Case No: A.15-02-023

Exhibit No: A4NR-1

Witness: John Geesman

Application of Pacific Gas and Electric Company for Compliance Review of Utility Owned Generation Operations, Electric Energy Resource Recovery Account Entries, Contract Administration, Economic Dispatch of Electric Resources, Utility Retained Generation Fuel Procurement, and Other Activities for the Period January 1 through December 31, 2014. (U 39 E)	Application 15-02-023 (Filed February 27, 2015)

PREPARED TESTIMONY OF

JOHN GEESMAN

ON BEHALF OF THE

ALLIANCE FOR NUCLEAR RESPONSIBILITY

BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF CALIFORNIA

JULY 14, 2015

PREPARED TESTIMONY OF JOHN GEESMAN

ON BEHALF OF THE ALLIANCE FOR NUCLEAR RESPONSIBILITY (“A4NR”)

Q01: Please state your name and business address for the record.

A01: My name is John Geesman, and my business address is: Dickson Geesman LLP, 1999 Harrison Street, Suite 2000, Oakland, CA 94612.

Q02: Are your professional qualifications included in your testimony?

A02: Yes, my professional qualifications are contained in Appendix A to my testimony.

Q03: Was your testimony prepared by you or under your direction?

A03: Yes, it was.

Q04: Insofar as your testimony contains material that is factual in nature, do you believe it to be correct?

A04: Yes, I do.

Q05: Insofar as your testimony contains matters of opinion or judgment, does it represent your best judgment?

A05: Yes, it does.

Q06: Does this written submittal complete your prepared testimony and professional qualifications?

A06: Yes, it does.

Q07: What is the purpose of your testimony?

A07: The purpose of my testimony is to elaborate upon A4NR's Protest, which I incorporate by reference, using PG&E responses to A4NR data requests as well as other documents in the public domain.

Q08: What do PG&E's data responses indicate about senior management's approach to the publication of the AB 1632 Seismic Studies Report, which PG&E also calls the Central Coastal California Seismic Imaging Project ("CCCSIP") report?

A08: The primary indication comes from Ed Halpin, Senior Vice President and Chief Nuclear Officer, who focuses most on how the CCCSIP report will be communicated to the public and often lacks a firm grasp of the report's key findings. A June 25, 2014 email (when publication was scheduled for July) from Jeff Summy, a Halpin lieutenant, to PG&E Geosciences Department Director Richard Klimczak captures this:

> *... he* [Mr. Halpin] *reviewed the Executive Summary that was presented in the recent webcast. I think John*[1] *really alerted him to it but it is important for all of us to understand. He specifically asked about the last set of ground motion curves in the presentation where it shows us using the 86*th *percentile for a deterministic evaluation that links Hosgris* [sic], *San Simeon, and Shoreline and shows exceedance both at low frequency and high frequency. He is asking why are we even including that. I said I thought it was because state of the art would require us to link these so the IPRP would expect this combination. I also said the NRC would not worry about this (since they actually told us they will not expect us to link faults until we do the Seismic PRA) but he said (and he is likely right) that our opponents will challenge us on this. I responded that Nozar*[2] *could demonstrate this is not really a safety challenge for the plant especially for how the NRC is treating eastern and Midwest plants. However his challenge is why do we need to include it at all?*[3]

---

[1] I believe this reference is to John Conway, Mr. Halpin's predecessor as Chief Nuclear Officer.
[2] I believe this reference is to Nozar Jahangir,
[3] A4NR-00348, included in Appendix B as Ex. 1.

