meralis

Subject: RE: Hosgri Slip Rates

Sounds good to me - thanks.

Also, I have your flash drive – you can pick it up (I will leave in the rock ashtray outside my T7C30 office on top of the file cabinet) or I'll give to you next time I see you.

Joe

From: John Stamatakos [mailto:jstam@swri.org]
Sent: Wednesday, April 29, 2015 12:03 PM
To: Giacinto, Joseph; Plaza-Toledo, Meralis

Subject: RE: Hosgri Slip Rates

How about I talk with San antonio today and we can meet tomorrow morning? We can set up a follow up call with them if needed.

John

From: Giacinto, Joseph [mailto:Joseph.Giacinto@nrc.gov]

Sent: Wednesday, April 29, 2015 12:00 PM **To:** John Stamatakos; Plaza-Toledo, Meralis

Subject: RE: Hosgri Slip Rates

John, can we have the call tomorrow - say late morning?

Joe

From: John Stamatakos [mailto:jstam@swri.org]
Sent: Wednesday, April 29, 2015 11:53 AM
To: Giacinto, Joseph; Plaza-Toledo, Meralis

Cc: Munson, Clifford; Ake, Jon; Jackson, Diane; Stirewalt, Gerry; Seber, Dogan; Miriam R. Juckett;

Graizer, Vladimir; Hill, Brittain **Subject:** Hosgri Slip Rates Joe and Meralis,

One of the more interesting, and more hazard sensitive, aspects of the Diablo canyon SSC is the Hosgri slip rate CDF. I suggest we focus our initial reviews on that aspect of the SSC. Dogan made a critical observation yesterday in our discussions, namely how can the lower tail of the CDF be justified. In thinking through the question last night I have a few suggestions.

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For each of these we should understand how the cumulative slip was determined (and uncertainty) and how the offset age was determined (and uncertainty).

- Age: For San Simeon, the age is based on the interpretation that the unconformity overlying
 the buried geomorphic featured tied to the Younger Dryas, so this one is rather
 straightforward. But the other three, especially Estero Bay and Point Sal, ages are based on
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 the TI team interpreted the offset parkers in terms of these curves and whether other
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We could also ask Cliff and Jon to some sensitivity studies to constrain the limits of what we are looking for. I think it might be helpful here to know how far the current slip rate estimates would have to be different from those used in the study to move the hazard needle. For example, what if the TI team were off by a single Marine Oxygen Isotope Stage (MIS)? For most of these my very preliminary guesstimate is that would correspond to about a 25% increase in the slip rates. Would such an increase in rates be significant?

I am going to have a call with my San Antonio team this afternoon, and would be happy to have you both on the call. Right now the call is set for 3:00 this afternoon, but it can adjusted to meet your schedules.

Thanks,		

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

jstamatakos@swri.org

John Stamatakos

From:John Stamatakos

Sent:29 Apr 2015 16:03:28 +0000

To: 'Giacinto, Joseph'; Plaza-Toledo, Meralis

Subject: RE: Hosgri Slip Rates

How about I talk with San antonio today and we can meet tomorrow morning? We can set up a follow up call with them if needed.

John

From: Giacinto, Joseph [mailto:Joseph.Giacinto@nrc.gov]

Sent: Wednesday, April 29, 2015 12:00 PM **To:** John Stamatakos; Plaza-Toledo, Meralis

Subject: RE: Hosgri Slip Rates

John, can we have the call tomorrow – say late morning?

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From: John Stamatakos [mailto:jstam@swri.org]
Sent: Wednesday, April 29, 2015 11:53 AM
To: Giacinto, Joseph; Plaza-Toledo, Meralis

Cc: Munson, Clifford; Ake, Jon; Jackson, Diane; Stirewalt, Gerry; Seber, Dogan; Miriam R. Juckett;

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Т	ha	n	ks.
			,

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

jstamatakos@swri.org

John Stamatakos

From:John Stamatakos

Sent:29 Apr 2015 16:02:21 +0000

To: 'Plaza-Toledo, Meralis' Cc: Giacinto, Joseph

Subject: RE: Hosgri Slip Rates

OK

Ill get a bridge

From: Plaza-Toledo, Meralis [mailto:Meralis.Plaza-Toledo@nrc.gov]

Sent: Wednesday, April 29, 2015 11:59 AM

To: John Stamatakos **Cc:** Giacinto, Joseph

Subject: RE: Hosgri Slip Rates

John,

I have some meetings in the afternoon but I will try to join the call, it may be a bit late though.

Meralis

From: John Stamatakos [mailto:jstam@swri.org]
Sent: Wednesday, April 29, 2015 11:53 AM
To: Giacinto, Joseph; Plaza-Toledo, Meralis

Cc: Munson, Clifford; Ake, Jon; Jackson, Diane; Stirewalt, Gerry; Seber, Dogan; Miriam R. Juckett;

Graizer, Vladimir; Hill, Brittain Subject: Hosgri Slip Rates

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T	h	a	r	ı	<	5,

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

jstamatakos@swri.org

John Stamatakos

From:John Stamatakos

Sent:29 Apr 2015 17:11:17 +0000

To: 'Seber, Dogan'

Subject: RE: Hosgri Slip Rates

Absolutely. Let me get Joe and Meralis up to speed on the data and some also get some high-level assessments of the seismic images from my guys. Then we can get together to comb through the details a bit and talk about what we should do next. Your insights would be very helpful and appreciated. I'll keep you posted.

Thanks,

John

From: Seber, Dogan [mailto:Dogan.Seber@nrc.gov]

Sent: Wednesday, April 29, 2015 1:07 PM

To: John Stamatakos

Subject: RE: Hosgri Slip Rates

John,

Thanks for pursuing this. Since I am not part of the Diablo Canyon review team, I have not looked at any of the issues in detail. However, having seen some of the presentations at the SSA meeting last week in Pasadena and seeing what the licensee is doing with slip rates yesterday, I really think there needs to be a special focus in NRC reviews to figure out whether adequate slip rates (not just the PG&E contractors, but also other efforts by USGS etc) are utilized in PG&E PSHA study. As you know, this directly impacts the PSHA results. I am always happy and ready to talk with anyone in more detail, if there is any need.

Best.

Dogan Seber, PhD
Senior Geophysicist
Geosciences and Geotechnical Engineering Branch 1
Division of Site Safety and Environmental Analysis
Office of New Reactors
U.S. Nuclear Regulatory Commission
301-415-0212

From: John Stamatakos [mailto:jstam@swri.org]
Sent: Wednesday, April 29, 2015 11:53 AM
To: Giacinto, Joseph; Plaza-Toledo, Meralis

Cc: Munson, Clifford; Ake, Jon; Jackson, Diane; Stirewalt, Gerry; Seber, Dogan; Miriam R. Juckett;

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Thanks,			

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

jstamatakos@swri.org

...

Munson, Clifford

From: Munson, Clifford

Sent:8 Jun 2015 13:32:28 +0000

To:Graizer, Vladimir; Ake, Jon; John Stamatakos; Stovall, Scott; Brittain Hill; Weaver,

Thomas; Devlin-Gill, Stephanie; Walsh, Lisa; Seber, Dogan

Cc:Jackson, Diane

Subject:RE: presentation for DCPP on Diablo site term

Great. We will have you present after John.

Cliff

From: Graizer, Vladimir

Sent: Friday, June 05, 2015 3:29 PM

To: Munson, Clifford; Ake, Jon; John Stamatkos; Stovall, Scott; Hill, Brittain; Weaver, Thomas; Devlin-

Gill, Stephanie; Walsh, Lisa; Seber, Dogan

Cc: Jackson, Diane

Subject: presentation for DCPP on Diablo site term

I used alternative approach to estimation of Diablo site term.

I can present my calcs comparing with theirs at our Wednesday, June 10th meeting.

Vladimir

Munson, Clifford

From: Munson, Clifford

Sent:28 May 2015 10:00:37 -0400 To:Graizer, Vladimir;Jackson, Diane

Cc:John Stamatakos; Ake, Jon; Plaza-Toledo, Meralis; Giacinto, Joseph; Stovall, Scott; Brittain

Hill;Li, Yong

Subject:RE: Reminder sent to Diablo for Information Request

Thanks Vlad. We will ask for this in the next batch of requests to DCPP.

Cliff

From: Graizer, Vladimir

Sent: Thursday, May 28, 2015 9:54 AM **To:** Jackson, Diane; Munson, Clifford

Cc: John Stamatakos; Ake, Jon; Plaza-Toledo, Meralis; Giacinto, Joseph; Stovall, Scott; Hill, Brittain; Li,

Yong

Subject: RE: Reminder sent to Diablo for Information Request

Diane and Cliff,

I don't know if it is considered an RAI, but as I mentioned at one of the Diablo meetings I need the following info:

Section 8.4.1 of the SWUS report discusses evaluation of median base models and their range. Please provide Excel files of the plots shown on Figures 8.4-17 and 8.4-18 showing comparisons of hazard curves for frequencies of 5 and 0.5 Hz.

In addition, please provide similar files for the frequencies of 10 and 1 Hz.

Vladimir Graizer, Ph.D. Seismologist Office of New Reactors Mail Stop: T-7F3

Washington, DC 20555-0001

From: Jackson, Diane

Sent: Thursday, May 28, 2015 9:43 AM

To: Munson, Clifford

Cc: Graizer, Vladimir; John Stamatakos; Ake, Jon; Plaza-Toledo, Meralis; Giacinto, Joseph; Stovall, Scott;

Hill, Brittain; Li, Yong

Subject: FYI: Reminder sent to Diablo for Information Request

Nick sent a reminder.

Diane

From: DiFrancesco, Nicholas

Sent: Thursday, May 28, 2015 9:16 AM

To: Philippe Soenen (Pns3@pge.com); Jahangir, Nozar

Cc: Michael Richardson (mjrm@pge.com); Strickland, Jearl; Shams, Mohamed; Jackson, Diane; Vega,

Frankie

Subject: Reminder on Diablo Information Request

Philippe, et, al

Just a reminder that the staff is interested in the following references to support NRC review:

- 1) Benchmark files for SWUS-DCPP median ground motion models.
- 2) ESTA 27 and 28 recordings of Parkfield and San Simeon earthquakes
 - a. Time histories
 - b. Response spectra
 - c. Response spectra adjusted for Vs30
- Engineering reports describing development of velocity profiles for stations ESTA 27 and 28.
- 4) Paper describing WAACY Magnitude PDF by Wooddell and others.

Please let me know when the references will be available.

Thanks,

Nick

Senior Project Manager - Seismic Reevaluation Activities U.S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation Japan Lesson Learned Project Division nicholas.difrancesco@nrc.gov | Tel: (301) 415-1115

Hill, Brittain

From:Hill, Brittain

Sent:18 Mar 2015 14:33:09 -0400 To:Miriam R. Juckett;John Stamatakos Subject:RE: Seismic Communications Plan

Attachments:IBMgetContent.docx

Here ya go - same nonpublic restrictions apply as usual.

Britt

From: Juckett, Miriam R. [mailto:miriam.juckett@swri.org]

Sent: Wednesday, March 18, 2015 2:02 PM

To: Hill, Brittain

Subject: RE: Seismic Communications Plan

Britt-

Unfortunately, I can't access non-public ADAMS. Can you send me/John a copy separately?

Thanks! Miriam

From: Hill, Brittain [mailto:Brittain.Hill@nrc.gov]
Sent: Wednesday, March 18, 2015 12:56 PM

To: Jackson, Diane; Munson, Clifford; Ake, Jon; Graizer, Vladimir; Seber, Dogan; Stieve, Alice; Plaza-Toledo, Meralis; Devlin-Gill, Stephanie; Weaver, Thomas; Stovall, Scott; Gerry Stirewalt; Li, Yong; Walsh,

Lisa; Heeszel, David; DiFrancesco, Nicholas; John Stamatakos; Miriam R. Juckett

Cc: Karas, Rebecca

Subject: Seismic Communications Plan

We recently updated the Communications Plan for 2.1 seismic to give some Q&A's for WUS topics, including why the review process is a bit different than for the CEUS plants. Many folks (including OPA) have contributed to writing, refining, and agreeing to the answers for these questions, including JLD and DSEA management.

Nevertheless, please note that this is an internal use document and not publically available on ADAMS.

View ADAMS P8 Properties ML14083A619

Open ADAMS P8 Document (5/21/2014, Communication Plan for Seismic Hazard Re-Evaluation Submittals in Response to NTTF Recommendation 2.1, Seismic)

Thanks-Britt

...

Sent:17 Apr 2015 03:32:30 +0000

To:Munson, Clifford

Cc: Ake, Jon

Subject: RE: Source Questions for DCPP visit?

Here are some preliminary questions.

There is no question that every part of this approach is unique.

Diablo Canyon Questions

- 1. Hosgri fault: Summarize the key seismic imaging, earthquake, geophysical, or geological information used to constrain the slip rate of the Hosgri fault.
- 2. Thrust faulting: Although the proposed San Luis Range Thrust is not explicitly modeled in the logic tree, can you clarify how elements of the thrust/reverse interpretation are incorporated into the SSC?
- Fault Slip Rate Model: Can you clarify (maybe by an example) how you extract the "target slip rate budget" from the slip rate CDF, and use it to assign fractional fault slip rates to the multiple fault segments in the fault geometry model (FMG).
- 4. Further to Q3, can you clarify (again by example) how the slip rate allocation is accomplished among the four different types rupture sources (characteristic, linked, complex, and splay).
- 5. Rupture Models: Can you clarify how rupture models are derived from the FMGs. The approach seems to be that because reasonable rupture combinations within a rupture model are included in the logic tree, aleatory variability with a given FGM is then accounted for? But is there additional epistemic uncertainty in how you constructed the FMGs?
- 6. Magintude-frequency: Explain how the four different magnitude-frequency distribution functional forms were derived and how they are used in reference to the characteristic and maximum magnitude distributions?
- 7. Recurrence: Can you summarize the methodology used to define the equivalent Poisson rates?

From: Munson, Clifford [Clifford.Munson@nrc.gov]

Sent: Thursday, April 16, 2015 2:28 PM

To: John Stamatakos

Cc: Ake, Jon

Subject: Source Questions for DCPP visit?

John,

Do you have some source questions that we PG&E to cover other than a basic overview of the SSHAC report?

Thanks Cliff Sent:6 Apr 2015 21:27:00 +0000

To:Alan Morris;Ronald McGinnis;David Ferrill;Sarah Wigginton

Cc:John Stamatakos

Subject: RE: Work in progress...

Looks pretty good to me. I think is will couple nicely to the mega data table.

I'd vote to keep everything for now and only start pruning if/when we absolutely have to.

--Kevin

From: Alan Morris

Sent: Monday, April 06, 2015 3:06 PM

To: Ronald McGinnis; David Ferrill; Sarah Wigginton; Kevin Smart

Cc: John Stamatakos

Subject: RE: Work in progress...

OK, it's 8 pages, and maybe too long, but for some reason these reports are always prolix.

THE PARTY OF THE P

Is this what we need?

Does it need pruning?

Does it need analysis?

Does it need anything?

Alan

Alan Morris
Department of Earth, Material, and Planetary Sciences
Geosciences and Engineering Division
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6220 Culebra Road, San Antonio, TX 78238, USA

Tel: 210.522.6743 Fax: 210.522.5155

Web page: http://www.swri.org/4org/d20/geosci/structur.htm

http://3dstress.swri.org/

From: Alan Morris

Sent: Friday, April 03, 2015 4:51 PM

To: Ronald McGinnis; David Ferrill; Sarah Wigginton; Kevin Smart

Cc: John Stamatakos

Subject: Work in progress...

T:\Diablo Canyon\Diablo Canyon\CNWRA report April 2015\DiabloCanyonPowerPlant - seismic risk data survey April 2015.docx

I was planning to cycle back through adding important conclusions for every chapter, but any of us could do that...

Chapter 1 is very useful in giving summaries of the data and goals for each of the subsequent chapters.

For the tornado diagram, equations 1-1 and 1-2 in chapter 13 are the key.

Gotta check posters for next week...

Happy Easter

Alan

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http://3dstress.swri.org/

John Stamatakos

From:John Stamatakos
Sent:14 Apr 2015 16:01:32 +0000
To:David Ferrill;Alan Morris;Kevin Smart;Ronald McGinnis;Wesley Patrick;Gordon Wittmeyer;Miriam R. Juckett
Subject:Sarah Wigginton
David,

Just wanted to let you know that the Diablo Canyon work is moving along very well. Many thanks so far to the DEPMs team for your inputs. They have been very helpful. I am especially grateful for Sarah's work. I've had a few follow-up calls with her and I am so impressed with her and her abilities. We should do all we can to retain her. She is clearly outstanding.

Thanks,

John

Dr. John Stamatakos Director of Technical Programs Center for Nuclear Waste Regulatory Analyses (CNWRA) Southwest Research Institute 1801 Rockville Pike, Rockville, MD 20852 301-881-0290

jstamatakos@swri.org

Munson, Clifford

From: Munson, Clifford

Sent:1 Jun 2015 17:23:37 +0000

To:Ake, Jon;John Stamatakos;Brittain Hill;Stovall, Scott

Cc:Jackson, Diane

Subject:See added sentence in yellow - thanks! Attachments:DCPP RAI (draft 3).docx

Let me know if I captured this correctly.

Thanks, Cliff

George Adams

From:George Adams Sent:7 May 2015 11:12:17 -0500 To:John Stamatakos Subject:SPREADSHEET John,

I found the error just after you left. The worksheet was renamed. It had a few characters following the normal text. The name of the worksheet Hardcoded in the macro and shown in fluorescent green below didn't match the worksheet name.

Worksheets("Oso Terrace Hosgri Slip Rate"). UsedRange.Columns("E:H").Calculate

-George -

Information (602-669/800) is in scope of FOIA and should be released.

Alan Morris

From: Alan Morris

Sent:22 May 2015 14:50:52 +0000

To: Kevin Smart; Ronald McGinnis; David Ferrill; Sarah Wigginton

Subject: Stuff I have done for Diablo Canyon

Most of what I have done is in the realm of self-education:

T:\Diablo Canyon\APM's stuff\Diablo Canyon-overview-APM.ppt - a work in progress...

<u>T:\Diablo Canyon\Diablo Canyon - Workshop presentations</u> - selected presentations downloaded from: http://www.pge.com/mybusiness/edusafety/systemworks/dcpp/SSHAC/workshops/index.shtml

Also, this document is very useful:

T:\Diablo Canyon\Diablo Canyon NRC\NTTF DCCP PSHA Review\DCPP SSC Report Rev A.pdf

That's all folks -- Alan

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Web page: http://www.swri.org/4org/d20/geosci/structur.htm

http://3dstress.swri.org/

George Adams

From:George Adams Sent:4 May 2015 16:54:59 -0500 To:John Stamatakos Subject:UPDATE John,

I placed an update to the spreadsheet at: S:\John Stamatakos\Slip and Age Distributions GA.xlsm

You can change the parameters and hit the calculate button. It does everything: copy, calculate, and sort. I set the calculate options to "Manual" Hitting F9 will force calculate

I added pdf plots (not certain about these though, please check)

George

Alan Morris

From: Alan Morris

Sent:3 Apr 2015 21:51:07 +0000

To:Ronald McGinnis; David Ferrill; Sarah Wigginton; Kevin Smart

Cc:John Stamatakos

Subject: Work in progress...

T:\Diablo Canyon\Diablo Canyon\CNWRA report April 2015\DiabloCanyonPowerPlant - seismic risk data survey April 2015.docx

I was planning to cycle back through adding important conclusions for every chapter, but any of us could do that... Chapter 1 is very useful in giving summaries of the data and goals for each of the subsequent chapters.

For the tornado diagram, equations 1-1 and 1-2 in chapter 13 are the key.

Gotta check posters for next week...

Happy Easter Alan

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Informal review of The Central Coastal California Seismic Imaging Project (CCCSIP) report (Pacific Gas and Electric Company)

Ву

GED

April 2015

The Central Coastal California Seismic Imaging Project (CCCSIP) report was produced by the Pacific Gas and Electric Company (PG&E) in response to a 2008 recommendation by the California Energy Commission (CEC). The California Energy Commission's 2008 report "An Assessment of California's Nuclear Power Plants: AB 1632 Report", also known as the "AB 1632 Report", recommended that Pacific Gas and Electric perform a series of geophysical investigations to explore fault zones near the Diablo Canyon Power Plant (DCPP). A primary goal of the investigations was to improve understanding of the seismic risk to the Diablo Canyon Power Plant, specifically:

- Hosgri Fault Zone slip rate
- · Hosgri Fault Zone dip
- Hosgri–San Simeon fault zone step-over (i.e., are these faults linked so that will rupture in unison?)
- · Los Osos fault zone slip rate
- Los Osos fault zone dip
- · Los Osos fault zone sense of slip
- · Hosgri-Shoreline fault zone rupture (i.e., are these faults linked so that will rupture in unison?)
- · Shoreline fault zone slip rate
- · Shoreline fault zone southern extent
- Shoreline fault zone segmentation

These issues were chosen because of their importance in choosing seismic source parameters used to model the seismic hazard for the Diablo Canyon Power Plant, and because of the uncertainty associated with them. Hazard is expressed as probability of ground motion acceleration exceeding 2 g at the key frequency of 5 hertz.

Three areas of study were specifically prescribed by the AB1632 report:

- (1) PG&E should use three-dimensional geophysical seismic reflection mapping and other advanced techniques to explore fault zones near Diablo Canyon.
- (2) As ground motion models are refined to account for a greater understanding of the motion near an earthquake rupture, it will be important for PG&E to consider whether the models indicate larger than expected seismic hazards at Diablo Canyon and if so, whether the plant was built with sufficient design margins to continue operating reliably after experiencing these large ground motions.

Comment [a1]: I think this is the frequency that is most damaging to human structures, and it is part of the NRC's seismic hazard regulation.

(3) PG&E should assess the implications of a San Simeon-type earthquake beneath Diablo Canyon. This assessment should include expected ground motions and vulnerability assessments for safety-related and non-safety related plant systems and components that might be sensitive to long period motions in the near field of an earthquake rupture.

Comment [KJS2]: Does this need to be defined/described somewhere or some reference citation provided?

A range of data is presented and analyzed in the Central Coastal California Seismic Imaging Project report, most of it collected between 2009 and 2014, but including and drawing upon a variety of work performed over the previous 30 years. Work incorporated in the report was performed by PG&E, its contractors, and by the United States Geological Survey. The report is organized into the following sections:

Marine seismic reflection surveys (including analysis of natural seismicity data)

Chapters 2 and 4 – 2D/3D low-energy seismic surveying (LESS) to map the the-Hosgri, Shoreline and Point Buchon fault zones and associated folding west, northwest and north of Diablo Canyon Power Plant. Chapter 4 includes older, deep deep-penetration seismic data to investigate linkage between Hosgri and San Simeon fault zones and folding offshore and south of the Los Osos fault zone.

Important conclusions, chapter 2:

- "The main structural elements mapped in the study area are the Hosgri fault zone (HFZ), the Point Buchon fault zone, and a prominent syncline that deforms Tertiary strata in the southern two thirds of the study area."
- "The Hosgri fault zone consists of numerous fault strands and is the best imaged and most continuous and complex fault zone in the region."
- "... the local style of faulting changes along strike of the Hosgri fault zone. Graben A, bounded by
 right-stepping strands of the Hosgri fault zone in the north, indicates extensional strike slip
 faulting. A single fault strand characterizes the fault zone in the center of the study area.
 Numerous, relatively short strands fan out to the southeast and are associated with folds in the
 south, indicating compressional strike-slip faulting."
- "The Point Buchon fault zone, northwest of the central segment of the Shoreline fault zone, is a northwest-trending fault that disrupts Tertiary strata east of the HFZ"
- "... the Point Buchon fault zone may connect to the central segment of the Shoreline fault zone and associated structures"
- . "Graben B is associated with the northern end of the Point Buchon fault zone"
- "...the structural relationship between the two grabens [A and B] and structures within Estero Bay to the north of the study area needs to be further evaluated"
- Because "the 3D/2D data are restricted to the shallow subsurface, the mapped surficial faults
 cannot be confidently extended to the earthquake hypocentral depths. Therefore, no conclusion
 can be made in regard to these faults being the source of the earthquakes that constitute the
 northern Shoreline seismicity sublineament"

Important conclusions, chapter 4:

- "...we were unable to observe any clear evidence in the seismic-reflection data for a recent fault
 connecting the San Simeon fault zone with the Hosgri fault zone. Our interpretations do not
 preclude the existence of a fault at depth or the possibility of a future rupture along this fault at
 depth, including propagation to the surface."
- "...we map the newly named Half Graben fault zone, a series of faults along which a half graben
 has formed, down-dropped on the east and tilted to the west ... The half graben is narrow in the
 north... To the south, the half graben widens considerably and appears to end near ... the Los
 Osos fault zone"

Chapter 3 – 2D/3D low-energy seismic surveying (LESS) to identify the southern extent, geometry, connectivity, and slip rate of the Shoreline fault, and the slip rate on the Hosgri fault zone. Older deep penetration data are also used.

Important conclusions:

- "Piercing points identified for constraining offsets along the Shoreline, Oceano, and Hosgri fault zones were identified ... buried paleochannels and paleoshorelines (paleostrandlines) were the best geomorphic features to use in evaluating offsets."
- "These studies reveal a more complex [Hosgri] fault zone than had previously been mapped"
- "...strands of the Hosgri fault zone [in the Estero Bay area] are generally steeply dipping to vertical..."
- "...sense of vertical separation across the Hosgri fault zone [in the Estero Bay area] is dominantly
 down to the west..."
- "Channel offsets and their interpreted ages yield a preferred lateral slip rate for the Hosgri fault
 zone in Estero Bay of approximately 1.6 ± 0.8 mm/yr within a high (90%) confidence interval.
 Accounting for uncertainties in ages and offset estimates, the range in lateral slip rate is
 between approximately 0.2 mm/yr and 3.6 mm/yr."
- [In the Point Sal Area] "The new mapping ... shows that from south to north, the Hosgri fault
 zone splits from a single strand with little or no vertical separation to multiple splays with
 substantial vertical and dextral shear, which converge to form a single strand once more. ... with
 transtension in the south and transpression in the north. There is an approximate 6-degree
 change in the strike of the Hosgri fault zone..."
- "Channel Complex F provides the preferred piercing points for estimating slip rates on the Hosgri fault zone in the Point Sal area."
- "a minimum estimated slip rate of 0.39 mm/yr (1.4 Ma at 550 m minimum offset) and a
 maximum estimated slip rate of 5.07 mm/yr (138 ka at 700 m maximum offset) is calculated for
 the Hosgri fault zone at Point Sal"

Chapter 5 - Deployment and monitoring of ocean bottom seismographs (OBS)

Important conclusions:

Comment [a3]: Can you spell r-e-l-a-y?

 "offshore events close to but outside the ocean bottom seismographs stations will have improved depth control; however, these events are still subject to uncertainty, particularly with regard to the focal mechanisms."

Chapter 6 – Characterization of the Hosgri fault zone using primarily post 1988 seismic reflection data but also some gravity and magnetic surveys. A 3D high-energy seismic survey (HESS) was proposed by PG&E, however, the California Coastal Commission denied PG&E's application due to concerns about the environmental impact of these studies.

Important conclusions:

- "Earlier models... that identified the Hosgri fault zone as a major thrust fault underlying the
 Coast Ranges are not supported by the (older) high-energy marine 2D seismic-reflection data
 acquired during the Long Term Seismic Program (LTSP); nor are they supported by potential field
 and seismicity data collected during the Long Term Seismic Program Update and Central Coastal
 California Seismic Imaging Project [that's this one] program."
- "Geologic observation, seismicity data, and geophysical data all demonstrate that the Hosgri
 fault zone is a right-lateral strike-slip fault that dips steeply (75°-90°) northeast to a depth of
 12–14 km in the vicinity of the Diablo Canyon power plant."
- "evidence for recent fault rupture between the Hosgri and San Simeon fault zones is not well
 imaged in some locations, [although] the data do not preclude the existence of fault linkage at
 seismogenic depths"
- "Chapter 13 presents a ground-motion hazard sensitivity analysis for the linkage of the Hosgri and San Simeon faults, and a combined rupture of the Hosgri—San Simeon and Shoreline faults"

Land seismic surveys

Chapter 7 – Description of the Geologic Mapping Project conducted by PG&E and also reported separately, well data from Honolulu-Tidewater #1, and introduction of natural seismicity, gravity and magnetic data, although the primary data presented in the chapter is 2D accelerated weight-drop (AWD) and a small vibro-seis 3D(?) volume of seismic reflection data. Several cross sections are drawn and the Pismo Syncline is described. The purpose was to evaluate the geometry of the Los Osos, San Miguelito, and San Luis Bay faults, as well as illuminate the deeper structure of the Pismo Syncline and the Edna fault system within the central Irish Hills.

Important conclusions:

- "The Pismo syncline in the central and southern Irish Hills is the deformed remnant of a Neogene extensional basin."
- The basin was bounded on the north by the Edna fault zone(s), fairly large basin bounding
 normal faults. The southern margin of the basin (now the southern limb of the Pismo Syncline)
 was formed by several smaller north-dipping normal faults, which have been inverted to reverse
 faults during synclinal folding. Many of these faults are "blind", i.e. are not exposed at the
 surface and are interpreted from seismic data.

Comment [a4]: It does, however, have significant evidence of both shortening (where it's strike is more EW than "average") and extension (where it's strike is more NS than "average"). See, for example, other conclusion bullets in this document – Chapters 2 and 4 especially.

- Folds are mappable at the surface.
- The overall interpretation is one of a negative flower structure that formed during a transtensional phase of slip, and that was later inverted during transpressional slip.
- · All faults are interpreted as steeply dipping.

Chapter 8 – 3D seismic reflection survey confined to an onshore area around the Diablo Canyon Power Plant about 3 x 5 km ("Phase 1"), and a small shoreline strip southeast of the power plant about 3 km long by 0.5 km wide including the Rattlesnake fault at the shoreline ("Phase 2"). Data collected and analyzed by Fugro. Detailed geologic map of the area around the power plant. The goal was to identify structures that might be significant to seismic hazard analysis of the power plant, and provide input data for ground motion modeling at the power plant site.

Important conclusions:

- "... folding in buried reflector packages consistent with out-of-syncline parasitic folding that
 discordantly detached and shortened Obispo volcaniclastic strata off of stiffer, relatively
 undeformed diabase bodies... folding event is old and no longer active, and took place during
 the compressional uplift event that inverted the ancestral Pismo Basin into the deeply eroded
 Pismo syncline."
- "Despite differences in elevation between time-correlated uplifted terraces, the terraces
 themselves remain horizontal, indicating that the style of late Quaternary deformation of the
 western Irish Hills is characterized by rigid block uplift with little or no rotation."
- ...[in Phase 1 area] "no throughgoing steep or vertical reflector truncations were observed that
 would indicate the presence of a significant steep fault offset. ... Any throughgoing faulting in
 the reflective depth range of 0 to 0.3 km would have to follow shallow to flat unconformities."
- [The updated surface mapping] "shows steep, generally north dipping Obispo volcaniclastic
 strata exposed along Discharge Cove. The tomography indicates that these steeply dipping
 strata are underlain by a shallowly north-dipping diabase intrusive. Future efforts that would
 consider the construction of a stratigraphic cross section through the Phase 1 area must be very
 wary of using only the surface dip data, and should honor the nearly flat-lying subsurface
 velocity structure as well."
- "Three lineaments mapped on the bedrock surface beneath the marine terrace sediments in the Phase 2 area merit investigation as potential faults. In order to directly examine the potential fault plane, ground-based investigations of the bedrock platform surface and the overlying Quaternary sediments would be required"

Chapter 9 – Results of Geologic Mapping Project, intended to help interpretation of onshore seismic reflection data. Data presented includes previously published and unpublished geologic maps plus new data collected in this study. There is a section dedicated to the Los Osos fault zone. One conclusion is: "new mapping in the vicinity of the Edna, Los Osos, San Luis Bay, San Miguelito, and Shoreline fault zones does not introduce any new hard constraints on fault location, dip, slip direction, or slip rate". Data presented in this chapter is also used in chapters 7 and 8.

Comment [a5]: good exposures of the Obispo Fm and Cretaceous sandstone in the cliffs Appendices contain daily field reports, photographs, sample catalogue, an Arc GIS catalogue of shapefiles and other information relating to data acquisition and geologic mapping in the Irish Hills, and a compilation of (primarily) stratigraphic data from 18 of 34 wells (26 oil and 8 hydrogeologic).

Important conclusions:

- "Edna and San Miguelito fault zones—minor changes to the geologic units adjacent to the faults."
- "Los Osos fault zone—minor changes to the geologic units adjacent to the fault zone, and changes to the depiction of the fault zone along the northern margin of the Irish Hills (including removal of the concealed, northwest-trending fault across southern Morro Bay)."
- "Shoreline fault zone—minor changes to the geologic units and bedrock faults adjacent to the fault zone for the reaches opposite Olson Hill and the Diablo Canyon power plant."
- "San Luis Bay fault zone—minor changes to the geology adjacent to the fault zone along the
 outer coast from Olson Hill to Rattlesnake Creek, and the addition of a generalized, concealed,
 and locally queried trace in San Luis Obispo Bay and on the outer coast between the Rattlesnake
 fault and the Olson Hill deformation zone."

Geotechnical studies

Chapter 10 – provides a 3D shear-wave velocity (V_s) model for the Diablo Canyon power plant foundation area. Both 3D acoustic compressional-wave velocity (V_P) models and one-dimensional V_s -depth profiles constrained by surface-wave dispersion were developed within the Diablo Canyon power plant site.

Important conclusions:

- There is significant spatial variability in V_{s.30} [shear-wave velocity in the top 30 meters]
 throughout the Diablo Canyon power plant site due to variations in near surface geology.
- The shear-wave-velocity model is used as input into the Site Conditions Evaluation report in Chapter 11.

Chapter 11 – Site conditions evaluation as relevant to the modeling of ground motion at the Diablo Canyon power plant site.

Chapter 12 – Addresses testimony from Dr. Douglas Hamilton concerning two postulated faults: the Diablo Cove and the San Luis Range/Inferred Offshore faults. In addition to using selected data from Hamilton, a variety of other PG&E reports, and published literature, this chapter uses data from chapters 2, 4, 7, 8, and 9 in Central Coastal California Seismic Imaging Project (this) report.

Important conclusions: Essentially they conclude that the Diablo Cove fault is a non-issue, and that the San Luis Range/Inferred Offshore fault – although not there – will be accounted for in their new seismic source characterization [hmmm].

Comment [a6]: This is a pretty important chapter that pulls together a number of strands to refute Hamilton's ideas – whether correctly or incorrectly I know not at this point...

- "We conclude that the Diablo Cove fault does not represent a seismic hazard to the Diablo
 Canyon power plant, and there is no basis for considering the Diablo Cove fault as proposed by
 Hamilton ... to be either a fault displacement hazard or a seismic source of strong ground
 motions. We make this conclusion based on the following key points:
- Trench and excavation mapping conducted prior to construction of the Diablo Canyon power
 plant documented that the fault zone is discontinuous, is associated with minimal offset, and
 does not displace marine terrace deposits that are 120 ka. Thus, the faulting where observed
 directly is minor and inactive in the late Pleistocene.
- Geologic mapping and interpretation of multibeam echo sounder imagery do not support connecting the Diablo Cove fault offshore to the Shoreline fault zone.
- There is no basis for correlating seismicity with the Diablo Cove fault based on an evaluation of microearthquake locations and consideration of their location uncertainty.
- The short length of the Diablo Cove fault zone—probably less than half a kilometer—is not
 consistent with a down-dip width of several kilometers that would extend the fault to
 seismogenic depths.
- Structural analysis of geologic data and high-resolution 3D land seismic data at the Diablo
 Canyon power plant supports an interpretation, shared by the original mappers of the faults,
 that the faulting is related to shallow fold deformation and shortening that predates the late
 Quaternary and probably dates to the Miocene or Pliocene. The faulting may or may not be
 related to a Miocene diabase intrusion imaged directly north of the north-dipping Diablo Cove
 fault at shallow depths. Based on this interpretation, the fault extends to only a few tens to
 hundreds of meters depth."
- We conclude that there is no clear evidence in the available data to support the presence of [the
 San Luis Range/Inferred Offshore thrust fault], and there is evidence that precludes its presence.
 Accordingly, there is no basis for considering the San Luis Range/Inferred Offshore thrust to be a
 seismic hazard to the Diablo Canyon power plant as proposed by Hamilton. We make this
 conclusion based on the following key points:
- Analyses of multibeam echo sounder bathymetry data and seismic-reflection data do not
 support the interpreted uplift rate boundary across the San Luis Range/Inferred Offshore thrust
 fault proposed by Hamilton. Instead, interpretations of the data are consistent with a very low
 or negligible change in uplift rate where the San Luis Range/Inferred Offshore thrust fault is
 interpreted to impinge on the Shoreline fault zone and where the SLRF is interpreted to diverge
 from the Shoreline fault zone south of Point Buchon. Interpretations of coastal marine terrace
 data and offshore marine terraces are consistent with uplift rate boundaries that instead
 coincide with other structures considered by PG&E in past seismic hazard analyses.
- We disagree with the assertion by Dr. Hamilton that the San Luis Range/Inferred Offshore thrust fault interpretation is required to fit the observed pattern of coastal terrace uplift and instead suggest the observed pattern of coastal uplift may be matched by several proposed fault geometries, including those proposed by PG&E in past seismic hazard analyses.

- We disagree with the assertion by Dr. Hamilton that the seismicity data beneath the Irish Hills show a clear alignment supporting the San Luis Range/Inferred Offshore thrust fault at depth.
 The seismicity data can be interpreted in different ways to support many different fault models.
- Interpretation of land seismic-reflection data do not show evidence for a gently to moderately
 dipping San Luis Range/Inferred Offshore thrust fault beneath the southern Irish Hills in the
 general location proposed by Hamilton. Instead, interpretations of the seismic-reflection data
 show steeply north-dipping structures down to approximately 7 km depth or deeper that
 coincide with recognized faults (the Irish Canyon and San Luis Bay) at the surface. The
 interpretation of these steeply dipping structures to depth precludes the presence of the San.
 Luis Range/Inferred Offshore thrust fault.
- Although the specific San Luis Range/Inferred Offshore thrust fault interpretation by Hamilton is not well supported by the available data, and by no means can be held up as a unique or preferred interpretation, the general solution of a primary, north- or north-northeast-dipping fault beneath the Irish Hills is consistent with several observations, and is a possible fault model that should be considered for seismic hazard analysis to the Diablo Canyon power plant. We note that the interpretations by Hamilton are being considered for evaluation and integration with other available data following the Senior Seismic Hazard Analysis Committee Level 3 process. The Senior Seismic Hazard Analysis Committee program for the Diablo Canyon power plant, which is being performed under regulatory review by the NRC, is creating a new seismic source characterization model.

Chapter 13 – Evaluation of sensitivity of the deterministic ground motions that were presented in the PG&E Shoreline Fault Zone Report (2011) to the seismic source characterizations for the Shoreline and Hosgri faults, using new ground motion models developed by the Pacific Earthquake Engineering Research (PEER) center as part of their "Next Generation Attenuation" program.

Important conclusion:

 "For all the cases considered in this sensitivity study, the 84th percentile ground motions for the power-block and turbine-building foundation levels are bounded by the 1977 Hosgri spectrum."

[In other words, their former analysis is not affected by any of the new data/interpretations.]

Chapter 14 – The findings and conclusions of the Central Coastal California Seismic Imaging Project report [this one].

Important conclusion:

 "These studies confirm previous analyses that the plant and its major components are designed to withstand—and perform their safety functions during and after—a major seismic event."

Evaluation of the Constraints for the Hosgri Fault Slip Rate

Stress Conditions in the Irish Hills Region:

- Transpressional with north-northeast orientation of maximum compression
- Faults in the region with a northwest strike typically have dextral slip
- Faults in the region with an easterly strike (or perpendicular to maximum compression) typically have a reverse sense of slip
- Strike-slip faults have a rake of ≤30°
- Reverse and reverse oblique faults have a rake of 90°±60°

Hosgri Fault Zone:

First studied by Wolf and Wagner (1970) and Hoskins and Griffith (1971). It is part of the larger San Gregorio-San Simeon-Hosgri fault system (410 km long). The Hosgri segment is approximately 110 km long and was mapped using multichannel seismic-reflection (O&G) data to a depth of 1.5-3 km (Willingham et al., 2013). Offshore from Diablo Canyon, the Hosgri was remapped using single-channel, high resolution USGS sparker data (Johnson and Watt, 2012) in order to provide better near-surface resolution of the fault trace. At its northern tip the Hosgri is linked to the San Simeon fault across a poor seismically imaged region interpreted to be either (i) a zone of transtensional normal faults in a right-releasing step-over (PG&E, 1988) or (ii) the Hosgri bends westward at this point and steps over the San Simeon fault across a zone of northwest-trending faults to the north (PG&E, 2014).

Fun Facts:

- Convergent right-lateral (transpressional) fault with late Quaternery slip rate of 1-3 mm/year
- Johnson and Watt (2012) confirmed this sense of motion on the Hosgri in the current stress regime
- Fault zone is up to 2.5 km wide directly offshore of Diablo Canyon.
- The fault trends N25°W to N30°W and is locally coincident with the shelf break.
- Fault dip varies from vertical to steeply dipping in the near surface data and in the multichannel data it dips steeply at a depth of ~1 km.
- Focal mechanisms along the Hosgri show nearly pure strike-slip on a near-vertical to steeply east-dipping (~75°) fault at a depth of 12 km (McLaren and Savage, 2001).