Several weeks later, on July 3, 2014, Mr. Halpin sends government relations director Tom Jones a stream-of-consciousness summary of his understanding of the AB 1632 Seismic Studies, lauding four ocean-bottom seismometers installed in 2013 seemingly unaware that they had stopped functioning soon after deployment, and hailing Diablo Canyon's site response data despite past criticism from the NRC and IPRP for relying upon only two earthquakes. Apparently uninformed of imaging problems in the shallow subsurface, Mr. Halpin extolls PG&E's 3D tomographic imaging at the plant site as *"unprecedented"*, *"customized"*, and "*(l)ike a cat scan".*[4] His conclusions were unhesitant:

- *PG&E has met our commitment to fully understand the seismicity surrounding DCPP in accordance with AB 1632 following the events of Fukushima.*
- *Our efforts as a part of our LTSP and this commitment have brought greater clarity, reduced uncertainty and confirmed our conclusions that DCPP is seismically bounded, safe and a reliable asset that can serve California for decades to come...*
- *We believe we have answered all of the questions posed by the IPRP of the PUC but will work with them to answer additional questions throughout the summer once the report is issued.*[5]

Twelve days later, on July 15, 2014, Dr. Stephen Thompson, Principal Geologist for PG&E's external coordinator of its SSHAC seismic source characterization ("SSC") project, Lettis Consultants International, Inc., communicates a radically different assessment to the SSC SSHAC technical integration team lead, Dr. William Lettis:

> *Things are going horribly.*
>
> *****
>
> *AB 1632 continues to be a major major distraction for me ... I am being asked to review all AB 1632 reports late this week and next ... From what I have read ... or have learned*

[4] A4NR-00999, included in Appendix B as Ex. 2.
[5] *Id.*

from others ... these reports are in bad shape and will be a blight on PG&E if they go out as is.

I brought up the subject of requesting a delay with Kent;[6] *it was immediately rejected. My impression is that you have to take the lead in that type of discussion, and perhaps get Norm*[7] *on board first.*

We need a major shift in focus and priorities if we are going to complete this project.[8]

Nine minutes later, Dr. Lettis emails Dr. Abrahamson:

Hi Norm

I need to have an urgent discussion with you early next week. Please see email from Steve below.

... Steve (in particular) and Hans have been tied up almost full time with the AB 1632 study, which is in very sad state (this is another issue that I would like to discuss with you, in terms of PG&E Geosciences credibility).

At this point in time, I think it would be wise for PG&E to talk with the NRC about a 3 to 6 month delay in submitting the 50.54f response. We can offer the NRC many reasons, but the fundamental reason is the completion of ongoing new studies (AB 1632, USGS CRADA, etc.) that we would like to incorporate into the model.[9]

Q09: Do PG&E's data responses indicate whether any such delay was sought from the NRC for the SSHAC submittal?

A09: No. The SSHAC submittal took place as originally scheduled on March 11, 2015, the four-year anniversary of the Fukushima catastrophe.[10] The CCCSIP publication date slipped slightly,

---

[6] I believe this reference is to Kent Ferre.
[7] I believe this reference is to Dr. Norman Abrahamson.
[8] A4NR-1000, included in Appendix B as Ex. 3.
[9] *Id.*
[10] The evening before submittal of the 50.54(f) response, Jearl Strickland, Mr. Summy's replacement, assured Mr. Halpin and his deputy, Barry Allen, that "*Based on our earlier discussion, (t)he process used to manage the SSHAC process will be evaluated in detail and a lessons learned developed with specific actions to improve the performance of the Geosciences department.*" A4NR-02215, included in Appendix B as Ex. 4.

from late July to September 10, 2015, but PG&E's documents show that all of the chapters except one (addressing the concerns raised on behalf of A4NR by Dr. Douglas Hamilton) were available for final review by July 17, 2014[11] and that the conclusions in the Executive Summary had not changed after July 2, 2014.[12]

Q10: What was PG&E's reaction to the finished CCCSIP draft before its simultaneous public release and transmittal to the IPRP?

A10: PG&E's pre-release reaction is best characterized by three emails. The first is the endorsement from Geosciences Department Director Klimczak of comments attributed to PG&E's media representative in an Associated Press story about the recommendation by Diablo Canyon's former NRC inspector, Dr. Michael Peck, that the plant be at least temporarily shut down due to violations of the seismic design requirements of its license. "*I agree with your statements in the article,"* Mr. Klimczak writes, citing the following: *"PG&E spokesman Blair Jones said the NRC has exhaustively analyzed earthquake threats for Diablo Canyon and demonstrated that it 'is seismically safe.' Jones said in an email that the core issue involving earthquake ground motions was resolved in the late 1970s with seismic retrofitting of the plant."*[13]