Constraints on the Hosgri:

- Deformed marine terraces on the San Simeon fault (onshore) are used to constrain the assessment of horizontal slip on the Hosgri.
- The Cross-Hosgri slope was identified to estimate the Pleistocene-Holocene slip on rate on the Hosgri.
- Offset channels in the southern Estero Bay were used to constrain slip rates on the northern end of the Hosgri

Offset channels in southern Point Sal were used to constrain slip rates on the southern end
of the Hosgri

These constraints have provided an estimate of 2 mm/year of right-lateral slip, which is consistent with regional geodetic data showing ~ 2 mm/year of plate-margin lateral shear in the region (DeMets et al., 2014). In addition, the slip rate should vary north to south (Hanson et al., 2004; Johnson et al., 2014) depending on the number of fault intersections along its trace. The northern and middle sections of the Hosgri should have a higher slip rate than the southern due to fewer faults intersecting the Hosgri as you move south along its trace.

San Simeon Fault Slip Rate:

The San Simeon projects into the Hosgri and the offset and slip rate on that fault are considered representative of the Hosgri. Field mapping of terraces on either side of the San Simeon fault and over 100 boreholes, numerous trenches, and soil pit excavations were used to delineate altitude and distribution of terrace remnants (Hall et al., 1994; Hanson and Lettis, 1994). This was performed in order to constrain the style and slip rate of deformation along the onshore San Simeon fault zone.

Cross-Hosgri Slope Slip Rate:

To be added

Estero Bay Slip Rate:

Estero Bay contains two dominate strands of the Hosgri Fault zone (Figure 8-24 in 2014 PG&E report). The Hosgri in this area marks the boundary between active tectonics to the eat and minor subsidence to the west. PG&E identified (Chapter 3 in 2014 PG&E report) multiple channel segments in upper continental slope sediments. Of all the channels PG&E identified only the Channel Complex De as a viable strain marker because it seems to correlate across the Hosgri to Channel Ee1 (Figure 8-25 and Plate 3 in Chapter 3 in 2014 PG&E report). Based on these markers, it was estimated that right-lateral separation was 260±60 m and vertical separation was 40±8 m down to the west.

Point Sal Slip Rate:

To be added

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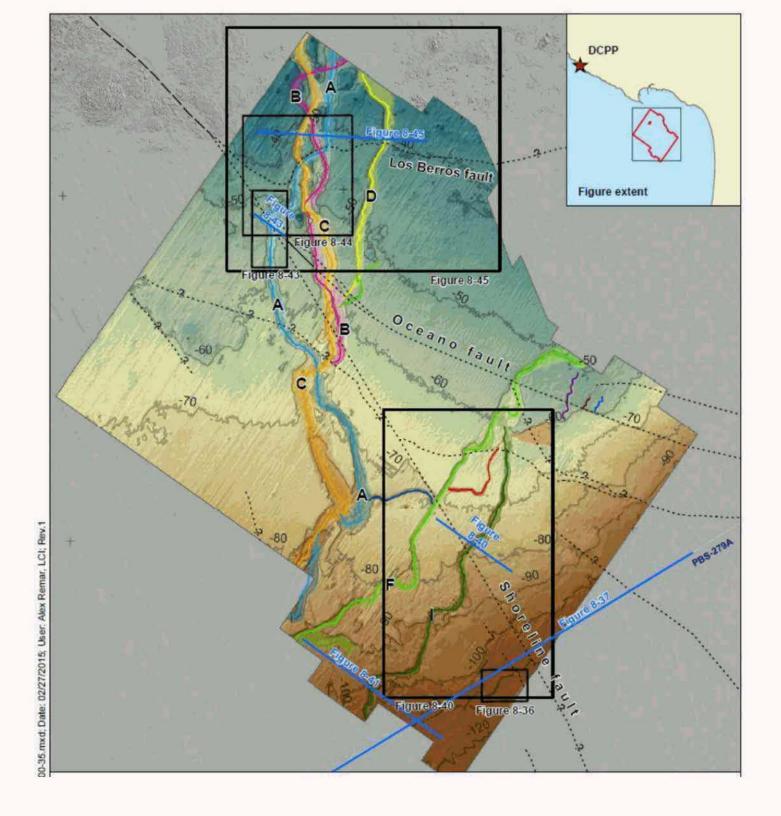
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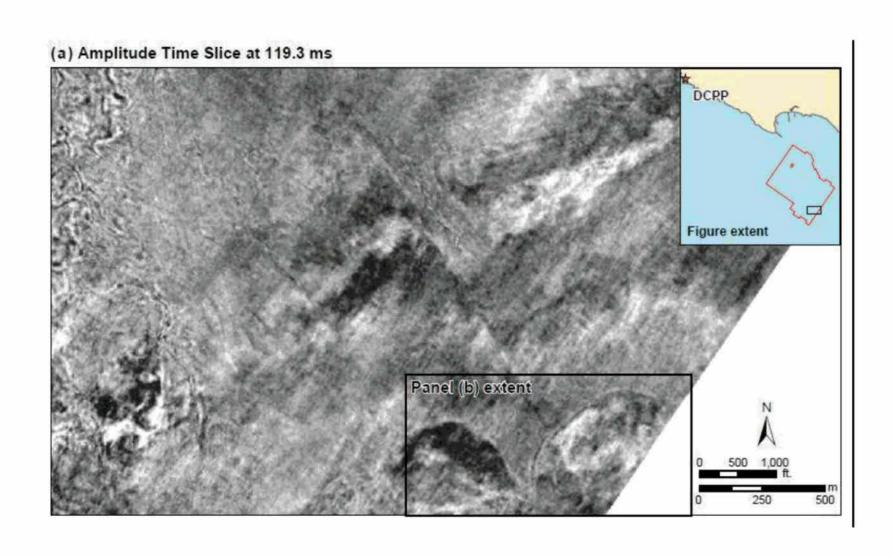
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Document Title	Figure/Sub-Document	Document Type	Page	Data Quality	Link to Document	Date	Source Presented by: John A. Stamatakos	Summary
B-Stamatakos-Fukushima Seismic and Flooding		PowerPoint		na (no data)	Figures\8-Stamatakos-Fukushima Seismic and Flooding.pptx	December 4, 2013	NRC Contracting Officer; Lisa Kauffmann NRC Contracting Officer Representative: Gerry Strewalt CNWRA Program Manager: Lane Howard Presented by: John A. Stamatakos	Fukushima Near Term Task Force Seismic and Flooding Assessments
30-Stamatakos-Eukushima Selsmic and Flooding		POF		na (no data)	Figures LIO Stamatakos-Fukushima Seismic, and Flooding polf	12/09/201-	NRC Contracting Officers: Sharlene McCubbin and Hugo Alcantara NRC Contracting Officer Representatives: Gerry Strewalt and Barbara Hugo Sarbara Hugo CNWAA Program Managers: Lane Howard and Miriam Juckett	FURUSHIMA NEAR TERM TASK FORCE SEISMIC. AND FLOODING ASSESSMENTS
Attachment_C-01_Primary_Linked_Sections_BuildPoints		Excel Doc		good	NTTF DCCP PSHA Review\Appendix C HID. Attachments\Attachment_C: 91_Primary_Unked_Sections_BuildPoints			Feats?
Attachment_C-02_Hosgri_RuptureModels_inputFiles		Excel Doc		good	NTTF DCCP PSHA Review Appendix C HID Attachments Attachment C 02 Hoseri Rupture Models Input Files			Hosgri Fault, Rupture model data
Attachment_C-03_OV_RuptureModel_InputFiles		Excel Doc		good	NTTF DCCP PSHA Review\Appendix C HID Attachments\Attachment. Cc. 03. OV. Rupture\Model InputFiles			Outward Vergent Faults, Rupture model data
Attachment_C-04_5W_RuptureModel_InputFiles		Excel Doc		good	NTTF DCCP PSHA Review\Appendix C HID Attachments\Attachment_C- 04_SW_Rupture\Model_InputFiles			Southwest Vergent Faults, Rupture model data
Attachment_C-05_NE_RuptureModel_InputFiles		Excel Doc		good	NTTF, DCCP PSHA Revew\Appendix C HID Attachments\Attachment_C- 05 Nr. AuptureModel Inputfiles			Northeast Vergent Faults, Rupture model data
Attachment_C-06_SAFZ_InputFile		Text Document		good	NTTF DCCP PSHA Review\Appendix C HID Attachments\Attachment_C- 06_SAFZ_InputFile		UCERF3 Mean Branch Average Solution file	The San Andreas Fault source hazard input files
Attachment_C-07_UCERF3_RegionalFaults_InputFile		Text Document		good	NTTI, DCCP PSHA Review\Appendix C.HID Attachments\Attachment_C. 67_UCERF3_RegionalFaults_inputFile		.UCERF3 Mean Branch Average Solution file	UCERF3 Mean Branch Average Solution files
Attachment_D-1.Rev_A		POF		na (analysis)	MTT, DCCP PSHA Revee\Appendix D WS. Summares Attachmeet\Attachmeet_D-1 Bev. A.pdf	11/79/2011	Katheryn Wooddell and Nick Gregor	Sensitivity studies. LTSP SSHAC Level three Update WSI. Contains graphs of annual probability of Exceedince, spectral acceleration, Sensitivity to Mean Char. Rupture length, Sensitivity to slip; rate, sensitivity to disp, sensitivity to disp, introduced, sensitivity to contain the path, sensitivity to contain the path, sensitivity to crustal michness, sensitivity to ground motion prediction equation, sensitivity to fraged characteristics, sensitivity to a signal model, sensitivity to sigma model, sensitivity to directivity.
Attachment_D-Z Rev_A		PDF		Good (all graph data)	NTTF DCCP PSNA Review\Appendix D WS Summaries Attachments\Attachment D-2 Rev. A.pdf	11/06/2012	Nick Gregor	Diablo Canyon SSHAC Level 3 Study on SSC Sensitivity results.
	SSC Sensitivity Base Case, PGA	Graph	3		NTTF DCCP PSHA Review\Appendix D WS. Summaries Attachments\Attachment D-2 Rev_A.pdf			Annual Probability of Exceedance over PGA (g) for large faults.
	SSC Sensitivity -Base Case, 5 Hz	Graph	4.		NTTF, DCCP PSHA Review/Appendix D WS Summaries Attachments/Attachment, D-2 Rev, A.pdf			Annual Probability of Exceedance over SA (g) for large faults,
	55C Sensitivity -Base Case, Example	Graph	8		NTTF, DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment_D-2 Bev_A.pdf			Annual Probability of Exceedance over SA (g) for large faults,
	SSC Sensitivity. Tornado Olagram-Hosgri S Hz	Graph	9		NTTF DCCP PSNA Review\Appendix D WS. Summaries Attachments\Attachment_D-2 flex_Apdf			Tornado Diagram

SSC Sensitivity Tornado Diagram-Los Osos 5 Nz	Graph	10		NTTF DCCP PSHA Review\Appendix D WS. Summaries Attachments\Attachment D-2 Rev_A.pdf			Yornado Diagram
SSC Sensitivity Tornado Diagram-Shoreline 5 Hz	Graph	11		NTTF DCCP PSHA Review\Appendix D WS. Summaries Attachments\Attachment_D-2. Rev_A.pdf			Tornado Diagram
SSC Sensitivity Tornado Diagram-San Luis Bay 5 Hz	Graph	12		NTTF, DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment_D-2 flov_A.pdf			Tornado Diagram
SSC Sensitivity Tornado Diagram-PGA	Graph	13		NTTF DCCP PSHA Review\Appendix D WS_ Summaries Attachments\Attachment_D-2 Rev_A.pdf			Tornado Diagram
SSC Sensitivity Tornado Diagram-S Ha	Graph	14		NTTF DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment D-2 Rev_A.pdf			Tornade Diagram
SSC Sensitivity Tornado Diagram-, S Hz	Graph	15		NTTF DCCP PSMA Review\Appendix D WS Summaries Attachments\Attachment_D-2 Rev_A.pdf			Tomado Diagram
	PDF		Good (graph data)	NTTF, DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment_D-3 Rev_A pdf	03/25/2014	Nick Gregor. Hazard Sensitivity, DCPP SSC Workshop	Hazard Sensitivity, DCPP SSC Workshop
DCPP: 5 Hz by Fault Sources	Graph	4		NTTF DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment_D-3 Rev_A.pdf			Annual Probability of Exceedance over PGA (g), for large faults.
DCPP: 1 Hz by Fault Sources	Graph	4		NTTF DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment_D 3 Rev_A.pdf			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: OV, 5Hz, (10-4) Desegregation	Graph	5:		NTTF DCCP PSHA Review/Appendix D. WS. Simmaries Attachments/Attachment_D-3. Rev_A.pdf NTTF DCCP PSHA Review/Appendix D. WS.			Magnitude v distance v percentage contribution to hazard
DCPP: Shareline (2011), SHz, (10-4) Desegregation	Graph	5		Summaries Attachments\Attachment_D-3 Rev_Appf NTTF DCCP PSHA Review\Appendix D. WS			Magnitude v distance v percentage contribution to hazard
DCPP: OV, 1Hz, (10-4) Desegregation	Graph.	6		Summaries Attachments\Attachment D-3 Bex_Apdf NTF-DCCP PSHA Review\Appendix D WS.			Magnitude v distance v percentage contribution to hazard
DCPP: Shoreline (2011), 1Hz, (10-4) Desegregation	Graph	6		Summaries Attachments/Attachment, D-3 Rev. A.pdf NTTF DCCP. PSHA Review/Appendix D. WS.			Magnitude v distance v percentage contribution to hazard
DCPP Fractile (GV, 1Hz)	Graph	X		Semmanes Attachments (Attachment, D-3 Box, A.pdf NTF DCCP PSHA Review (Appendix D WS			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: Tectonic Models 5Hz	Graph	7		Summaries Attachments \Attachment_D-3 Rev_A pdf NTTF DCCP_PSHA Review\Appendix D_WS			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: Tectonic Models 1Hz	Graph	8		Summaries Attachments\Attachment_D-3 Rev_A.pdf NTTF DCCP PSHA Review\Appendix D.WS			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: Additional Faults SHz	Graph	8		Summaries Attachments\Attachment_D-3 Rev_A.pdf NTTF DCCP PSHA Review\Appendix D WS			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: Additional Faults: 5Hz	Graph	9		Summaries Attachments\Attachment_D-3 Rev_A.pdf NTTF, DCCP PSHA Review\Appendix D WS			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: Hosgri Slip Rate 1Hz	Graph	9		Summaries Attachments\Attachment_D-3 Rev_A.pdf NTTF DCCP.PSHA Review\Appendix D.WS.			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: Hosgri Dip 1Hz	Graph	10		Summaries Attachments\Attachment_D-3 Rev_A.pdf NTTF DCCP.PSHA Review\Appendix D WS.			Annual Probability of Exceedance over PGA (g) for large faults,
DCPP: Hosgri Location 3Hr	Graph	10		Summaries Attachments\Attachment_D-3. Rev_A.pdf NTTF DCCP PSHA Review\Appendix D WS.			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP-Shoreline Slip Rate 1Hz	Graph	11		Summanes Attachments Attachment 0-3 Rev A.pdf NTTF, DCCP PSHA Review Appendix D WS			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: Los Osos Slip Rate 1Hc	Graph	11:		Summaries Attachments\Attachment_D-3 Rev_A.pdf NTTF DCCP PSHA Review\Appendix D WS			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: SLB Slip Rate 1Hs	Graph	12		Summaries, Attachments \Attachment_D-3. Rev_A.pdf NTTF DCCP_PSHA_Rovew\Appendix_D_WS			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: Other Fault Slip Rate 1Hz	Graph	12		Symmaries Attachments/Attachment D-3 Rev. A.pdf NTTF DCCP. PSHA Review/Appendix D-WS			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: Los Osos Sirp Rate-NE 1Hz	Graph	11		Summaries Attachments/Attachment D-3: Rev. A.pdf NTTF, DCCP PSMA Review/Appendix D-WS			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: SLB Skp Rate SW 1Hz	Graph	11		Summaries Attachments/Attachment_D-3 Rex_A.pdf NTTF DCCP PSHA Review/Appendix D WS			Annual Probability of Exceedance over PGA (g) for large faults.
DCPP: Maximum Magnitude	Graph	M.:		Summaries, Attachments (Attachment, D-3 Rex, A.pdf NTTF DCCP, PSHA Review (Appendix D. WS.			Annual Probability of Exceedance over PGA (g) for large faults.
DEPP: Characteristic maximum Magnitude	Graph	14		Summaries Attachments\Attachment_D-5 Rev_A-pdf			Annual Probability of Exceedance over PGA (g) for large faults.