The second is from Mr. Halpin:

> *>>>Rich-as I retread the executive summary section of the report and go to the last page that summarizes old vs new data/assumptions, it seems the majority of the data has worsened and not improved. The optics look bad. If I was to color code the summary sheet and show all data in red that's worse in regard to assumptions it would not look*

[11] A4NR-00263, included in Appendix B as Ex. 5.
[12] A4NR-00264, included in Appendix B as Ex. 6.
[13] A4NR-00331, included in Appendix B as Ex. 7.

good. I wonder how do I express that those areas that have worsened are low contributors to overall impact? How are they weighted in a deterministic calc and where is that weighting explained?
>>>
>>>Thanks
>>>
>>>Ed[14]

And the third is Dr. Abrahamson's response to Mr. Halpin, sent through Mr. Klimczak:

... the increase in the maximum magnitudes will probably be the focus for the public. A key issue to communicate is that for a site a [sic] *close distances to the earthquakes, the high frequency ground motions do not increase much with increasing magnitude once the magnitude reaches M6.5...So the level of the ground motion is not sensitive to these changes in the magnitudes. The maximum magnitude remains an* [sic] *topic of ongoing scientific study, but the seismic hazard as* [sic] *DCPP is not sensitive to this uncertainty. This is good...*[15]

Q11: In 2014, did the IPRP communicate to PG&E a desire to review the CCCSIP Report and/or any inputs to the Report prior to its completion?

A11: PG&E's data responses indicate that the IPRP expressed such intent early in the year. After attempts on March 12,[16] April 2,[17] and the morning of April 3[18] to establish an agreed meeting proved unsuccessful (other than to trigger an inquiry from Dr. Stuart Nishenko to PG&E legal counsel Jennifer Post as to how to respond, and her "*What is the agenda for the meeting?"* rejoinder[19]), CPUC staff Eric Greene becomes more emphatic. At 2:49 p.m. on the afternoon of April 3, he writes to Dr. Nishenko:

[14] A4NR-00115, included in Appendix B as Ex. 8.
[15] *Id.*
[16] A4NR-00529, included in Appendix B as Ex. 9.
[17] A4NR-00520, included in Appendix B as Ex. 10.
[18] *Id.*
[19] A4NR-00721, included in Appendix B as Ex. 11.

> *I'm hearing that PG&E plans on submitting a report of its results and findings to the NRC in June 2014. The IPRP would like to see a draft before then ... the sooner the better ... so that any comments or suggestions we might have could be incorporated into your report.*[20] (ellipses in original)

Mr. Greene reiterates that concern to Dr. Nishenko the following day (*"The IPRP would like the opportunity to review any data, analyses, drafts before PG&E submits to the NRC so that our comments and suggests might be incorporated."*[21]), but by then – aware that the IPRP planned to meet with visiting NRC Commissioner William Magwood -- PG&E is already strategizing how to explain its dealings with the IPRP to NRC Commissioner Magwood before he holds any meeting with the IPRP.[22] As Chief Nuclear Officer Halpin later explains, "*he* [Magwood] *is going to want to understand the advanced studies as well as the role of the IPRP. He will want to be horsed up on their concerns and how we have, or intend to address their concerns."*[23]

Q12: Did PG&E share drafts of any of the inputs to the CCCSIP Report with the IPRP?

A12: No. PG&E's data responses indicate the choice to withhold drafts from the IPRP as a source of concern to Regulatory Relations staff Valerie Winn and Mark Krausse. On March 19, 2014 Ms. Winn emails Mr. Krausse:

> *See slide 3 from Feb 2013 presentation that says we're sending draft technical reports on Irish Hills to the IPRP in February 2014. I've rec'd nothing to send them... but clearly we indicated we were going to share drafts.*[24]

Mr. Krausse responds:

---

[20] A4NR-00517, included in Appendix B as Ex. 12.
[21] *Id.*
[22] A4NR-00719, included in Appendix B as Ex. 13.
[23] A4NR-00772, included in Appendix B as Ex. 14.
[24] A4NR-00798, included in Appendix B as Ex. 15.

Why don't you just remind the Dream Team of that representation and see if they have something for you to share. They'll likely say they will get what they get at SSHAC next week, but it's worth a try.[25]

And Ms. Winn makes the attempt:

>All,
>
>In Monday's briefing with John Conway, it was indicated that we were not planning to share the draft technical report with the IPRP before it became public. Just wanted to make folks aware that in a presentation to the IPRP last year, we indicated that we were sending draft technical reports on Irish Hills 2D/3D onshore to the IPRP in February 2014 (see page 3)
>
>Not sure where that leaves us with respect to sharing or not sharing drafts, but wanted to make you aware of earlier communications with the IPRP on the topic.
>
>Thanks!
>
>Valerie[26]

And Dr. Nishenko responds the next day, March 20, with:

Valerie et al
Basically, the report is not finished at this time and is now scheduled for release in June
Stu[27]

But a March 19, 2014 "*Seismic Path Forward"* meeting inside PG&E had already apparently resolved the question of sharing drafts. A summary of the meeting written by Phillippe Soenen, Supervisor of Licensing Regulatory Services at DCPP, acknowledging that "*Not*

---

[25] *Id.*
[26] A4NR-00729, included in Appendix B as Ex. 16.
[27] *Id.*

all the required stakeholders were invited to the meeting" and addressed to Mr. Halpin, Mr. Summy, Mr. Klimczak, and Ms. Post, notes,

> *It was agreed upon that once the seismic report is finalized that it will be sent out enclosed to two different letters. One letter will be sent to the State with a copy to the ASLB and the other letter will be sent to the NRC. The cover letters will be written to specifically address the commitments to and concerns of the receiving party.*[28]

Of the three Action Items identified in Mr. Soenen's summary of the March 19 meeting, only the one assigned to Ms. Post (*"Develop a draft agenda for the IPRP follow up meeting and include required stakeholders"*) is labeled "*COMPLETE".*[29]

Consequently, Dr. Nishenko rebuffs Mr. Greene's request for drafts again on April 15, 2014:

> *While we are not going to present our findings at this time, our presentation of the report outline at the May Workshop will provide opportunity for dialogue about the report, our schedule to issue the final results report to the IPRP in June, coordination for a public meeting later in July, and the IPRP review schedule.*[30]

And Mr. Greene's plea on behalf of the IPRP 31 minutes later is to no avail:

> *If we do meet with you at PG&E, it would be a closed technical session. Would be preferable if you could provide some our* [sic] *your findings, however preliminary. We recognize that the information is still in draft form and very preliminary, but any insight into the direction you are taking should be beneficial to the IPRP and PG&E.*[31]

[28] A4NR-00516, included in Appendix B as Ex. 17.
[29] *Id.*
[30] A4NR-00108, included in Appendix B as Ex. 18.
[31] *Id.*

Q13: Hadn't the IPRP been planning to hold public meetings at least quarterly?

A13: Yes, that's what CPUC Energy Division Director Ed Randolph had indicated at the February 25, 2013 IPRP meeting. Thirteen months later, on March 21, 2014 (two days after the *"Seismic Path Forward"* meeting) PG&E's internal compliance program generated an automatic alert to Geosciences Department Director Klimczak, with a follow-up email from Conor Doyle in Regulatory Relations: "*Rich, Remind me, when is the next meeting?"*[32] Mr. Klimczak's reply:

> *No meeting is currently scheduled. We are issuing a final report June 30th. I expect meetings after we issue the report based on when the CPUC/IPRP requests them. If a meeting is scheduled for any reason, I will let you know.*
>
> *Rich*[33]

When Mr. Klimczak presents *"a timeline for required reviewers"*[34] of the CCCSIP Report as one of his Action Item assignments from the *"Seismic Path Forward"* meeting, even Mr. Halpin stumbles over the illogic of post-submittal IPRP review:

> *What about the post June 30th submittal date in regard to IPRP feedback? In other words is the report final once submitted? What is the purpose of the 30 day review by the IPRP?*[35]

Mr. Summy explains to Mr. Halpin:

> *Ed,*
> *We discussed that to a certain extent in a call we had Friday to discuss a request from IPRP to have a meeting with us before they meet with Magwood while he is here. Our sense is they will not be happy not getting an advanced review before we issue but we really have no choice at this point. I suspect if they come back with substantive*

[32] A4NR-00404, included in Appendix B as Ex. 19.
[33] *Id.*
[34] A4NR-00377, included in Appendix B as Ex. 20.
[35] *Id.*

comments that we agree with we could see a way to revise but not if they are just providing comments that express their general disagreement with our approach or things to that affect [sic].