Attachment_D-3 Rev_A

	DCPP: WAACY Model	Graph	15		NTTF DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment D-3 Rev. A.pdf			Annual Probability of Exceedance over PGA (g) for large faults.
	DCPP: Background	Graph	15		NTTF DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment_D-3 Rev_A.pdf			Annual Probability of Exceedance over PGA (g) for large faults.
	DCPP: Recurrence (Time Dependent)	Graph	16		NTTF DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment_D-3, Rev. A.pdf			Annual Probability of Exceedance over PGA (g) for large faults.
	DCPP: Tornado Plot Ratios	Graph	16		NTTF DCCP PSHA Review\Appendix D WS, Summaries Attachments\Attachment_D-3 Rev_A.pdf			Tornado Diagram
	DCPP: Tornado 5 Hz	Graph	17		NTTF DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment D-3 Rev_A.pdf			Ternade Diagram
	DCPP: Tornado 3 Hz	Graph	17		NTTF DCCP PSMA Review\Appendix D WS Summaries Attachments\Attachment_D-3 Rev_A.pdf			Tornado Diagram
	DCPP: Tornado 5 Hz	Graph	18		NTTF DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment_D-3. Rev_A.pdf			Tornado Diagram
	DCPP: Tornado-1 Hz	Graph	18		NTTF DCCP PSHA Review\Appendix D WS Summaries Attachments\Attachment_D-3 Rev_A.pdf			Tornado Diagram
Attachment_F-1		Text Documents		good	NTTF DCCP PSHA Review\Appendix F.EQ. Catalogs Attachments\Attachment_F.1.txt		Hardebeck (2010) and N. Lewandowski	Tab delimited earthquake data.
Attachment_F-2		Text Documents		good	NTTF DCCP PSMA Review\Appendix F EQ Catalogs Attachments\Attachment_F-2.txt		Northern California Earthquake Data Center. (NCEDC) website	Tab delimited earthquake data.
Attachment_F-3		Text Documents		good	NTTF DCCP PSHA Review\Appendix F EQ Catalogs Attachments\Attachment, F-3.txt NTTF DCCP PSHA Review\Appendix F EQ		PG&£ Seismicity Catalog	Tab delimited earthquake data.
Attachment_F-4		Text Documents		na (no data)	Catalogs Attachments Attachment F- 4 README.txt		UCERFS	Tab delimited earthquake data.
Attachment G-1_Rev_A		PDF		Good (graph data)	NTTF DCCP PSHA Review\Appendix G WAACY Attachment\Attachment G- L. Rev. A pdf			
	Figure 1	graph	a		NTTF.DCCP PSHA Review\Appendix G WAACY Attachment\Attachment G 1_Rev_A.pdf NTTF.DCCP PSHA Review\Appendix G		Youngs and Coperamith	Annual number of earthquakes v Magnitude, comparison of different models
	Figure 2	graph	5		WAACY Attachment\Attachment G- 1. Rev. A adf NTTF DCCP PSHA Review\Appendix G		Youngs and Copersmith	General form and parameters of the Youngs and Coppersmith (1985) MFD.
	Figure 3	graph	6		WAACY Attachment Attachment G 1. Rev. A adf NTTF DCCP PSHA Revew\Appendix G			General form and parameters of the WAACY model.
	Figure 4	graph	8		WAACY Attachment\Attachment G- L. Rev. A.pdf NTTF DCCP PSHA Review\Appendix G.			Comparison of three models for the scaling of magnitude with average surface slip.
	Figure 5a	graph	9		WAACY Attachment\Attachment G- 1 Rev Apdf NTTF DCCP PSHA Review\Appendix G.		Hecker et al. (2013).	Results for WCSH magnitude displacement scaling. The black dashed lines show the range of acceptable CV values based on Hecker, et al. (2013).
	Figure 5b	graph	10		WAACY Attachment Attachment G- 1. Rev. A. pdf NTTF DCCP PSHA Review Appendix G.		Hecker et al. (2013).	Results for HEA13 magnitude displacement scaling. The black dashed lines show the range of acceptable CV values based on Hecker et al. (2013).
	Figure 5c	graph	11		WAACY Attachment \Attachment G- L Rev. A pdf NTTF DCCP PSHA Review\Appendix C HID		Hecker et al. (2013).	Results for \$1.1 magnitude displacement scaling. The black dashed lines show the range of acceptable CV values based on Hecker et al. (2013).
Attachment_C-09_LocalSoureZone_inputFile		Excel Doc		good	Attachments\Attachment C- 09_LocalSoureZone_InputFile			Fault input files for VF (virtual faults) SS, Reverse and geometry files.
							Presented by: John Stamatakos	
Annual Review Glable Canyon 2002		PowerPoint		na.(no data)	Figures/Annual Review Diable Canyon, 2002, ppt	December 3-5, 2002	Participants, A.H. Chowdhury, B. Dasgupta, D. S. Dunn, A. Ghosh, D. G. Gute, S. M. Hsiung, P. C. Mackin, C. Manepally, G. I. Ofoegbu, D. J. Pomerening, O. Povetko, B. Russell.	Diablo Canyon Independent Spent Fuel Storage Installation
							M. Smith, and R. T. Sewell (Consultant).	
							Presented by: John Stamatakos	
Annual Review Diable Carryon 2003		PowerPoint		na (no data)	Figures Annual Review, Diable Canyon 2003, pps	November 18- 20, 2003	Participants: A.H. Chowdhury, B. Dasgupta, D. S. Dunn, A. Ghosh, D. G. Gute, S. M. Hsiung, P. C. Mackin, C. Manepally, G. I. Ofcegbu, D. J. Pomerening, O. Povetko, B. Bussell, M. Smith, and R. T. Sewell (Consultant).	
Appendix C HID_Rev_A		PDF		Good (table data)	NTTF DCCP PSHA Review\Appendix C			
30.00 mm 10.00 mm 500 400 5	Figure C-2	map	38	na (fault traces)	HID Rev A.pdf NTTF DCCP PSHA Review\Appendix C HID_Rev_A.pdf	03/04/2015	DCPP SSC Report (PG&E)	Map of Primary and connected Fault sections in the Hospii and Outward- Vergent (OV) fault geometry Model, DCPP Vicinity
	Figure C-9	map	39	na (fault traces)	NTTF DCCP PSHA Review/Appendix C.	03/04/2015	DCPP SSC Report (PG&E)	Map of Primary and connected Fault sections in the Hosgri and Southwest-
	Figure C-0	mag	40	na (fault traces)	HID_Rev_A.pdf NTTF DCCP PSHA Review\Appendix C HID_Rev_A.pdf	03/04/2015	DCPP.SSC.Report (PG&E)	Vergent (SW) fault geometry Model, DCPP Vicinity Map of Primary and connected Fault sections in the Hosgri and Northeast- Vergent (NE) fault geometry Model, DCPP Vicinity
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	Figure C-5	map	41	na (fault traces)	NTTF DCCP PSHA Review\Appendix C HID_Rev_A.pdf	03/04/2015	DCPP SSC Report (PG&E)	Primary and Connected fault sections in the fault geometry models, southern region.
	Figure C-6	map	42	na (fault traces)	NTTF DCCP PSHA Review\Appendix C HID Rev A.pdf	03/04/2015	DCPP SSC Report (PG&E)	Primary and Connected fault sections in the fault geometry models, Northern region.
	Figure C-9	map	45	na (fault traces)	NTTF DCCP PSHA Review\Appendix C HID Rev. A.pdf	03/03/2015	DCPP SSC Report (PG&E)	UCERF3 Regional Fault Sources
	Figure C-10	map	46	na (fault traces)	NTTF DCCP PSHA Review\Appendix C HID_Rev_A.pdf	03/03/2015	DCPP SSC Regort (PG&E)	Non-UCERF3 Regional Fault Sources
	Figure C-11	map	47	na (fault traces)	NTTF DCCP PSHA Review\Appendix C HID_Rev_A.pdf	03/04/2015		Areal Source Zones Used in the Diablo Canyon SSC Model
	Figure C-12	map	48	na (fault traces)	NTTF DCCP PSHA Review\Appendix C	03/03/2015	(Petersen et al, 2008) DCPP SSC Report (PG&E)	Local Areal Source Zone and Virtual Faults
			227	12 11 12 1 (2002)	NTTF DCCP PSHA Review Appendix C	*********	DCPP SSC Report (PG&E). Grid from 20008	Regional Areal Source Zone Showing 1 degree gridded seismicity rates from
	Figure C-14	map	50	Good	HID_Rev_A,pdf NTTF DCCP, PSHA Review\Appendix C	03/04/2015	National Seismic Hazard Mapping Project, (Petersen et al., 2008) DCPP SSC Report (PG&E). Grid from 20008.	2008 NSHMP Vicinity Areal Source zone showing .1 degree and finer .02 degree gridded
	Figure C-15	map	51	Good	HID_Rev_A.pdf NTTF DCCP PSHA Review\Appendix F EQ	03/04/2015	National Seismic Hazard Mapping Project (Petersen et al., 2008)	seismicity rates based on the 2008 NSHMP
Appendix F EQ Catalogs_Rev_A				Good (table data)	Catalogs Rev A.pdf			
	Figure F-1	map	14	Good (earthquke event locations)	NTTF DCCP PSHA Review\Appendix F EQ Catalogs Rev_A.pdf	02/23/2015	Hardebeck 2014a. DCPP SSC Report (PG&E)	Hardebeck (2014a) Seismicity Catalogue. 1987 through 2013
	Figure F-2	graph	15	Good (earthquke event locations)	NTTF DCCP PSMA Review\Appendix F EQ Catalogs Rev. A.pdf	02/13/2015	Hardebeck 2014a and 2010. DCPP SSC Report (PG&E)	Earthquake location difference statistics between Hardebeck 2010 and 2014 in the San Luis Obispo Sub-region
	Figure I-3	map	16	Good (earthquke event locations)	NTTF DCCP PSHA Review\Appendix F EQ Catalogs_Rev_A.pdf	02/27/2015	DCPP SSC Report (PG&E)	PG&E seismicity catalogue developed for seismic Hazard evaluation for the DCPP, 1984 through February 2009
	Figure F-4	map	17	Good (earthquie event locations)	NTTF DCCP.PSHA Review\Appendix F EQ. Catalogs_Rev_A.pdf	02/26/2015	DCPP SSC Report (PG&E)	Updated UCERF3 seismicity catalog 1984 through January 2014
ppendix G WAACY Magnitude PDF_Rev_A				Good (graph data)	NTTF DCCP PSHA Review\Appendix G			
	Figure G-2	graph	13	Waster State of the State of th	WAACY Magnitude PDF Rev_A.pdf NTTF DCCP PSHA Review\Appendix G WAACY Magnitude PDF_Rev_A.pdf	03/05/2015	DCPP SSC Report (PG&E)	CV Versus btail, grouped by magnitude-displacement relation and showing WAACY Model sariables Examined in the Parametric study
	Figure 5-3	graph	14		NTTF DCCP PSNA Review\Appendix G WAACY Magnitude PDF Rev. A.pdf	03/05/2015	DCPP SSC Report (PG&E)	CV. Versus htail for HEA13 Relation, Evaluating Logic, Tree groupings of Mch. Mmax pairs for implementation of the WAACY model
	Figure G-4	graph	15		NTTF DCCP PSHA Review/Appendix G WAACY Magnitude PDF Rev. A.pdf	03/05/2015	DCPP SSC Report (PG&E)	CV Versus F1 for HEA13 Relation. Evaluating Logic Tree groupings of Michar Mmax pairs for implementation of the WAACY model
ppendix H EPR Method_Rev_A				Good (graph data)	NTTF DCCP PSHA Review\Appendix F EQ Catalogs_Rev_A.pdf			
	Figure H 1	graph	21		NTTF DCCP PSHA Review\Appendix F EQ. Catalogs Rev. A.pdf	02/24/2015	DCPP SSC Report (PG&E)	Conditional Probability calculation illustrated for exponential and lognorms earthquake probability distributions
	Figure H-2	graph	22		NTTF DCCP PSHA Review\Appendix F EQ Catalogs Rev. A pdf	02/24/2015	DCPP SSC Report (PG&E)	conditional probability ratio.
	Figure H-3	graph	23		NTTF DCCP PSHA Review\Appendix F EQ. Catalogs: Rev. A.pdf	02/24/2015	DCPP SSC Report (PG&E)	Displacement per event models for the Hosgri and Los Osos or San Luis Bay faults
	Figure H-4	graph	24		NTTF DCCP PSHA Review\Appendix F EQ	02/24/2015	DCPP SSC Report (PG&E)	Two probability distribution of coefficient of variation values
	Figure H-5	graph	25		Catalogs_flev_A.pdf NTTF_DCCP_PSHA_Review\Appendix F_EQ_	02/25/2015	DCPP SSC Report (PG&E)	Lognormal PDF, Survivor function, 3D year conditional probability, and 30 y
					Catalogs Rev. A.pdf NTTF DCCP PSHA Review\Appendix F EQ			conditional probability ratio for three values of long-term mean.
	Figure H-6	graph	26		Catalogs Roy Apdf	02/24/2015	DCPP SSC Report (PG&E)	Conditional probability surface for the lognormal Model
	Figure H-7	graph	27		NTTF DCCP PSHA Review\Appendix F.EQ. Catalogs Rev. A.pdf	02/24/2015	DCPP SSC Report (PG&E)	(TM-tMRE joint probability surface used to select regions in the conditional probability ratio
	Figure H-8	graph	28		NTTT DCCP PSHA Review\Appendix F EQ Catalogs_Rev_A.pdf	02/24/2015	DCPP SSC Report (PG&E)	Sorted equivalent, Poisson Ratio, corresponding cumulative weight
	Figure H-9	graph	29		NTTF DCCP PSHA Review/Appendix F EQ Catalogs Rev A pdf	02/24/2015	DCPP SSC Report (PG&E)	Conditional Probability ratios for four values of historical constraint Tmin
	Figure H-10.	graph	30		NTTF DCCP PSHA Review\Appendix F EQ. Catalogs Rev_A.pdf	02/24/2015	DCPP SSC Report (PG&E)	Weighted Mean Equivalent Poisson ratio estimates by coefficient, of variation to lognormal model and three fault slip rates.
	Figure H-11	graph	31		NTTF DCCP PSHA Review\Appendix F EQ Catalogs Rev. A pdf	02/24/2015	DCPP SSC Report (PG&E)	Three-point distribution equivalent Poisson ratio values for the lognormal model and three fault slip rates.
	Figure ri-12	graph	32		NTTF DCCP PSHA Review\Appendix F EQ Catalogs Rev. A pdf	02/25/2015	DCPP SSC Report (PG&E)	Survivor Functions and conditional probability ratios compared for the lognormal, BPT, and Weibuil distribution and Five Coefficient of variation values.
	Figure H-13	graph	31		NTTF DCCP PSHA Review\Appendix F EQ. Catalogs Rev. A.pdf	02/24/2015	DCPP SSC Report (PG&E)	Pre-coefficient of variation equivalent Poisson ratio using the Weibull recurrence distribution for three fault slip rates
	Figure H-14	graph	34		NTTF DCCP PSHA Review\Appendix F.EQ. Catalogs. Rev. A.pdf	02/24/2015	DCPP SSC Report (PG&E)	Coefficient of variation weighted equivalent Poisson ratio distribution point for lognormal, BPT, and Weibull recurrence distributions
	Figure #F15	graph	35		NTTF DCCP PSHA Review\Appendix F EQ Catalogs Rev A.pdf	02/24/2015	DCPP SSC Report (PG&E)	San Andreas Fault Equivalent Poisson ratio estimation comparing known MRE = 1857 to a Bounded MRE > 1857
Beach_balls		TIFF		Poor (no reference for magnitudes)	Figures\Beach balls.tif			focal Mechanisms along the Hosgri Fault zone, Los Osos Fault Zone, and extending north to the Ragged Point Earthquake
California_Tsunami_CSSC		PDF		na (no data)	Figures/California_Tsunami_CSSC.pdf	December 2005	State of California Seismic Safety. Commission	THE TSUNAMI THREAT TO CALIFORNIA: FINDINGS AND RECOMMENDATION ON TSUNAMI HAZARDS AND RISKS
Central Coastal California Seismic Imaging Project								
		PDF			Central Coastal California Seismic Imaging			
Ch1.Introduction_Figures.(1)		PDF			Project\Ch1 Introduction_Figures (1) pdf			

	Figure 1-2	Мар	2	Good (graph data)	Central Coastal California Sciencic Imaging Project/Ch1.Introduction_Figures (1) pdf	07/30/2014	PG&£ CCCSIP Report	2011 Tornado Diagram Showing the Ranking of Hazard Sensitivity with Respect to the CCCSIF Source Characterization Studies (Graph showing sensitivity Hazard /1E-4 (at 2g), Shoreline, Los, Dios, Hospi faults)
Ch2.GEO.DCPP.TR.12.01_R1_AppA		PDF			Central Coastal California Seismic Imaging Project\Ch2.GEO.DCPP.TR.12.01_R1_AppA.p df			
	Figure I	Мар	9	Good (Seismic location map)	Central Coastal California Seismic Imaging Project\Ch2.GEO.DCPP.TR.12.01_R1_AppA.p df	06/05/2012		2010-2011-3D Survey Areas. Shows bathymetry, faults, and 2D and 3D seismic survey areas.
	Figure, 2	Мар	11	Good (Details integrated seismic)	Central Coastal California Seismic Imaging Project/Ch2, GEO, DCPP TR. 12 01_R1_AppA.p at		Fugro Seismic Imaging contracted by PG&E. Processed by FSI (green) with the USGS (Sitter et al., 2009, 2010) PBS 2D Lines (Red).	30 and 20 seismic lines. 2010/2011 30 Seismic Survey
	Figure 3a	Bathymetry and Seismic	14	Poor (unreadable bathymetric scale)	Central Coastal California Seismic Imaging Project/Ch2. GEO. DCPP TR. 12.01_R1_AppA.p. gl		MBES data from the California Seafloor Mapping Program (CSMP) and the 2010/2011 30 Survey by Fugro Seamic Imaging contracted by PG&E.	Central Coast MBES time converted data with the 2010/2011 PG&E 3D seismic survey seaffloor times displayed.
	Figure 3b	Bathymetry and Seismic	14	Poor (unreadable bathymetric scale)	Central Coastal California Seismic Imaging Prosectich 2.6EO.DCPP.T8.12.01_81_AppA.g df		MBES data from the California Seafloor Mapping Program (CSMP) and the 2010/2013 No Survey by Pigro Seismic Imaging contracted by PG&E.	Central Coast/South of Morro Bay-Avilla Bay Blocks A-B MBES converted time data surrounding 2010/2011 PG&E 30 seismic survey.
	Figure 3c	Bathymetry, and Seismic	15	Poor (unreadable bathymetric scale)	Central Caastal California Seismic Imaging Project (Ch2. GEO DCPP TR.12-01_R1_AppA.p of		MBES data from the California Seaffoor Mapping Program (CSAPF) and the 2010/2011 35 Survey by Fugor Seismic Imaging contracted by PG&E.	2010/2011, 30 seismic survey seafloor time highlighted within MBES Data water-bottom time. MBES bathymetry data has been shaded
	Figure 3d	Bathymetry and Seismic	15	Poor.(unreadable bathymetric scale)	Central Coastal Californiu Seiumic Imaging, Projectich2 GEO DCPP TR.12.01_R1_AppA.p df		MBES data from the California Seafloor Mapping Program (CSMP) and the 2010/2011 3D Survey by Fugor Seismic Imaging contracted by PG&E.	Variations of sea floor time between the MBES and the 2010/2011 3D Survey
	Figures 4-8	Seismic	16-18	Average (reflectors are overprinted, noisy)	Central Coastal California Seismic Imaging Projectich 2 GEO DCPP_TR.12.01_R1_AppA.p df		MBES data from the California Seafloor Mapping Program (CSMP) for the bathymetry horizons and 3D seismic lines from the 2010/1011 survey (Fugro Seismic Imaging contracted by PG&E)	The 3D seismic survey profiles were displayed in Unises and the bathymetry data was displayed as a horizon above the water bottom of the seismic data. Several 3D seismic volume survey in-lines were extracted as 2D lines in order to view the horizon in vertical section [Figures 4 through 8].
	Table 2		19	Good (data table)	Central Coastal California Seismic Imaging Project/Ch2 GEO.DCPP TR. 12.01 R1 AppA.p			Difference of MBES depths Converted to Time (ms) and the 3D Survey Seafloor Time (ms).
	Table 1		13	Good (data table)	Central Coastal California Seismic Imaging Project/Ch2 GEO. DCPP TR. 12.01 RJ AppA p of			Horizontal and Vertical Datum Information for, the different surveys
	Figure 9-14	Seismic	21-23	Poor (unreadable amplitude scale)	Central Coastal California Seisonic Imaging Project\Ch2.GEO.DCPP.TR.12.01_R1_AppA.p of		Fault structure shape files from the California Geologic Survey Quaternary Faults. Seismic area from, 2010/1011, survey (Fugro Seismic Imaging contracted by PG&E)	Un-Named Q-Fault locations (in Red) mapped across northern portion of the 30 volume. Data has been displayed using the Batik program in Unisea.
	Figure 15		24	Good (seismic processing)	Central Coastal California Seismic Imaging, Project\Ch2 GEO.DCPP.TR.12.01_RJ_AppA.p df		Several in-lines from the PG&E 3D Survey (2010/2011 by FSI) were extracted as 2D lines to compare with the USGS 2D dataset	USGS 2D LinePBS-30 in wiggle mode & 3D in-Line 12440 in wiggle mode. Different Acquisition sources construct dissimilar phase and pulse, of the two data sets.
	Figure 16		25	Good (seismic processing)	Central Coastal California Seismic Imaging Project/Ch2.GEO.DCPP.TR.12.01_R1_AppA.g ff		Several in-lines from the PG&E ID Survey (2010/2011 by FSI) were extracted as 2D lines to compare with the USGS 2D dataset	Amplitude Spectrum of USGS 2D Line 30, the Peak Frequency is 1291 Hz (taken from CDF4935-4893); the 50 In-line 12440 Amplitude Spectrum show a peak frequency at 189 Hz (taken from CDP's 12689-12644). Image shows that data sets show large differences in source volume and peak frequencies.
	Figure 17		26	Good (seismic integration)	Central Coastal California Seismic Imaging Project Ch2 GEO DCPP TR 12 01 R1 AppA p of		Lines from the PG&E 3D Survey (2010/2011 by FSI) and 2D lines from the USGS 2D dataset	Intersection display of 3D Line 12969 and USGS 2D Line PBS-28. Time shifts were calculated in order to match the 3D dataset with the 2D data.
	Figure 18		26	Good (seismic integration)	Central Coustal California Seismic Imaging, Project/Ch2.GEO.DCPP.TR.12.01_R1_AppA.p. dl		Lines from the PG&E 3D Survey (2010/2011 by FSI) and 2D lines from the USGS 2D dataset	Intersections of 2010/2011 3D Seismic Survey Cross-Line 13211 and USGS 2D Line PBS-22. Several intersections were used to calculate time shifts needed to match the 3D Seismic Data set with the 2D Seismic data.
	Figure 19		27	Good (seismic integration)	Central Coastal California Semmic Imaging Project Ch2.GEO.OCPP.TR.12.01_R1_AppA.p.dl		Lines from the PG&E 3D Survey (2010/2011 by FSB and 2D lines from the USGS 2D dataset	3D extracted in-Line 12210 is displayed with USGS 2D Line PBS-23. Line separation distances average 16 to 1 meter.
	Figure 20	Seismic	27	Average (reflectors are overprinted, noisy)	Central Coastal California Seismic Imaging Project\Ch2 GEO.DCPP.TR.12.01_R1_AppA.p df		Lines from the PG&E 3D Survey (2030/2011 by FSI) and 2D lines from the USGS 2D dataset	Side-by-Side comparison of 2D Line P85-23 and 3D extracted in-Line 12210. 3D processing is comparable but has improved imaging when compared to the USGS 2D data. Displays are zoomed in 10-200ms; approximately 2km in- cross-section.