Rich/Stu would you agree with that?
Thanks
Jeff S[36]

Mr. Summy's email did not explain why, as of April 6, 2015, "*we really have no choice at this point*" regarding IPRP *"review before we issue."* PG&E's data responses do not include any replies from Mr. Klimczak or Dr. Nishenko. Mr. Greene's earlier-mentioned April 15, 2014 request[37] for drafts from PG&E prior to the IPRP meeting with NRC Commissioner Magwood may have proven futile, but it did stir concern in Mr. Klimczak. He calendars a teleconference for April 17 with Mr. Strickland, Mr. Summy, Dr. Nishenko, Dr. Abrahamson, and Ms. Post with the following notation: "*Discuss CPUC/IPRP response (below) to our request to move the meeting. Notice reference to SSHAC....*"[38]

In planning a June 30, 2014 submittal date, with a 30-day IPRP review starting on July 1, PG&E's *"2014 Rollout Plan"* acknowledges a need for further internal discussions in light of IPRP requests for more extended review.[39] Mr. Klimczak emails Mr. Summy on May 29 with the news:

Since our meeting with the IPRP on 5/21 we learned that they want about ~ 6 months to respond to our report and to hold ~4 public meetings. We did not agree with this, but

---

36 *Id.*
37 A4NR-00108, included in Appendix B as Ex. 18.
38 A4NR-00142, included in Appendix B as Ex. 21.
39 A4NR-00773, included in Appendix B as Ex. 22. PG&E's proposed schedule also contains a notation concerning a possible mid-July public meeting of the IPRP, *"Prior to meeting, Geosciences to establish an agreement with the IPRP on how to address public comments during the public presentation."*

asked them to revisit this topic after they get the report for review. We will need to discuss and agree upon our position on IPRP review time and public meetings.[40]

Mr. Summy's response: *"As we have discussed in the past the IPRP will be what it will be and we will have to deal with it as it occurs. It would be nice if it was clearly defined and played by some fixed set of rules but it doesn't."*[41]

Q14: As the envisioned submittal date slipped past June 30, 2014, did PG&E make any explicit plans for the IPRP post-submittal review to be reflected in the models used for the SSHAC process?

A14: The PG&E data responses indicate an acute awareness of the time pressure on incorporating any IPRP review comments on the CCCSIP Report into the SSHAC process. On July 7, 2014, Geosciences Manager Kent Ferre responded to a schedule inquiry from media spokesperson Blair Jones:

> *I have a call into Norm but have not heard back. I spoke to Steve Thompson at LCI regarding the seismic source model, and he feels September 1 is when the model needs to be completed. He did leave the door open for subsequent minor tweaks. It is really Norm to establish the final date since he does much of the downstream work.*
> *If Norm calls back I will give you an update.*[42]

Forty-two minutes later, Mr. Ferre elaborates:

> *Blair, I just spoke to Norm, and he said that for the site response and sensitivity studies, they need final models no later than October 15. Working backwards, the TI team would therefore need the IPRP input no later than October 1 to make final tweaks to the source model. This establishes a last date for the AB1632 final report transmittal to the IPRP at*

[40] A4NR-00364, included in Appendix B as Ex. 23.
[41] *Id.*
[42] A4NR-00279, included in Appendix B as Ex. 24.

mid to late August, depending on the amount of time allowed for their review and comment.[43]

Notwithstanding the CCCSIP Report concerns voiced by Dr. Thompson on July 15 ("*these reports are in bad shape and will be a blight on PG&E if they go out as is*"[44]) or Dr. Lettis' request that same day for extra time on the SSHAC report ("*I think it would be wise for PG&E to talk with the NRC about a 3 to 6 month delay in submitting the 50.54f response*"[45]), PG&E allowed the IPRP review opportunity to compress as the CCCSIP Report release slid through August and the SSHAC deadline remained intact. Ironically, the day before the Thompson/Lettis emails, Mr. Ferre informed Mr. Klimczak that as of June 30, 2014, PG&E's 2014 budgeted amount for the IPRP contained a $720.1k unspent balance, 52% of the 2014 total unspent amount for the AB 1632 Seismic Studies.[46]

Q15: What happened to the IPRP review window as the CCCSIP Report's submittal date slipped to late August?