	Figure 21				Central Coastal California Seiumic Imaging	Lines from the PG&E 3D Survey	
	The state of the s		28	Good (seismic integration)	Presentich2 GEO DCPP TR. 12.01. R1. AppA.p. eff	(2010/2011 by FSI) and 2D lines from the USGS 2D dataset	3D extracted in Line 12440, and USGS 2D Line PBS-30. Line separation, distances average 25 to 35 meters.
	Figure 22		28	Average (reflectors are overprinted, noisy)	Central Coastal California Sciumic Imagine, Franct/Ch2 GEO DC99 TR 12:01, R1 AppA.a et	Lines from the PGRE 3D Survey (2010/2011 by FSI) and 2D lines from the USGS 2D dataset	Side-by-Side Comparison of USSS 25 Line PBS-30 with 3D extracted in-Line 12440, deologic features such as disping leds are comparable but enhanced in the 8D dataset. Vertical profiles used to compare the datasets are approximately Zim.
	Figure 23		29	Good (seismic integration)	Cantral Coastal California Scientic Imaging Project\Ch2.GEO.OCPP.TH.12.01_H1_AppA.p of	Lines from the PG&E 3D Survey (2010/2011 by FSI) and 2D lines from the USG\$ 2D dataset	3D extracted survey in-Line 12960 and USGS 2D Line PBS-28. Line separation distances average 2 to 35 meters, across.
	Figure 24	Sessic	29	Average (reflectors are overprinted, noisy)	Central Coastal Cathornia Senanti Imaging Projectisch 2,660,0079-TR 12.01 81 Arp A.p 8f	Lines from the PGSE 30 Survey (2010/2011 by FSI) and 20 lines from the USGS 20 dataset	Side-br-Side comparison of USGS 2D, Line, 28 with 3D extracted in-Line 12960. Similar goologic features are integed in both the 2D and 3D datasets but the 3D dataset contains more detailed impedance contrasts. The section of data used for comparison is approximately [Julin] in cross-section.
	Table 3		25	Good (Seismic shift table)	Sentral Coastal California Selbmic Imaging Projecti/Ch2 GEO DCPP TR.12.01_R1_AppA.p eff		Time Shifts Calculated to Match the 2009/2010 Mini-Sparker 20 Dataset to the 3D Dataset
	SOFTWARE VALIDATION & VERIFICATION OF UNISEIS Software Validation for Selsmic		33-65	na (software validation)	Central Coastel California Selivoic Imaging Project/Chiz GEO DCPP TR 12 01 H1, AppA.g. 2011 iff	Fugro Seismic Imaging	The processing will be performed using Fugro Seismic, Insaging's proprietary selsink processing software UNISES. Prior to performing this work, a Software Validation and Verification of UNISES was performed, This report summarises the Software Validation and Verification effort.
Ox. 610 DOW: TR.32 81, Figure	Processing Workshop and Qualification of 20120-2011 2d High resolution Seismic Reflection data		66-111	na (software validation)	Central Casatal California Sesonic Impeline: Project/Ch2, GEO. DCPP.TR. 12.01 _ R1_AppA.g 2012 iff Central Coastal California Seismic Imaging.	Fugro Seismic Imaging	In order to validate that UNOSES is functioning properly during QC data processing, Fugio proposes to generate, 20 Brute Stacks of two selvents lines acquired during the provious 2010/2011 survey campaign near the proposed survey area.
Secretaria Anna Secretaria Secretaria del Compositorio del Compositori del Compositorio del Compositorio del Compositorio del		PDF			Project/Ch2 GEO DCPF TR. 12.01 R1 Figure at all		
	Structural Blocks and Faults in the DCPP Area (figure 1-2)	Мар	2	Good (context for Los Osos,DCCP, and 3d/2d seismic)	Central Coastal California Securic Imaging Projectich 2.GEO. DCPP. TR. 12.01. RL. Figure. p. 08/04/2015 df	DCPP 30/20 Seismic Reflection investigation (PG&E) (Modified from PG&E, 1988)	Structural blocks are faults in the DCPP areas, also shows 2D and 3D sessenic areas.
	Figure 1-3	Graph	3	Good (Seismic paramter graph)	Central Coastal California Sesimir, Ilmesina, Projectich2, GEO, DCPP, TR. 12.01, R1, Figure, p. 07/17/2014 df	DCPP 3D/2D Seismir, Reflection investigation (PG&E)	Frequency Spectrum from 30/20 Selumic-Reflection Data Set Showing Dominant(Fundamental) Frequency of 200-225 Hz and Calculation Using 1,600-1,650 m/l, to Determine Vertical Resolution (2,000-2,06 and 1,28-1,83 m)
	Figure 2-2	Map	5	Good (context for 2d tracklines and 3d domain)	Central Coastal California Seismir, Imaging Project V.h.2.0EO.0CPP.TB.12.01_A1_Figure_0_07/17/2014 iff	DCPP 3D/2D Seismic Reflection investigation (PGBE). MBES data source: CSLMM Seafoor Mapping Lab	Trackline Map of 2D Seismic-Reflection, Lines and Boundary of 3D Survey, Area. Shows 100m spacing of seismic lines (2D) and 3D seismic area
	Figure 2-3		6	Good (Seismic aquisisiton diagram)	Central Coastal California Seismic Imaging Project/Ch2 GEO.DCPP.TR.12.01_R1_Figure.p_07/17/2014 df	DCFF 1D/20 Sessmic Reflection investigation (PG&E)	Schematic Diagram of Streamer Array Showing Navigation Positioning Accuracy During 3D/2D Seamic Reflection Survey
	Figure 2-5	seismic	8	Good (CPM)	Central Coastal California Sensol, Imaging Praiect)Ch2.GEO.DCPP.18.12.01.81 Figure p. 08/04/2015 ef	DCPP 3D/2D Seismic Reflection investigation (PG&E)	Example of "Bubble Pulse" Recorded During 3D/2D Setemic-Reflection Survey Showing "5 ms ("4 m) Thick Shallow Subsurface Section Not Resolvable due to Marking of Legitimate, Reflectors, by Pulse Width
	Figure 2-6	Chart	9	na (flow chart)	Central Coastal California Securic Imaging Project Ch2 GEO DCPP TR 12:01 R1 Figure g 67/17/2014 ef	DCFP 3D/2D Sessinic Reflection Investigation (PG&E)	Flow Chart Showing Procedures and Steps Undertaken in the Processing of the 3D Data
	Figure 3-1	Seismic	10	overprinted, noisy)	Central Coastal California Seismic Imaging Project VCh2 GEO DCPP TR 12:01 R1 Figure p 08/04/2015 df	DCPP 3D/2D Seismic Reflection investigation (PG&E)	Examples of Data Quality (interpretability) Shown in (a,b) 3D Seismic- Reflection Profile Line 12120 and on (c) Amplitude Time Since at 150 mg (TWTT). Since from 3D seismic
	Figure 4-1	Map	11		Central Coastal California Sessoric Imaging Project Ch2, GEO.DCPP.18, 12:01, 81 Figure p. 07/17/2014 of	DCPF 3D/2D Seismic Reflection investigation (PGEE) and MBES halflymetry data	ARRES Bathymetry Overlain on 3D Amplitude Time Slice at 138 ms (TWTT) Showing a Good Correlation, Between the Two Data Sets
	Figure 6-1	Seismic	1.2	overprinted, noisy)	Central Constal California Seronia, Imagine Project Ch2 GEO DCPP TR 12:01_R1_Figure # 07/29/2014 of	DCPP 3D/2D Seismic Reflection Investigation (PG&E)	Example of, a Wave-Cut Platform and Shireline Angles Shatrated in 30 Seismic-Reflection Profile 13340 and Showing Badding Artifacts. Slices from 30 seismic
	Figure 6-2	Seismic.	13	bathymetry and 3d slice)	Central Coastal California Solomic Imaging Project Sch 2 GEO DCPP JR 12 01 Rt. Figure g. 07/17/2014 of	OCPP 3D/2D Seamor Reflection investigation (PG&E). MBES bathymetric data	illustrations of Mobile Sand Sheets Shown in (a, b) 3D Seismic Reflection Profile 12120 and on (c) MRES Shaded, Relief Bathymetry Map. Silces, from 3D seismic.
	Figure 6-3	тар	34	bedrock, earthquake data, and 3d/2d seimic)	Central Coastal California Seumir, Imaging Project/Ch2 GEO DCPP TR 12:01 R1 Pigure p 07/17/2014	DCPP 3D/2D Seismic Reflection investigation (PG&E)	DEM of Bedrock Surface with Sediment Removed in the Point Buchon Study Area, Earthquake data differentiates by depth and magnitude overlain.
	Figure 6-4	Solomic	35	overprinted, noisy)	Central Coastal California Senimic Imaging Protection 2 (ECO OCPT TR 2:01 81 Figure 8 07/17/2014 If	DCPP 3D/2D Seismic Reflection investigation (PG&I). MBES birthymetric data	Vertical and Horizontal Geometry of Hosgir Fault Zone Strands in (a, b) 3D Seamic-Reflection Profile 11380 and on (c) MIRCS Bathymetry Map Within Northern Part of Survey Area
	Figure 6-5	Seame	16	Good	Central Coastal California Sciomic Imaging Triple(ISD)2.050.0XPP.18.12.01_81_Figure p: 07/29/2014 If	DCPP 3D/2D Seismic Reflection investigation (PGSE)	Amplitude Time-Slice Maps at 95 ms (TWTT) in Southern Part of 3D Study Area Showing (a) Uninterpreted and (b) Interpreted Strands of the Point Buchon Fault Zons
	Figure 6-6	Seisme	17	data)	Imtral Coastal California Selsmir, Imaging Project/Ch2 GEO DCPP TR 12:01 R1 Figure p 07/17/2014	DCPP 3D/2D Seismic Reflection Investigation (PGSE)	Fault Strands Associated with Fault Intersection of Point Buchon Fault Zotte Shows in (a) Uninterpreted and (b) Interpreted Similarity Time Slices at 74 ms (TWTT)
	Figure 6-7	Seome	18	overprinted, noisy)	entral Coastal California Serunic Imaging Palest Ch.J. GEO. DC99-TR. 12.01 Rt. Figure p. 07/17/2014	DCPP 10/20 Serumic Reflection investigation (PG&E)	Graben at Northern End of Point Buchon Fault Zone Shown on (a, b) 20 Seismic-Reflection Profile 1120 and (c) MBES Bethymetry
	Figure 6-8	Seismic .	19	Average (reflectors are overprinted, noisy)	entral Coastal California Seneric Imaging Insarctich 2 GEO. DCPP TR. 17.01 R1. Figure p. 07/17/2014	investigation (PG&E)	Structure Associated with Northern Part of Point Buchon Fault Zone Shown in (a, b) 30 Seismic-Reflection Profile I1820 and (c) Amplitude Time Slice at 150 ms [TWTT]
	Figure 6-13	Sessmic	20	Average (reflectors are overprinted, noisy)	antral Coastel California Selonic Imaging coarctSch2.0EO.0CPP.TR.12.01.R1_Figure.g: 07/17/2014 g	DCPF 3D/2D Seismic Reflection Investigation (PG&E)	Principal, Structural, Elements, in Northern Part of Study, Area Shewing Faults, and folds in In the 25 Service Reflection Profile 1999 and on Ict Amplitude, Time-Sico Mog. at 1500 ms, (TWTT)

	Figure 6-10	map	21	Good (correlation of seismicity and focal mechanisms)	Central Coastal California Sentinic Imaging Engers Sch.2 GEO. 0CPP TR. 12.01. Rt. Figure at 07/18/2014 df	DCPP 3D/2D Seismic Reflection investigation (PG&B). Earthquakes from Hardebeck, 2010, QASH, Eartebeck and Shearer, 2002), (FPFIT; Reasemberg and Opporthetmer, 1985)	Seminicity and Focal Mechanisms in the Study Area. Earthquakes overlain on fold map (differentiated by depth and mapritude). Beach balls (focal mechanisms) differentiated by magnitude.
	Figure 7-1	Seisme	22		Central Coastal California Sesmic Imaging Project/Ch2 GEO DCPP TR 12 01 RT Figure a DR/04/2014 ef	DCPP 3D/2D Seismic Reflection investigation (PG&E). Earthquake refocations from Hardebeck (2010).	Searmicity in Relation to Depth of 3D/2D Searmic Reflection and Potential Field snaging, Cross Section of the Hosgir Fault zone. Overfain with earthquakes and focal mechanisms (differentiated by magnitude)
	Feidout A	Seume	23		Central Coastal California Sessing Imaging Project/Ch-2 GEO DCPP TR 12 D1 R1 Figure p 07/17/2014 Iff	DCPP 30/20 Seismic Reflection investigation (POSt)	Comparison of Ampillude and Similarity Time Slices at 150 ms Showing Uninterpreted Data (s and b) and interpreted Maps (c and d)
	Foldout 8	Seismic	24		Central Coastal California Seismic Imagine traectiche GEO EXPTTR. 12 01 RJ. Figure a: 07/17/2014 df	DCPP 3D/2D Seismic Reflection Investigation (PGBE)	Marker Horizons Identified in (a) User Selected 3D Strike Line and (b) Mapped on Amplitude Time Size at 150 ms (TWT1)
	Foldout C	Seismic	25		Central Countel California Seriorio Imaging Project/Ch2 GEO OCPP TR.12 01_R1_Equire_p_07/29/2014 st	DCPP.3D/2D Seismic Reflection, Investigation (PGBE)	Graben Associated with Hospit Fault Zonic (a) 2D Seisens: Reflection Profile 1039 Showing Fault Boundaries and Sediment Fill and (b) Map View Showing Faults, Graben, and MBES Bathymetry
	Foldout D	Sesmic	26		Central Coastal California Seionic, Imaging, Endertich 2 GEO DCPP TR 12 01 R1 Figure 2 08/40/2014 eff Central Coastal California Seionic Imaging	DCFP 30/2D Seismic Reflection investigation (PGSE)	Relationship of the Houge! and Point Buchen Fault Zones in Northern Part of Survey Area (b) Unimitary letted and (b) Interpreted 30 Profile 11200, (c) Unimitary period and (c) Interpreted Amplitude, Time, Side at 150 ms (TWFT)
Ch2.GEO.DCPP.18.12.01_R1_Pleties		PDF			Prosect\(ch2 GEO.DCPP.TR.12.01_R1_Plates p eff Central Coastal California Seismic Imaging	According to Salari Salar	5W 12 1 1 24 1 5 7 2 5 1 5 1
	Plate 1	map	1		Project\Ch2 GEO.DCFF.TR.12.01 #1 Plates.p 07/03/2012 05	FROM 2011 Shoreline Fault Zone Report (PG&E 2011b).	Geology of Interpreted Offshore Structures. Shows units, structures, earthquaker, and seismic survey boundaries.
	/ Plate.2	map	ž		Central Coastal California Seismic Imaging Project/ICH2.0EQ.DCPF.TR.12.01_RS_Plates.p. 07/03/2012 df	Base map is hilfshade image developed from MBES harhymatry, taken from Shoreline Fault Zone Report, the PG&E (2010) coastal UDAR surrey, and the San Luis Obispo County 5, m DEM.	Structure Map Based on Low Energy 3D/20 Seismic-Reflection Data.
	Plate, 3(s and b)	mag	,		Central Coastal California Sessonic Imagine. Projection J. GRO, IXPP TR. 12.01, Pt. 1915tes.g. 07/03/2012 et	FROM 2011 Shoreline Fault Zone Report (PG&E 2011b). Base map a hillahade from PG&E (2011b) project OFM. The OFM includes Immuliibeam bathymetry data, 1, m nearhace LIDAR topography data, and 5 m inSAR data.	Comparison of Interpreted Offshore Structures. Shows earthquakes differentiate by magnitude and depth as well.
Oct. GEO. DCPP.TR. 14.02_RO_App_A_Figures		POF			Enteral Coastal California Seismic Imaging Projecti(Ch3 GEO OCPP TR 14 02 RQ App A Yances auff		
	A-I	seismic	2		Central Coastal California Seismic Imagine Project/Ch3 GEO.DCPP.TR.14.02 R0 App. A 07/27/2014 Flacers.pdf	OFFSHORE LESS STUDIES, seismic from Fugro?	Seismix Interpretation, 1980 GSI Line, 201, Offshore, Point Sel
	42	seismic	3		Central Strastal California Seismic Imaging, Projects/Chil GEO DCPP, TR. 14 02, 90, App. A. 07/27/2014 Figures pdf	OFFSHORE LESS, STUDIES, seismic from Fugns?	Seismic Interpretation, 1979 Line W-22-2024, Offshore Foint Sal
	A3	seismic	4		Central Coastal California Seisme, Imaging Project/Ora GEO DCPP TR 14 02 RG App. A 01727/2014 Figures pdf	OFFSHORE LESS STUDIES, seismac from Fugra?	Inlines 1370 and 1020 Showing Structure and Stratigraphy East and West of HFZ, Offshore Point Sal
	A-4	selsmic	5		Central Coastal California Seromic Imaging Projection3 GEO DCPP TR 14 92 NO. App. A. 07/17/2014 Faures pdf	OFFSHORE LESS STUDIES, seismic from Fugno?	651 1985 Line 5M-201 Showing Regional Structure Between HFZ and Casmaña Faults, Offshore Print Sal
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	Figure 3-2	graph	16	Central Coastal California Seismic Imaging Project\Ch6.HESS_HOSGRI Report_Figure.pdf	Aug-14	Hosgri Fault Geophysical Survey (PG&E). HASH; Hardebeck and Shearer, 2002. FPFIT; Reasenberg and Oppenheimer, 1985	Graph of Hospri seismicity depth sections a-a' and b-b'
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Figure A-7	map	79	Central Coastal California Seismic Imaging Project\Ch8.Fugro.PGEQ.PR 21 RO Figures Incl App A.pdf	2011	CCCSIP (PG&E and Fugro). 2012 Onshore Seismic Survey Report	Isovelocity Map, 10,500 ft/s
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Figure A-11	map	83	Central Coastal California Seismic Imaging Project\Ch8 Fugro PGEQ PR 21 RO Figures incl. App. A pdf	2011	CCCSIP (PG&E and Fugro). 2012, Onshore Seismic Survey Report	Isovelocity Map. 14,000 ft/s.

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	Figure A-16	тар	8.8	Central Coastal California Seismic Imaging Project\Ch8. Fugro. PGEQ-PR- 21_RO_Figures_incl_App_A.pdf	2011	CCCSIP (PG&E and Fugro). 2012 Onshore Seismic Survey Report	Isovelocity Mag, 16,500 ft/s
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	Figure A-18	map	90	Central Coastal California Seismic Imaging Project\Ch8 Eugro.PGEQ-PR- 21 RO Figures incl. App. A.pdf	2011	CCCSIP. (PG&E and Fugro). 2012 Onshore. Seismic Survey Report	Isodensity Map, 2.00 g/cm3
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	Figure A-22	map	94	Central Coastal California Seismic Imaging Project ChB, Fugro, PGEQ, PR- 21, RO, Figures, Incl. App., A pdf	2011	CCCSIP. (PG&E and Fugro). 2012 Onshore. Seismic Survey Report	isodensity Map, 2,20 g/cm3
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							Document contains a letter from a consulting geologist to Lois M. James, Senior Allegations Coordinator Office of Nuclear Reactor Regulation.
Concern Document 3		PDF		DCPP Shoreline and Thrust Fault. Allegation\Concern document 3.pdf	08/16/2011		comments for CEC IEPR Seismic Safety Workshop, Revised Seismic Hazard to DCNPP, and a list of three instances where PG&E appears to have either underestimated or failed to recognize (or acknowledge) potential seismic
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Concern Document 4		PDF (text)		DCPP Shoreline and Thrust Fault, Allegation\Concern document 4,pdf	04/29/2011	Dr. Annie Kammerer (seismic hazard and risk specialist)	Document contains report titled "Evaluation of Technical Information. Provided in Allegation NRR-201 O-A-022" This report evaluates the technical information provided in allegation NRR-2010-A-0022.
pCnrcTs8fnl		Word Doc		Diable Canyon 15551 SER\DCnrcTSBfml.doc			TECHNICAL SPECIFICATIONS BASES FOR THE DIABLO CANYON INDEPENDENT SPENT FUEL STORAGE INSTALLATION, Docket No. 72-26 Materials License No. SNM-2511
DCnrcTSfnl		Word Doc		Diablo Canyon ISFSI SER\DCnrcTSfnl.doc			Appendix: TECHNICAL SPECIFICATIONS BASES FOR THE DIABLO CANYON INDEPENDENT SPENT FUEL STORAGE INSTALLATION. Docket No. 72-26
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			NTTF DCCP PSHA Review\DCPP SSC Report			GPS strain rates from the NeoKinema Model in South-Central Coastal
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			NTTF DCCP PSHA Review\DCPP SSC Report.		DCPP SSC Report (PG&E). USGS seismic	
121693	STEEL STEEL	726	flev A.pdf		reflection data (Sliter et al 2010). Modified- Jan-15 from PG&E (2013) and Gray et al (2013)	Evidence of Central and Weastern Hosgri Fault Trace Activity
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Figure 7-8	Focal Mechanisms	205	Rex A.pdf	Non-Ap	Modified from Hardebeck 2012c	Hongri Fault Dip from first motion Polarity.
Figure 7-9	Seismic cross section	206	NTTF DCCP PSHA Review\DCPP SSC Report Rev A pdf NTTF DCCP PSHA Review\DCPP SSC Report	Mar-15	Hardebeck 2014a	Seismicity cross section oriented perpendicular to the Hosgri Fault Cross sections of the hosgri fault geometry models compared to seismic
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figure 8-15	graph	302	NTTF DCCP PSHA Review\DCPP SSC Report Rev A pdf		Feb-15 Handon et al 1994, Muhs et al 2012	Alternative correlations and Paleosea-level models used to evaluate ages of san simeon marine terraces
			NTTF DCCP, PSHA Review\DCPP, SSC Report Rev A. pdf		DCPP SSC Report (PG&E). USGS seismic reflection data (Siter et al 2010). Modified	Excerpt of profile PBS-34 showing Regional Transgressive unconformities and
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Figure 8-22	seismic	309	NTTF DCCP PSHA Review\DCPP SSC Report Rev A.pdf		DCPP SSC Report (PG&E). USGS seismic Mar-15 reflection data (Siter et al 2010).	Excerpt of profile PB5-T2 showing channels deep in stratigraphy west of the HFZ in Estero Bay
figure, 8-23	seismic	310	NTTF DCCP PSHA Review\DCPP SSC Report Rev A pdf		Feb-15 DCPP SSC Report (PG&E).	excerpt of line 1020 showing channel f west of the HFZ in the point sal study area
52.00		311	NTTF DCCP PSHA Review\DCPP SSC Report		Mar-15 DCPP SSC Report (PG&E)	mag of channels, faults, and bedrock surface on shelf, estero bay study area.
Figure 8-24	mag		Rev A.pdf NTTF DCCP PSNA Review\DCPP SSC Report			
figure 8-25	map	312	Rev A pdf NTTF DCCP PSHA Review\DCPP SSC Report		Mar-15 DCPP SSC Report (PG&E).	estero bay; piercing point DBw-Ee1-De separation and uncertainty
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Figure 8-27	seismic	314	Rev A pdf NTTF, DCCP PSHA Review\DCPP SSC Report		Mar-15 3D and 2D seismic USGS	Interpreted fence diagram showing cannot DBw west of the HFZ Exerpt of line 1368 showing channel complex f East of the HFZ in the point Sal
Figure 8-30	seismic	317	Rev A.pdf		Feb-15 2012 point sal 3d	Study area
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			NITE DCCP PSHA Review\DCPP SSC Report			Shaded relief image of the bedrock surface interpreted from 3D seismic- reflection data in San Luis Obispo Bay study area showing faults, channels,
Figure 8-35	map	322	Rev A pdf		Feb-15 PG&E 2014 chapter 4	and figure extents.
figure 8-36	seismic	323	NTTF DCCP PSHA Review\DCPP SSC Report Bex A.pdf		Mar-15 San Luis Obispo Bay 3D survery	Time Slice 119.3 ms, showign terace riser and assessment of offset across shoreline fault
figure 8-32	selsmic	324	NTTF DCCP PSHA Review\DCPP SSC Report Bev A.pdf		Feb-15 San Luis Obispo Bay 3D survery	exerpt of line PBS 279A showing Stratigraphic context of terrace sequence
Figure 8-40	seismic	327	NTTF DCCP PSHA Review\DCPP SSC Report Rev A.pdf		San Luis Obispo Bay, 30, survery. USGS 20 Mar-15 lines 2010	Smoothed similarity of bedrock surface and crossline 1276 showing channel I intersection with shoreline fault
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A TELEPHONE			NTTF DCCP PSHA Review\DCPP SSC Report			time slice at 72 ms, and crossline 1775 showing channel a intersection with
Figure 8-43	selsmic	330	Rev A pdf NTTF DCCP PSHA Review\DCPP SSC Report		Mar-15 San Luis Obispo Bay 3D survery	shoreline fault time slice 66.3 ms showing crossctting relationships between channels A B
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			NTTF DCCP PSHA Review\DCPP SSC Report		USGS 2D seismic reflection data (Sixter et al.	Except of seismic reflection profile PBS-32 and contours of bedrack surface
figure 8-50	seismic	337	Rev A pdf		Feb-15 2010	showing absence of vertical separation across and the Point Buchon Fault
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Yable 11-J	table	522	NTTF DCCP PSHA Review\DCPP SSC Report Rev A.pdf		DCPP SSC Report (PG&E)	SLPB fault equivalent Poisson individual estimates
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Table 13-5	table	569	Rex A.odf		DCPP SSC Report (PG&E).	Independent earthquakes M>2.5 in the UCERF3 catalog, 1988 through 2013 Independent earthquakes M>4 used and considered to estimatre
(table 1976)	table	1675	NTTF DCCP PSHA Review\DCPP SSC Report Rev A.pdf		DCBB SSC Beauty 400 B T	earthquakes rates in the local source zone based on the updated UCERF3
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DCPP FSAR Update

Figure 2.5-2	map	82	Shoreline and RIL\DCPP FSAR Update.pdf	Image quality is too poor to read sources	Earthquake epicenters within 200 miles of the plant site. FAULTS AND EARTHQUAKE.EPICENTERS WITHIN 75 MILES, OF PLANT, SITE (FOR EARTHQUAKES WITH ASSIGNED)
Figure 2.5-3	map	83	Shoreline and RIL\DCPP FSAR Update.pdf	Image quality is too poor to read sources	MAGNITUDES) FAULTS AND EARTHQUAKE EPICENTERS WITHIN 75 MILES OF PLANT SITE (FOR EARTHQUAKES WITH ASSIGNED
Figure 2.5-4	map	84	Shoreline and RIL\DCPP FSAR Update pdf	image quality is too poor to read sources	INTENSITIES ONLY) GEOLOGIC AND TECTONIC MAP OF SOUTHERN COAST RANGES IN THE
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Figure 2.5-6	map	87	Shoreline and RIL\DCPP FSAR Update.pdf	Image quality is too poor to read sources	Obispo county, California.
Figure 2.5-7	Cross Section	88	Shoreline and RIL\DCPP FSAR Update.pdf	image quality is too poor to read sources	Geologic Cross Section through explanatory oil wells in the San Luis Range
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Figure 2.5-9	map	90	Shoreline, and RIL\DCPP FSAR Update.pdf	image quality is too poor to read sources	geologic map of switchyard area
Figure 2.5-10	Cross Section	91	Shoreline and RIL\DCPP FSAR Update.pdf	Image quality is too poor to read sources	Geologic Cross Section through the plant site
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Figure 2.5-17	map	98	Shoreline and RIL\DCPP FSAR Update pdf	image quality is too poor to read sources	plan of excavation and backfill
Figure 2.5-19	graph	100	Shoreline and RIL\DCPP FSAR Update.pdf	Image quality is too poor to read sources	Soil module of elasticity and Poisson's ratio
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			Update Slides 1-5-2010 pdf	05-Jan-10	
			Shoreline, and RIL\DCPP Seismic Hazard	Lloyd Cluff & Norm Abrahamson (PG&E).	
Small faults in Southwest Boundary Zone	map	2	Update Slides 1-5-2010.pdf	PG&E 1988	fault map around the Los Osos fault
			Shoreline and REL\DCPP Seismic Hazard	Lloyd Cluff & Norm Abrahamson (PG&E), J	
Seismicity - October 1997 to March 2007	map	3	Update Siides 1-5-2010 pdf	Hardebeck (USGS)	map of earthquakes
Alignment of small earthquakes (M < 1 to			Shoreline and RIL\DCPP Seismic Hazard	Lloyd Cluff & Norm Abrahamson (PG&E). J	
8.5)	map	34	Update Sides 1/5-2010.pdf	Hardebeck (USGS)	map of earthquakes
				Lloyd Cluff & Norm Abrahamson (PG&E). J	
			Shoreline and RIL\DCPP Seismic Hazard	Hardebeck (USGS) and Thurber, 2009 fault	
Epicentral uncertainty	mep	7	Update Sides 1-5-2010 pdf	11/25/2009 interpretation, 2008 MBES data	map of earthquake epicenters
	was a company of the		Shoreline and RIL\DCPP Seismic Hazard	Lloyd Cluff & Norm Abrahamson (PG&E). J	
Seismicity alignment Cross Section Point, Buchon area with respect to	Seismic Cross Section	8	Update Slides 1-5-2010.pdf	Hardebeck (USGS) and Thurber	Seismicity Cross Section projecting Hardebeck and Thurber locations
Hardebecks (2009) micro seismicity			Shoreline and RIL\DCPP Seismic Hazard	Lloyd Cluff & Norm Abrahamson (PG&E). J	
lineament.	map	9	Update Slides 1-5-2010.pdf	Hardebeck (USGS)	map of earthquake epicenters differentiated by depth and magnitude.
			Shoreline and Rit\DCPP Seismic Hazard	The Assessment of the Co.	
2009 USGS Manne Survey Area.	mag	11	Update Slides 1:5-2010 pdf	2009 Lloyd Cluff & Norm Abrahamson (PG&C).	map of 2009.USGS Marine Survey Area Track line map of marine geophysical data collected in 2008 and 2009. Blue = tracks of high resolution marine seismic reflection and magnetic data were collected at 800 m spacing.
Track line map of marine geophysical data			Shoreline and RIL\DCPP Seismic, Hazard		Red = additional marine magnetics tracks for a net 400 m spacing (Watt et al.,
collected in 2008 and 2009.	map	12	Update Slides 1-5-2010 pdf	Lloyd Cluff & Norm Abrahamson IPG&EL	2009).
Onshore and Offshore Magnetic			Shoreline and RIL\DCPP Seismic Hazard		map of the Boundaries of 2009 helicopter magnetic survey flown with 150 m
Integration Survey	mag	33	Update Slides 1-5-2010.pdf	Lloyd Cluff & Norm Abrahamson (PG&E).	line spacing at a nominal altitude of 100 m.
MultibeamEcho-Sounding (MBES)			Shoreline and RIL\DCPP Seismic Hazard		map of topography/bathymetry, Shaded area offshore
Coverage Offshore Area	map	14	Update Slides 1-5-2010 pdf	Lloyd Cluff & Norm Abrahamson (PG&E). collected as part of	of Pt. Buchon collected in 2007 Red track lines = areas collected in 2009
				CA State Waters Mapping Program	
			Shoreline and RIL\DCPP Seismic Hazard	byCSU Monterey Bay	
Pt. Buchon Multibeam Bathymotry Schematic diagram of shoreline features	map	15	Update Slides 1-5-2010.pdf	Seaffoor Mapping Lab 2006-2007	geologic map of Point Buchon area
used in tectonics studies	44	17	Shoreline and RIL\DCPP Seismic Hazard	Lloyd Cluff & Norm Abrahamson (PG&E).	SEC. 101 C. M. M. St. Coll. M. COMM.
used in tectonics studies	diagram	12	Update Slides 1-5-2010.pdf	Lloyd Cluff & Norm Abrahamson (PG&E).	diagram of manne deposits, terrace surface, and wavecut platforms.
			Shoreline and RIL\DCPP Seismic, Hazard	Lloyd Cluff & Norm Abrahamson (PG&E).	color coded map of paleoshorelines around DCPP
a succession of the second sec	5555		Update Slides 1-5-2010.pdf	LIOVE CIUTT & Norm Abrahamson (PG&E).	color, coded map of paleosnorelines, around DCPY
Paleoshorelinesin Point Buchonarea	map	18	Character and COLOROR Coloror House		
	(1/25/7)	77	Shoreline and RIL\DCPP Seismic Hazard	Charles Market Street Market Street	
Paleoshprelinesin Point Buchonarea Profile Delta across N80W Fault Zone	map Cross Section	18	Shoreline and Rit\DCPP Seismic Hazard Update Slides 1-5-2010 pdf	Lloyd Cluff & Norm Abrahamson (PG&E).	profile from southeast to northwest
Profile Delta across N40W Fault Zone	Cross Section	23	Shoreline and RIL\DCPP Seismic Hazard Update Slides 1-5-2010 pitf Shoreline and RIL\DCPP Seismic Hazard		PaleoWave-Cut Platform Tectonic Strain-Gauge
	Cross Section	77	Shoreline and RIL\DCPP Seismic Hazard Update Sides 1-5-2010.pdf Shoreline and RIL\DCPP Seismic Hazard Update Sides 1-5-2010.pdf	Lloyd Cluff & Norm Abrahamson (PG&E). Lloyd Cluff & Norm Abrahamson (PG&E).	
Profile Delta across N80W Fault Zone Seismic line PBS-32 across the N40W Fault	Cross Section	28 24	Shoreline and RIL\DCPP Seismic Hazard Update Sildes 1-5-2010.pdf Shoreline and RIL\DCPP Seismic Hazard Update Sildes 1-5-2010.pdf Shoreline and RIL\DCPP Seismic Hazard.	Lloyd Cluff & Norm Abrahamson (PG&E).	PaleoWave-Cut Platform Tectonic Strain-Gauge Evidence of No Faulting in Past 50 to 60,000 Years
Profile Delta across NADW Fault Zonii Seismic line PBS-32 across the NAOW Fault Hosgri Fault	Cross Section	23	Shoreline and BIL\DCPP Selsonic Hazard Update Sides 1-5-2010.pdf Shoreline and BIL\DCPP Selsonic Hazard Update Sides 1-5-2010.pdf Shoreline and BIL\DCPP Selsonic Hazard Update Sides 1-5-2010.pdf		PaleoWave-Cut Platform Tectonic Strain-Gauge
Profile Delta across N80W Fault Zone Seismic line PBS-32 across the N40W Fault	Cross Section	23 24 25	Shoreline and BILLDCPP Selsome Hazard, Undate Billeds 1-5-2010, and Shoreline and BILLDCPP Selsomic Hazard, Update Sindes 1-5-2010, pdf Shoreline and BILLDCPP Selsomic Hazard, Update Sindes 1-5-2010, pdf Shoreline and BILLDCPP Selsomic Hazard, Shoreline and BILLDCPP Selsomic Hazard.	Lloyd Cluff & Norm Abrahamson (PG&E). Lloyd Cluff & Norm Abrahamson (PG&E).	PaleoWive-Cut Platform Tectonic Strain-Gauge Evidence of No Faulting in Past 50 to 60,000. Years screen shot of seismic along the Hospri Fault
Profile Delta across N80W Fault Zone Seismic line PBS-32 across the N40W Fault Hosgri Fault Raw Multibeam data without	Cross Section s seismic seismic	28 24	Shoreline and BiLLOPP Selsmic Hazard, Update Bides 1-5-2010 ptdl Shoreline and BiLLOPP Selsmic Hazard, Update Bides 1-5-2010 ptdl Shoreline and BILLOPP Selsmic Hazard, Update Bides 1-5-2010 ptdl Shoreline and BILLOPP Seismic Hazard, Update Bides 1-5-2010 ptdl Update Sides 5-3-2010 ptdl.	Lloyd Cluff & Norm Abrahamson (PG&E). Lloyd Cluff & Norm Abrahamson (PG&E). Lloyd Cluff & Norm Abrahamson (PG&E).	PaleoWave-Cut Platform Tectonic Strain-Gauge Evidence of No Faulting in Past 50 to 60,000 Years
Profile Delta across N80W Fault Zone Seismic line PBS-32 across the N40W Fault Hosgri Fault Raw Multibeam data without	Cross Section s seismic seismic	23 24 25	Shoreline and BILLDCPP Selsome Hazard, Undate Billeds 1-5-2010, and Shoreline and BILLDCPP Selsomic Hazard, Update Sindes 1-5-2010, pdf Shoreline and BILLDCPP Selsomic Hazard, Update Sindes 1-5-2010, pdf Shoreline and BILLDCPP Selsomic Hazard, Shoreline and BILLDCPP Selsomic Hazard.	Lloyd Cluff & Norm Abrahamson (PG&E). Lloyd Cluff & Norm Abrahamson (PG&E).	PaleoWive-Cut Platform Tectonic Strain-Gauge Evidence of No Faulting in Past 50 to 60,000. Years screen shot of seismic along the Hospri Fault

NTTF DCCP PSHA Review\Appendix C HID.
Attachments\Attachment_C11_Vitinity\SourceZone_InputFile\DCCP_Vitini
ty\Grid_InputFile_2014-11-04.slsx Excel Doc

These are the Vicinity gridded areal source zone coordinates and rates

DCPP Seismic Hazard Update Slides 1-5-2010

DC_tsunami_memo_13Dec02	Word Doc	District Conysto (SFS), SERVICE, Interests, Interest, 1 NOve 02 dos	12/17/2062		TSUNAME HAZARD AND DESIGN BASES; SPECIFIC ISSUES FOR THE DIABLO CANYON SITE AND IMPUCIT GENERIC ISSUES FOR EXISTING COASTAL NUCLEAR FACULTIES
Diabibo 7	Graph/IPEG	Figures'(Disbible 7. jpg			Spectral Acceleration (g) over Frequency
Exable 2	Map/IFEG	Figures/Dishlot.ipg			Map of the study area with the major faults mapped.
Diablo 2	Graph/IPEG	Flanarenh Disableu, Z. Java			Spectral Acceleration (g) over Frequency. Comparison of DE, DDE, Hosgri, and LTSP Ground Motion Spectra
Diablo 3	Map/IPEG	Figures\Diable 8 ppg		HASH: Handebeck and Shearer, 2002.	Map of focal mechanisms along the Hosgri Fault
Daible 7	Graph//PEG	Figures\Dashlo 7.pg		FPFiT: Reasenberg and Oppenheimer, 1985	PGA. Annual Hazard over Spectral Acceleration (g)
Diablo_Calcs	Excel Doc	Diable Canyon (SFS) SER\Diable Calcaxis			Contains calculation number, volume and title
Diable Canyon-linal	PDF	Fasures\Disable Carryon-final pdf			(Information Extracted from Reports in ADAMS, Summary of the site,
Diablo Canyon Resources-1	Excel Doc	Figures\Diablo Canyon Resources-1 xls			geology, hydrology, seismic hazards, ecology, etc.
Diablo Shoreline	PowerPoint				List or resources and appendices 4 slide PowerPoint about a "capable fault". Includes images from CCCSIP
TOTAL AND MAINTAIN		Famres\Diable Shoreline.ppts			report cites elsewhere in the document satalogue
Cliable USGS EQ data	Text Document or . Excel Doc	Discretine and RS\Diable MSGS EQ data be		USGS	USGS earthquake data
Evaluation of Technical Information Provided in DCPP Senic Allegation	Word Disc	DCPP Shoreline and Thruss Fault Milestronid relivation of Technical Information Provided in DCPP Series Afregation doze	62/10/2012		This report summariess technical evaluation of information provided in allegation NRB-2010-A-0022, including the retent information provided by the Cooleane's individual (IOI) in their January 14, 2012 response to NRC Request for Information
Fig 4-17 ANNOT Part A Lores	Map	Shareline and MILYFig 4-17 ANNOT Fart A		Shoreline Fault zone study	Earthquake Epicenters with residual manne and coastal helicopter magnetic
The transport of the property	100	Loller and			field data
Fig. 4-12 ANNOT Part B Figure 2, CL, Report	Map Map	Shoreline and Mil/Fig. 4.17 ANNOT Part 6 pig Shoreline and Mil/Figure 2. Cl. Report pg.		Shoretine Fault zone study	Earthquake, Epicenters with residual marine and coastal helicopter magnetic field data. Map of earthquake epicenters and a Cross Section of earthquakes across the
		Schooling and servicence 5 of Hebrer 158			shoreline fault and san andreas fault
Figure 3 Figure 1_C1_Report	Мар	Shoreline and #U\Figure 3.pg			Map showing the proposed 10 km-long extension of the south segment of the Shoreline fault. Map of earthquake epicenters and a Cross Section of earthquakes across the
Jaffaraz Ci_Kabort	Map	Shoreline and Att\Figure1_Cl_Report.pg			shoreline fault and san andreas fault
Figure3-1b	Map	Shoreline and MIL\Figure 3-1b ang			Earthquake Epicenters with residual marine and coastal helicopiter magnetic field data
Figure 3.2	Worll Dor	Shoreline and 86 \Figure 8.2 docs			Map showing the proposed 10 km-long extension of the south segment of the Shoreline fault
Hardebeck's data for John 9 Feb 2012	Map	Storeline and All/Hamilebeck's data for John 9.5 eb.2012, July Shoneline and All/Hamilebecks Hypocenters			Map of earthquake epicenters and a Cross Section of earthquakes across the shoreline fault and san andreas fault.
Hardebecks, Hypocenters Cross Section	Map	Cross Section by			Map of earthquake epicenters and a Cross Section of earthquakes
Houger	map/IPSG	Elektrica Monters Long			Map of the Hosgri fault
Hongri bath DEM	map/illustrator Map/iPEG	Estuaries \Horsers.at			Map of the Hospri fault
IPRP Report no 6	POF	Equipment that DEM and Equipment the Equipment on Equipme	08/12/2013	CALIFORNIA GEOLOGICAL SURVEY, CALIFORNIA COASTAL COMMISSION CALIFORNIA GOVERNOR'S OFFICE OF EMARGIANCY SERVICES CALIFORNIA PUBLIC LITLITIES COMMISSION, CALIFORNIA ENERGY	Map of the Hospri fault and bathymetry Site shear wave velocity at Diablo Canyon: summary of available data and comments on analysis by POBE for Diablo Canyon Power Flant serans, hazard.
				COMMISSION CALIFORNIA SEISMIC SAFETY	mattes
1 manus		NTTE DCCP PSHA Reven/Appendix C HID.		COMMISSION, COUNTY OF SAN LUIS OBISPO	
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Plate 8-18		map		Shoreline and RIC\Plate B-18 pdf			Central section geologic map Point Buchon to Double Rock
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Plate i-2b		map		Shoreline and RIL\Pfate i-2a.pdf			Map showing submerged strandlines, wave-cut platforms, and geology
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							Longitudinal profile along coastline showing correlation of submerged
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						WF Hanna, SH Burch, TW Dibblee Jr.	Gravity, Magnetics, and Geology of the San Andreas Fault Area near Cholame,
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							Figure la compares the epicenters from Hardebeck's tomographic inversion to epicenters derived from a tomographic inversion using a decimated.
							version of Hardebeck's model as a starting model with all of the available
		Map and Cross		Shoreline and RIL\Report on Analysis of		Report on Analysis of Shoreline Fault Zone.	data. Figure lb shows a
	Figure 3	Section	5	Shoreline Fault Zone Appendices C&D.pdf		Hardebeck	depth section for the target events.