A15: A series of PG&E emails on August 20 and 21, 2014 describe the squeeze:

- First, from Regulatory Director Thomas Jones to Mr. Klimczak and Ms. Post:

  The Sr. leadership of Corporate Affairs has requested a simple timeline that shows the drop dead dates in sequence to understand the required vs. desired timing for release of the report to address concerns raised on related business matters based on our conversations and emails of yesterday and today. The goal is to understand the due dates for ground motion to the NRC in March, and how the intermediate steps are driven by the release on August 28. I need this tomorrow and will help support this in any way you need. I suggest a simple timeline and a reference below for each milestone and its weighted importance to satisfy the March 2015 NRC order for ground motion value.[47]

---

[43] *Id.*
[44] A4NR-1000, included in Appendix B as Ex. 3.
[45] *Id.*
[46] A4NR-00231, included in Appendix B as Ex. 25.
[47] A4NR-00402, included in Appendix B as Ex. 26.

- Then Mr. Klimczak's request for assistance from Geosciences Manager Ferre:

  Kent

  I will need your help putting the requested timeline together today has [sic] *I am traveling to Washington D.C. Put the timeline together based on your SSHAC schedule and send it to me P&C. Show the 30 day IPRP review in the timeline. I will call to talk when I am able.*

  Thanks,
  Rich[48]

- Then Mr. Summy's input:

  Rich/Kent,
  We need to be clear on the potential impact to IPRP's ability to provide input to SSHAC if we delay past August 28.
  Thanks
  Jeff S[49]

- And Mr. Ferre's work product:

  Rich, Jeff:

  Attached is a high level SSC SSHAC schedule with the IPRP review and SSC TI team evaluation and integration (of IPRP comments) included (tasks 8c3 and 8c4).[50]

- Finally, Mr. Klimczak's summation:

  As we discussed, to meet March 2015 NRC deadline we need:

  1) SSC logic trees with documentation due 10/31/14 to PPRP.[51] *To meet this date it requires published AB1632 results to be used as input by the SSC TI team for the logic trees development. It also requires time to allow 30 days for IPRP review and for them to provide comments to the SSC TI team. The SSC TI team needs time to consider integration of IPRP input and still meet the 10/31/14 due date.*[52]

---

[48] *Id.*
[49] *Id.*
[50] *Id.*
[51] I believe this reference is to the Participatory Peer Review Panel, an NRC-required aspect of the SSHAC process.
[52] A4NR-00402, included in Appendix B as Ex. 26.

Then, on August 28, the very threshold warned of by Mr. Summy one week earlier ("*We need to be clear on the potential impact to IPRP's ability to provide input to SSHAC if we delay past August 28"*[53]), another burst of emails:

- First from CPUC staff Eric Greene, on behalf of the IPRP, to Dr. Nishenko :

  Is PG&E still on schedule to submit to us your seismic studies report for DCPP by the end of August? If not, do you have a realistic revised delivery date for the report? The IPRP is anxious to begin our review without further delay. Thanks.[54]

- Then from Dr. Nishenko to Mr. Klimczak, and Regulatory Relations staff Valerie Winn and Thomas Jones, with a copy to Ms. Post:

  To follow up on my email earlier today – please advise as to response.[55]

- And Ms. Winn's response:

  Stu, let me give Tom a call to discuss. I would like Eric to poll the IPRP as to what they need in terms of hard copies, CDs, etc [sic] *and being able to communicate a date (e.g., in* [sic] *or before September 15) would be helpful. It would also be nice, to manage IPRP expectations, to work with Eric to set a date for meeting with the IPRP to discuss. That might help to get them into our court or at least minimize any blow back from the delayed issuance.*[56]