					Figure 2a compares the epicenters from Hardebeck's tomographic inversion. [red stars] to epicenters derived from a tomographic inversion using an initial
	Map and Cross		Shoreline and RIL\Report on Analysis of	Report on Analysis of Shoreline Fault Zone.	model extracted from the statewide 3D Vp model of Lin et al. (2009). Figure
Figure 2	Section	7	Shareline Fault Zone Appendices C&D.pdf	Lin et al. (2009) and Hardebeck	2b shows a depth section for the target events from their Figure 2a locations. Figure 3a compares the epicenters from Hardebeck's tomographic inversion
					(red stars) to epicenters derived from a tomographic inversion using an initial
	Map and Cross		Shoreline and Rit \Report on Analysis of	Report on Analysis of Shoreline Fault Zone.	3D Vp model from Thurber et al. (2006) for the greater Parkfield region. Figure 3b shows a depth section for the target events from their Figure 3a
Figure 3	Section Cross	8	Shoreline Fault Zone, Appendices, C&O, pdf	Hardebeck	locations.
					Figure 4a compares the epicenters from Hardebeck's tomographic inversion
					(red stars) to epicenters derived from a tomographic inversion using the same input model but excluding the waveform cross-correlation data. Figure 4b
	Map and Cross		Shoreline and RIL\Report on Analysis of	Report on Analysis of Shoreline Fault Zone.	shows a depth section for
Figure 4	Section	10	Shoreline Fault Zone Appendices C&D.pdf	Hardebeck	the target events from their Figure 4a locations. Figure Sa, compares, the epicenters from Hardebeck's tomographic inversion
					(red stars) to epicenters derived from a tomographic inversion using the same
	Map and Cross		Shoreline and RIL\Report on Analysis of	Report on Analysis of Shoreline Fault Zone.	input model but excluding the S-wave data. Figure 4b shows a depth section
Figure 5	Section	11	Shoreline Fault Zone Appendices, C&D. pdf	Hardebeck	events from their Figure 4a locations.
	12007507.		ACCUSANCE CONTRACTOR AND CONTRACTOR CONTRACT		Figure 1. (a) Map view and (b) cross-section of replicated locations from
Figure 1	Map and Cross Section	24	Shoreline and REL\Report on Analysis of Shoreline Fault Zone Appendices C&D.pdf	Report on Analysis of Shoreline Fault Zone. Hardebeck	Hardebeck's tomographic inversion. The box in (a) indicates the earthquakes plotted in (b).
Checker					Map showing the distribution of all the earthquakes (colored circles),
					explosions (red stars), seismic stations (black triangles) and model grid nodes (colored diamonds) included for
			Shoreline and RIL\Report on Analysis of		the DD tomography inversions for Sub region 3 of Lin et al. (2009), from
Figure 2a	map	25	Shoreline Fault Zone Appendices C&D.pdf	.Un et al. (2009)	which the initial velocity model used here was extracted. Map showing the distribution of seamic stations (red triangles) and model
			Shoreline and RIL\Report on Analysis of	Report on Analysis of Shoreline Fault Zone.	grid nodes (black dots) for my, tomoDD inversions, modified from the work of
Figure 2b	map	26	Shoreline Fault Zone Appendices C&D.pdf	Un et al. (2009)	Lin et al. (2009)
					(a) Map view, and (b) cross-section (center point at 35.2, 10, _120.86', azimuth 1290 CW from North, half-width 1 km) of locations from a tomoDD inversion
					using P.and S.waves,
Figure 3	Map and Cross Section	27	Shoreline and RIL\Report on Analysis, of Shoreline Fault Zone Appendices, C&D.pdf	Report on Analysis of Shoreline Fault Zone. Lin et al. (2009)	the modified initial model from Lin et al. (2009), and cross-correlation data from my reanalysis of PG&E data.
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	Map and Cross		Shoreline and RIL\Report on Analysis of	Report on Analysis of Shoreline Fault Zone.	azimuth 129° CW from North, half-width 1 km) of locations from a tomoDD inversion using the modified initial model from Lin et al. (2009), cross-
Figure 4	Section	28	Shoreline Fault Zone Appendices, C&D.pdf	Lin et al. (2009)	correlation data from my reanalysis of PG&E data, and P,waves only.
					(a) Map view and (b) cross-section (center point at 35.2 10, _120.86o, azimuth
					1290 CW, from North, half-width 1 km), of locations from a tomoDD inversion, using P and S waves, the modified initial model from Lin et al. (2009), and
	Map and Cross		Shoreline and Rit\Report on Analysis of	Report on Analysis of Shoreline Fault Zone.	cross correlation data from my reanalysis of PG&E data plus Hardebeck's
Figure 5	Section	29	Shoreline Fault Zone Appendices C&D.pdf	Lin et al. (2009) and Hardebeck	cross-correlation data for NCSN and SCSN stations. Map view and (b) cross-section (center point at 35,210, 120,860, azimuth
					129° CW from North, half-width I km) of locations from a tomoDD inversion
Figure 6	Map and Cross Section	30	Shoreline and RIL\Report on Analysis of Shoreline Fault Zone Appendices C&D.pdf	Report on Analysis of Shoreline Fault Zone. Hardebeck	using P and S waves, F the 4-km grid decimated Hardebeck model, and cross- correlation data from my reanalysis of PG&E data.
rigure o	section	39	Shoreline Fault Zone Appendices Calo, por	Hardebeck	(a) Map view and (b) cross-section (center point at 35.21', -120.86', apimuth
					1290 CW from North, half-width 1 km) of locations from a tomoDD inversion
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Figure 7	Section	31	Shoreline Fault Zone Appendices C&D.pdf	Hardebeck	PG&E data.
			Shoreline and RIL\Report on Analysis of	Report on Analysis of Shoreline Fault Zone.	Comparison of the epicenters from Hardebeck's tomographic inversion (red
Figure Sa	Мар	32	Shoreline Fault Zone Appendices C&D.pdf	Hardebeck.	to the epicenters shown in Figure 3
Figure 8b	W2227	33	Shoreline and RIL\Report on Analysis of Shoreline Fault Zone Appendices C&D.pdf	Report on Analysis of Shoreline Fault Zone. Hardebeck	Comparison of the epicenters from Hardebeck's tomographic inversion (red stars) to the epicenters shown in Figure 7
rigure on	Мар	33	Shoreline Fault zone Appendices C&U.por	Hardebeck	Study, area in Central California. Epicenters color-coded by depth. Coastline
5353000		22.5	Shareline and RIL\Report on Analysis of	Report on Analysis of Shoreline Fault Zone.	and mapped surface traces of faults are shown. Polygon includes events
Figure 1	map	39	Shoreline Fault Zone Appendices C&D, pdf	Hardebeck and USGS	analyzed in this study. Histograms of differences between P-wave cross-correlation delay-times
					obtained by Jeanne Hardebeck, and corresponding delay-times formed from
Figure 2	graph	41	Shoreline and RIL\Report on Analysis of Shoreline Fault Zone Appendices C&D.pdf	Report on Analysis of Shoreline Fault Zone. Hardebeck	the phase picks.
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				(2001) model; USGS CST: model used by	
			Shoreline and RIL\Report on Analysis of	the NCSN for routine location purposes for the Central Coast (CST) region	
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Rev 11 of DCCP SAR, DCPP FSAR 2010				Shoreline and RIL\Rev 11 of DCCP SAR.pdf	2010	history*
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response to diablo campon senior resident inspector concerns regarding shoreline fault research information letter res2 - includes additional comment from John Stamatakos

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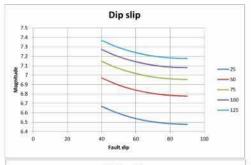
yon senior resident inspector concerns regarding shoreline tion letter rev2 - includes additional comment from John		Word Doc		DCPP Shoreline and Thrust Fault Allegation/response, to diable camen service resident inspector concerns regarding shoreline fault research information letter rev2 - includes additional comment from John Stamatakos.docx	07/25/2012	Michael T, Markley, Chief Plant Licensing Branch W Division of Operating Reactor Licensing Office of Nuclear Reactor Regulation	A memo to Teel F. O'Reefe which document the resolution of concerns from the Diablo Canyon Senior Resident Inspector (\$MI) regarding the Diablo Caryon Research Information Certer (RIL) associated with the Shoreline fault.
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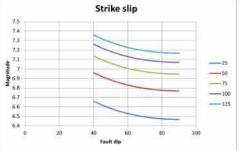
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Figure 5-19	graph	85	Shoreline and RIL\RIL 12-01 as published docx	Research Information Letter 12-01	Contribution to seismic hazard by seismic source for 5 Hz (Figure 6-20 (b) of the PG&E Shoreline Fault Report).
Figure 5: 20	graph	84	Shoreline and RIL\RIL 12-01 as published dock	Research Information Letter 12-01	the Pusas andreine Fault Report). Contribution to seismic hazard by seismic source for 1 Hz (Figure 6-20 (c) of the PG&E Shoreline Fault Report). The DCPP shear-wave velocity profile is shown as an inset on the generic.
Figure 811	Velocity profile	8-6	Shoreline and Rtt\Rtt. 12-01 as published duck	Research Information Letter 12-01	central California shear-wave velocity model (upper panel). Illustration of upper crustal amplification function (A(f) = (Zsource,Zavg(R))0.5) for the Diablo Canyon site, Bower panel) computed from profile in upper panel.
Figure 8-2	graph	B-7	Shoreline and RIL\RIL 12-01 as published docx	Research information Letter 12-01	Fit to the acceleration Fourier amplitude spectrum of the 2003 Door Canyon event recorded at the DCPP. Linear best fit kappa value of 0.03 s. Fits to the acceleration Fourier amplitude spectra of the 2003 San Simeon
Figure 8-1	graph	B-8	Shoreline and RIL\RIL 12-01 as published dock	Research Information Letter 12-01	(top) and 2004 Parkfield (bottom) earthquakes recorded at the DCPP. Linear best fit kappa value of 0.056 and 0.042 s, respectively.
Figure 8-4	graph	8-9	Shoreline and Rt\Rit 12-01 as published doox	Research Information Letter 12-01	fliustration of tradeoff between stress drop and kappa for M 6.5 2003 San Simeon earthquake recorded at DCPP Kappa value of 0.04,5 and stress drop of 170 bars produce best fitting (root mean square error) spectral estimates.
Figure 8-5	graph	B-10	Shareline and RIL\RIL 12-01 as published dock	Research Information Letter 12-01	Best fitting response spectral results for the Deer Canyon (top) and San Simeon (bottom) earthquakes in red, compared to observed recordings from DCPP in black. Shear-wave velocity profiles used in the time history based approach to
Figure 8 - 6	graph	B-11	Shoreline and RIL\RIL 12-01 as published dock	Research Information Letter 12-01	developing DCPP-specific amplification functions. The red line indicates the DCPP shear-wave velocity profile used and the blue line the generic 760 m/s profile of Silva (2008). The profiles are identical below 80 m (262.ft). Subset of 27 of the 55 time histories used in the time series based response.
Figure 8-7	graph	6-12	Shoreline and Rit\Rit 12-01 as published dock	Research Information Letter 12-01	analysis. Events are from the Northridge, imperal Valley, San Fernandon. Gazil, and Frisin earthquakes. The geometric mean of the records is indicated by the heavy black line. Comparison of correction factors developed by NRC staff to those applied by PRS&E black shaped line. The heavy black line is the arithmetic mean of the
	graph		Shoreline and RIL\RIL 12-01 as published docx	Research Information Letter 12-01	correction factors developed by the NRC using the time-series (TS) method (shown in blue) and the RVT method (shown in red and green). The average of those three curves (solid black curve) was used by the NRC staff in the
Figure 8 - 8		B-13			deterministic evaluation A graphical display of the magnitude frequency distribution for the Shoreline
Figure C-3	graph	C-17	Shoreline and RIL\RIL 12-01 as published dock	Research information Letter 12-01	fault based on the characteristic earthquake model of Youngs and Coppersmith (1985) for the magnitude range 0 s m s 6.5. The 97.7% probability large of the shaded regionil that surface rupture occurs.
Figure C-4	graph	C-17	Shoreline and RIL\RIL12-01 as published docx	Research Information Letter 12-01	during a magnitude 6.8 event on the central and southern segments of the Shoreline fault. Probability of surface rupture obtained from the empirical data (Wells and
Figure C-5	graph	C-18	Shoreline and RII\RII 12-01 as published dock	Research Information Letter 12:01	Coppersmith, 1993 (blue curve) and for the Shoreline fault developed by PG&E (rad curve).
	graph		Shoreline and RIL\RIL 12-01 as published dock	Research Information Letter 12-01	Figure 4 of Petersen et al. (2004) showing the frequency of secondary surface
Figure C+6	7920	C-18	SID IN COMPANY AND ADDRESS OF THE STATE OF T		rupture within a 50250 m2 footprint as a function of distance from the principal trace, shown with an overlay of the PGBE and NRC assumptions.
Figure C-7	graph	C-19	Shoreline and REL\RII. 12-01 as published dock	Research Information Letter 12-01	A plot of secondary rupture probability as a function of distance from the principal fault trace within a 50250 m2 cell.
Figure C-II.	Diagram	C-20	Shoreline and RIL\RIL 12-01 as published docx	Research Information Letter 12-01	General schematic diagram illustrating the final calculation in the determination of conditional probability for secondary rupture.
Figure C-9	map	C-21	Shoreline and RIL\RIL 12-01 as published docx	Research Information Letter 12:01	Distance of Shoreline fault from intake structure and power block.
- v=coxi5050	207E 1	20,772/4			

		graph	w.#2)	Shoreline and RIL\RIL 12-01 as published doc	×	Research Information Letter 12-01	Histogram provided it Figure 6 in Petersen et al. (2004) showing the distribution of the ratio of the secondary rupture to the maximum displacement on the principal trace overlain with curve used by PG&E (in
	Figure C-10		C-22				blue) and NRC (in red), from Petersen et al. (2011).
	Figure C-11	graph	C-22	Shoreline and RIL\RIL 12-01 as published door	×	Research Information Letter 12-01	An example of the loghormal distribution for secondary rupture associated with a magnitude 6.25 strike-slip earthquake (shown here in red).
	Figure C-12	graph	C-23	Shoreline and RIL\RIL 12-01 as gublished doci	K	Research Information Letter 12-01	Graphical representation of Equation C-20. Plots of the distribution of the ratio of secondary rupture to the average.
	Figure C-13	graph	C-23	Shoreline and RIL\Rit 12-01 as published docs	X.5	Research Information Letter 12-01	displacement on the principal trace at 300 meters and 600 meters from the principal fault trace (Petersen et al., 2011). Diagram illustrating the relative plate motions and the relative motions of
	Figure D-1	map	D-4	Shoreline and RIL\RIL12-01 as published doc	K.	Research Information Letter 12-01	major fault systems (base figure from Unruh presentation at the DCPP SSHAC WS#1, annotated for this report)
Santa_Lucia_Bank		Excel Doc		NTTF DCCP PSMA Review\Appendia C HID Attachments\Attachment_C-08_Non- UCERF3 Faults_InputFiles\Santa_Lucia_Bank xisx			Fault input file
Shelf topo map		map/TIFF		Figures\Shelf topo mao tif			Map of the Hoseri fault and bathymetry
slip budget		Map/IPEG		Figures\slip budget.ipg			Map of local faults with slip rate of the Pacific plate
Slope section		Diagram/ Illustrator		Figures\Slope section.ai			Slope Cross Section
Slope_section		Diagram/JPEG		Figures\Slope_section.jpg			Slope Cross Section
wope_section		Diagramysrco		Lifeti estatobe section (198			Supe cross section
						Presented by: John Stamatakos	
						NRC Technical Project Manager: Joe	
				Figures\Stamatakos Diablo Canyon Seismic	November 27,	Sebroski	
Stamatakos Diablo Canyon Seismic 2012		PowerPoint		2012.pptx	2012	NRC Project Officer; Linda Yee/April	DIABLO CANYON POWER PLANT. SEISMIC HAZARD REVIEW
				2012.000		Bucher	
						CNWRA Manager Todd Mintz	
						Carran manager 1000 minte	
Summary of Information to Close out Allegation NRR-10-22 V2		Word Doc		DCPP Shoreline and Thrust Fault. Allogation/Summary of Information to Close out Allogation NRR-10-22 V2 docs	03/07/2012	Annie Kammerer and John Stamatakos	This document provides a description and summary of information, assessments and findings related to the linestigation and closing of NRR-2010-A 0022. This report follows an earlier RES report entitlest, "Investigation and Recommended Findings of Allegation NRR-2010-A-0022" that was provided by NRR in June 2011.
	Figure 1	Мар		DCPP Shoreline and Thrust Fault. Allegation\Summary of Information to Close out Allegation NRR-10-22-V2 dock	2011	PG&E's Shoreline Fault Report	NCEDC earthquakes 1987 through 2011 piotted on a UTM grid. Inset map is the geologic map. The Cross Section plot above shows the hypocentiers located from the Line of Cross Section up to the northwest (also shown in red).
	Figure 2	Мар		DCPP Shoreline and Thrust Fault Allegation (Summary of Information to Close out Allegation NRR-10-22 V2 docx	2011	PG&E's Shoreline Fault Report	Earthquake data from Hardebeck (2010) plotted on a UTM grid. Inset map on the plant view plot is the geologic map developed by PG&E as part of PG&E's Shoreline Fault Report (PG&E, 2011).
Table 1 SFZ_Hard, Th, 1D_3D comparison		Excel Doc		Shoreline and REL\Table 1 SEZ Hard Th 1D 3D companion als		Hardebeck and Thurber	Earthquake data that includes Epicentral and depth differences between 1D and 3D
West_Basin_SW_Channel		Excel Doc		NTTF DCCP PSNA Review/Appendix C HID Attachments\Attachment C 58 Non- UCRF3 Faults InputFiles\West_Basin_SW (bannel_siss	<u>c</u>		Fault input file

Histogram provided in Figure 6 in Petersen et al. (2004) showing the distribution of the ratio of the secondary rupture to the maximum

ons from Leonard, M., 2010. E Strike slip					Dip slip				
Max Fault Length (km)	Min Fault Dip	Thickness of seismogenic crust		Magnitude	Max Fault Length (km)	Min Fault Dip	Thickness of seismogenic crust		Magnitude
25	90		12	6.4671213	2	9)	12	6.477121
25		ĝ	12	6.4737698	2	8)	12	6.483769
25		ľ.	12	6.4941354	2	j 70)	12	6.504135
25			12		2:				6.539590
25	50	B	12	6.5828673	2	5)	12	6.592867
25	40	Ř.	12	6.6590538	2:	4)	12	6.669053
SO	90	e C	12	6.7681513	5)	12	6.77815
50	80	Ŕ	12	6.7747998	54	8)	12	6.784799
50	70	Ď.	12	6.7951654	Si	7)	12	6.805165
50			12	6.8306206	51			12	6.840620
50			12	6.8838973	5			12	6.893897
50	40	(i	12	6.9600838	50) 4)	12	6.970083
75	90	Ĝ	12	6.9442425	7	9)	12	6.954242
75	80	Č.	12	6.9508911	7:	8)	12	6.96089
75	70		12	6.9712567	7:	7)	12	6.981256
75		(12	7.0067119	7				7.016711
75		6	12	7.0599885	7:			12	7.069988
75	40	Ç.	12	7.136175	7	4)	12	7.146179
100	90		12	7.0691812	10			12	7.079181
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100	50	Č.	12	7.1849273	10			12	7.194927
100	40	ii H	12	7.2611137	10	1 4)	12	7.271113
125	90		12	7.1660913	12	9)	12	7.176091
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125	70	Ġ.	12	7.1931054	12	7)	12	7.203109
125	60	6	12	7.2285606	12	6)	12	7.238560
125	50	Ē.	12	7,2818373	12	5)	12	7.291833
125	40	Ö	12	7.3580238	12	4	1	12	7.368023





John Stamatakos

From:John Stamatakos

Sent:27 Mar 2015 16:18:39 +0000

To:'Stieve, Alice'
Cc:Marla Morales
Subject:RE: Palo Verde
That would be great.

Marla ... can you run by and pick up this CD for me? Its 7th floor of Two White Flint.

Thanks,

John

From: Stieve, Alice [mailto:Alice.Stieve@nrc.gov]

Sent: Friday, March 27, 2015 12:12 PM

To: John Stamatakos Subject: RE: Palo Verde

It is a huge. Several files. Perhaps Jane can make a copy and mail to you.

From: John Stamatakos [mailto:jstam@swri.org]

Sent: Friday, March 27, 2015 12:01 PM

To: Stieve, Alice

Subject: RE: Palo Verde

If I could get a copy that would be great.

I am unfortunately off to San Antonio next week to work with my guys on Diablo so I am not sure how I would get it?

John

From: Stieve, Alice [mailto:Alice.Stieve@nrc.gov]

Sent: Friday, March 27, 2015 11:58 AM

To: John Stamatakos Subject: FW: Palo Verde

John

Sorry I forgot you.

From: Stieve, Alice

Sent: Thursday, March 26, 2015 3:58 PM

To: Munson, Clifford; Devlin-Gill, Stephanie; Heeszel, David; Ake, Jon; Graizer, Vladimir; Li, Yong; Hill,

Brittain

Cc: Spence, Jane Subject: Palo Verde We have 2 CDs (duplicates) for the Palo Verde SSHAC material. I made a copy and will pass CD1 to Jane Spence. Stephanie has made a copy and will pass onto to David and then to Cliff.

John Stamatakos

From:John Stamatakos

Sent:20 Apr 2015 15:56:42 +0000

To: 'Stieve, Alice'; Devlin-Gill, Stephanie; Heeszel, David

Cc:Graizer, Vladimir;Munson, Clifford;Ake, Jon Subject:RE: Palo Verde public meeting in mid-June?

I can

John

----Original Message----

From: Stieve, Alice [mailto:Alice.Stieve@nrc.gov]

Sent: Monday, April 20, 2015 11:17 AM To: Devlin-Gill, Stephanie; Heeszel, David

Cc: Graizer, Vladimir; Munson, Clifford; Ake, Jon; John Stamatakos

Subject: Palo Verde public meeting in mid-June?

Can the Palo Verde team support a APS public meeting in mid-June?

I have no vacation plans yet so I guess I am open in June. What about the rest of you? Of course Vlad is in CA for the week. Maybe he will check his email.

----Original Message----From: Devlin-Gill, Stephanie

Sent: Monday, April 20, 2015 11:10 AM

To: Stieve, Alice; Heeszel, David

Subject: FW: Inquiry: Palo Verde Public Meetings Dates

From: DiFrancesco, Nicholas

Sent: Monday, April 20, 2015 10:24 AM

To: Munson, Clifford

Cc: Jackson, Diane; Ake, Jon; Devlin-Gill, Stephanie; Vega, Frankie

Subject: Inquiry: Palo Verde Public Meetings Dates

Cliff, et. al.

Any preferences or limitations for planning the Palo Verde public meeting in mid-June.

Thanks, Nick

From: DiFrancesco, Nicholas

Sent: Thursday, April 16, 2015 10:07 AM

To: Munson, Clifford

Cc: Ake, Jon; Jackson, Diane; Vega, Frankie; Hill, Brittain; Shams, Mohamed

Subject: Planning Items - DC Focus Areas and PV Meetings Dates

Cliff,

I am out PM today and Friday.

PG&E Licensing Coordination and NRC Public Meeting Prep Frankie is PM backup and has a licensing call with PG&E Friday at 1pm to discuss NRC technical focus areas as part of the April 28 public meeting. For Friday I would like to communicate a few topics for them to begin work on. Perhaps the 1. ergodic method vs. single-station correction weighting. Early next week I plan to email a formal request for incorporation into the meeting notice. Please let us know a couple of focus areas by noon Friday.

PV Meeting Date Coordination.

The licensee (APS) cannot support meeting until the 2nd week of June. As I recall, I thought we had conflicts starting then with NGA-East Working Group. Let me know if I can propose any dates in the 2nd and 3rd week of June

Thanks,

Nick

Senior Project Manager - Seismic Reevaluation Activities U.S. Nuclear Regulatory Commission Office of Nuclear Reactor Regulation Japan Lesson Learned Project Division nicholas.difrancesco@nrc.gov<| Tel: (301) 415-1115

John Stamatakos

From:John Stamatakos

Sent:18 May 2015 18:50:43 +0000 To:Miriam R. Juckett; Spence, Jane'

Cc:Stieve, Alice

Subject:RE: PV material

Yes

Thanks

John

From: Miriam R. Juckett

Sent: Monday, May 18, 2015 2:39 PM **To:** 'Spence, Jane'; John Stamatakos

Cc: Stieve, Alice

Subject: RE: PV material

Thanks Jane- I think John was planning to come by to pick it up but he was out sick this week. John, will you be able to pick it up maybe tomorrow?

Cheers-Miriam

From: Spence, Jane [mailto:Jane.Spence@nrc.gov]

Sent: Monday, May 18, 2015 1:38 PM **To:** John Stamatakos; Miriam R. Juckett

Cc: Stieve, Alice

Subject: RE: PV material

CD is still here... do you want me to mail it?

Jane Spence Administrative Assistant Office of New Reactors NRO/DSEA/RGS1 & RGS2 (301) 415-4717 T-7F01B

From: Spence, Jane

Sent: Wednesday, May 13, 2015 12:37 PM

To: John Stamatakos; Miriam Juckett (mjuckett@swri.org)

Cc: Stieve, Alice Subject: PV material

Hi all,

CD is ready.

Please let me know when you'd like me to meet you to pick up the CD. Thanks!

Jane Spence Administrative Assistant Office of New Reactors NRO/DSEA/RGS1 & RGS2 (301) 415-4717 T-7F01B

From: Spence, Jane

Sent: Wednesday, May 13, 2015 9:36 AM

To: Stieve, Alice Cc: John Stamatakos Subject: RE: PV material

Will do when I return -John, I'll let you know when ready for p/u.

Jane Spence Administrative Assistant Office of New Reactors NRO/DSEA/RGS1 & RGS2 (301) 415-4717 T-7F01B

From: Stieve, Alice

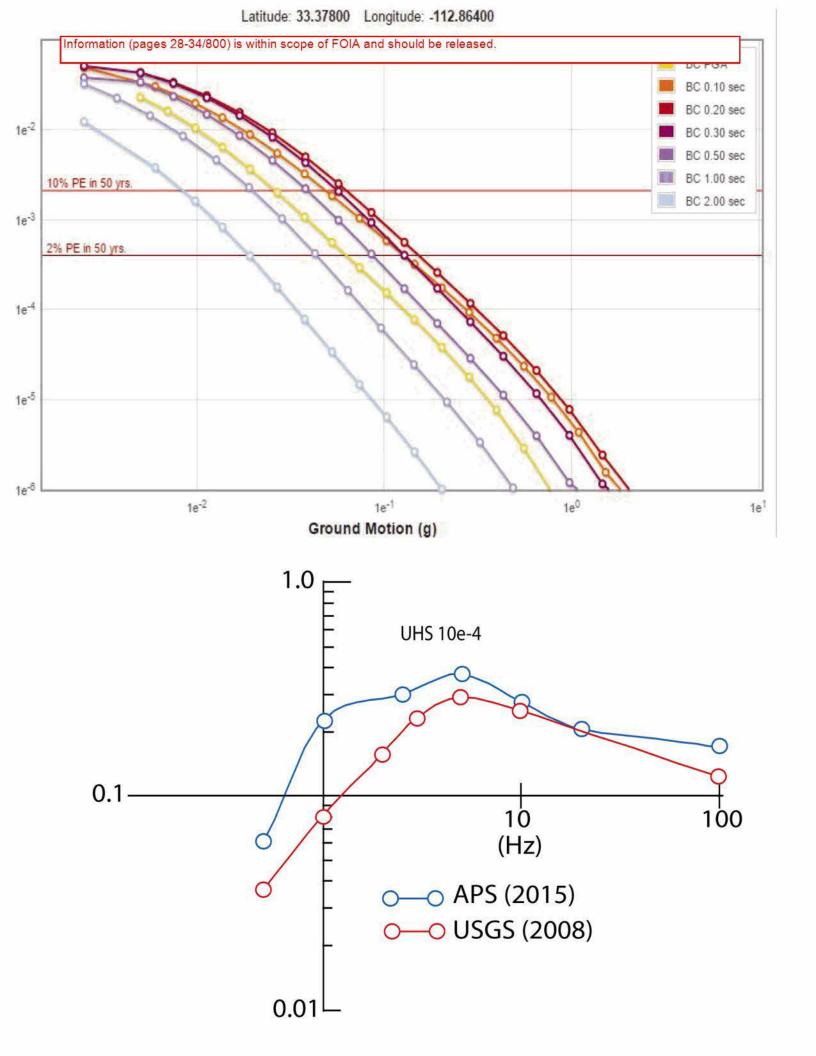
Sent: Wednesday, May 13, 2015 9:27 AM

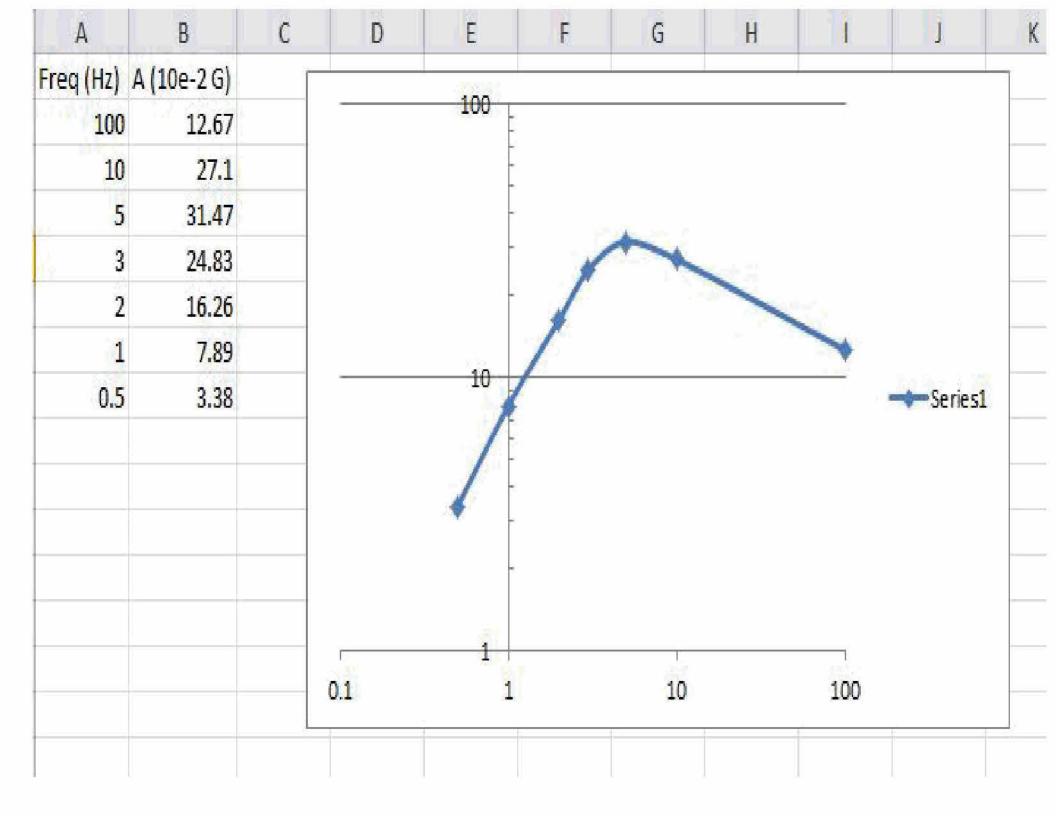
To: Spence, Jane Subject: PV material

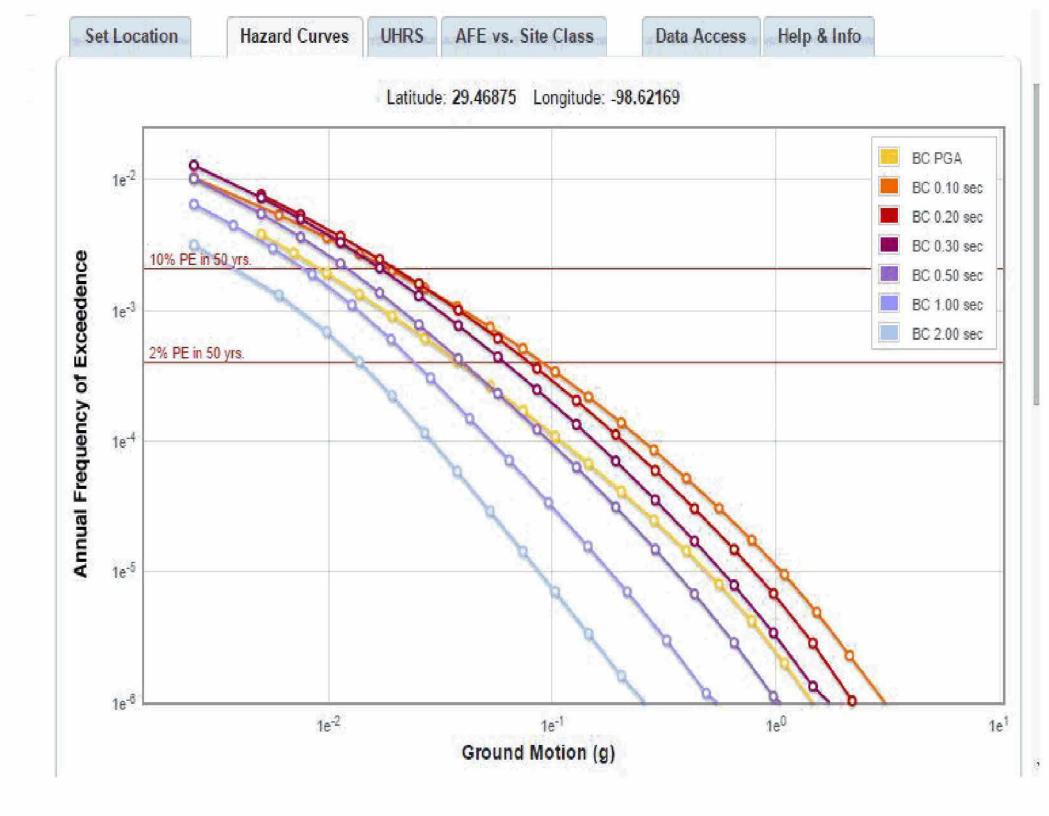
Jane

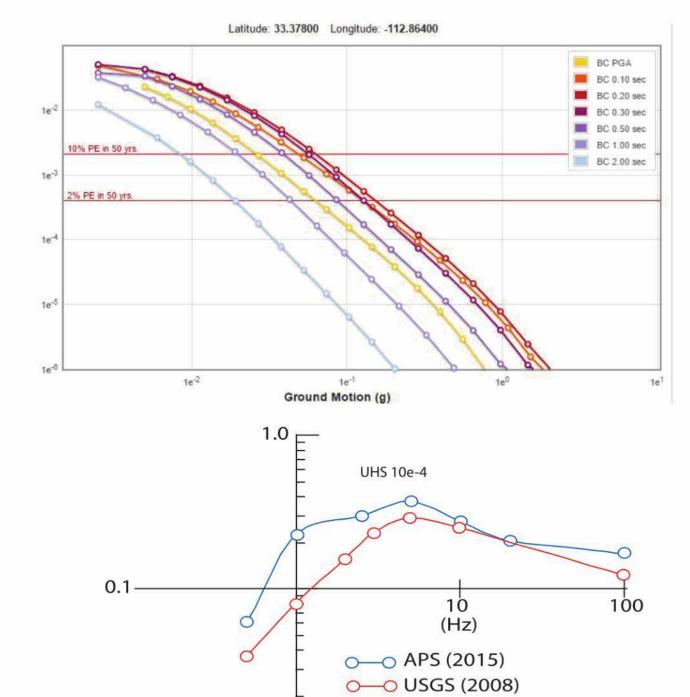
Could you make a CD of all the files in the <u>Palo Verde folder</u> for John Stamatkos? He said he would drop by today or tomorrow. I told him you were out this morning and to wait until this afternoon. Let me and John know if you can accommodate that request.

http://epm.nrc.gov/environmental/jlltg/wus-sshac/Shared%20Documents/Forms/AllItems.aspx



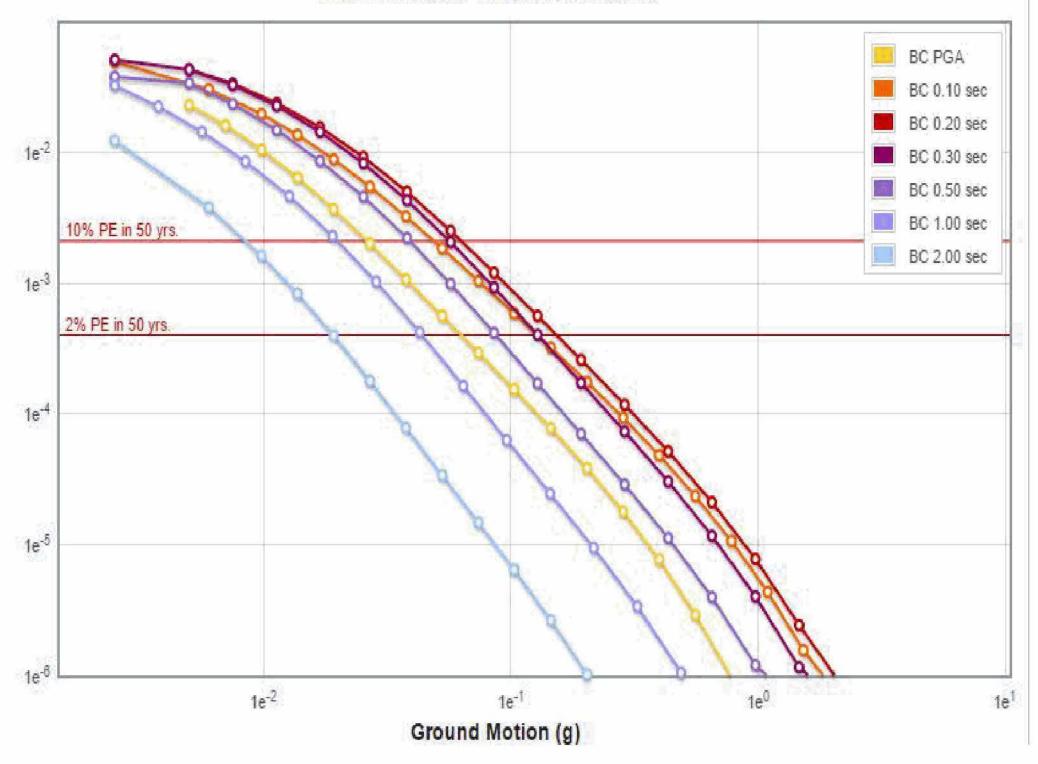


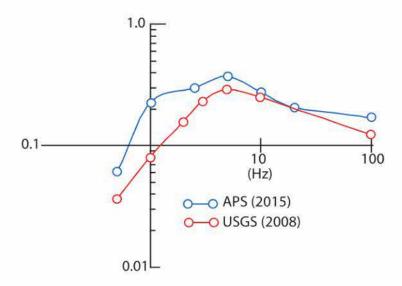




0.01

Latitude: 33.37800 Longitude: -112.86400





	USGS	Palo Verde	PV	
Freq (Hz)	A (g)	Freq (Hz)	A (g)	
100	0.1267	100	0.17	
10	0.271	20	0.207	
5	0.3147	10	0.275	
3	0.2483	5	0.371	
2	0.1626	2.5	0.297	
1	0.0789	1	0.226	
0.5	0.0338	0.5	0.061	