Ms. Winn, whose full title is *"Chief, State Agency Relations,"* may have been particularly attuned to PG&E's need to *"at least minimize any blow back from the delayed issuance"* in light of her earlier communications with the IPRP:

- On June 11, 2014 she writes to CPUC staff Eric Greene, with a copy to IPRP Chair Chris Wills:

  Hi Eric (and Chris),

[53] *Id.*
[54] A4NR-00707, included in Appendix B as Ex. 27.
[55] *Id.*
[56] A4NR-00584, included in Appendix B as Ex. 28.

I wanted to provide this month's report to the ASLB on various DCPP issues. Please note that for the item "Issue Final Seismic Report to the NRC and ASLB", we had previously indicated submittal in June 2014. That date has now slipped to July 2014.

While I don't have a precise date today for when the report will be submitted to the NRC (and the IPRP) in July, I expect the submittal will now be made in late July. I'll be in touch as I know more.

Please don't hesitate to call if you have any questions.[57]

- Eight weeks later, on August 5, 2014 Mr. Wills inquires:

  Hi Valerie

  Since I haven't heard anything, I assume that the reports for NRC and ASLB are still not quite done. Can you give me a date when we might expect to receive them? I need to plan for staff time to review them. I also need to know the dates when PG&E expects to finalize their seismic hazard model inputs, so we can try to provide our review comments before then.

  Chris[58]

- Ms. Winn responds ten minutes later:

  Hi Chris and Eric,

  Sorry for the delay in communicating to you. As I understand the current schedule submitted to the ASLB, it looks like a late August release date. I'll check with the team on other dates for finalizing the seismic hazard model inputs and let you know. Thanks!

  Valerie[59]

- Thirty days later, on September 5, 2014 (eight days past Mr. Summy's forewarned threshold), Mr. Wills inquires again:

  Hi Valerie

  Any update on the schedule?

[57] A4NR-00800, included in Appendix B as Ex. 29.
[58] *Id.*
[59] *Id.*

Chris[60]

- This time Ms. Winn takes several hours to respond:

  Hi Chris and Eric:

  I just received word that the report will be submitted to the NRC on Wednesday, September 10, at which time the report will become public. While we're working to finalize the report and prepare hard copies ad CDs (no easy feat, it's a big report) and other logistics, we'd be happy to do a pre-brief of the report's findings with the IPRP on Tuesday afternoon, if that is possible. We could do the briefing by phone if you'd like. Please let me know your availability and I'll work to get this set up.

  Eric, I know the IPRP is also interested in having a meeting or two once the report is submitted to the NRC. Now that we know the date for the submittal, could you please let me know when/where the IPRP may wish to meet to discuss the report in greater depth? I can then get this on my team's calendars.

  Best regards,

  Valerie Winn[61]

Q16: Do the PG&E data responses identify any specific accommodations of the IPRP's review role as publication of the CCCSIP Report slipped across the August 28, 2014 threshold?

A16: An 8:26 a.m. September 2, 2014 email from Dr. Thompson to PG&E Geosciences Manager Ferre states, "*Bill Lettis and I are coming to 245 Market today to meet with Norm. Are you free to talk briefly about implications of the new IPRP scope?*"[62] At the end of that same day, at 5:29 p.m., Dr. Thompson sends an email to the SSC TI team (with copies to Mr. Ferre, Mr. Klimczak, and Dr. Nishenko) with a proposal:

Subject:	*DCPP SSHAC: Possible meeting with IPRP to discuss implementation of AB 1632 in SSC model*

[60] *Id.*
[61] *Id.*
[62] A4NR-00256, included in Appendix B as Ex. 30.

SSC TI Team plus Kent, Rich, and Stu:

We understand that the IPRP – a review board working on behalf of the California PUC to review the AB1632 program – has new scope to explore how the results of the AB1632 program are being used in the SSHAC for the SSC model. As such, we are just beginning to figure out how we can accommodate this change. A proposed approach for interacting with the IPRP to help them achieve their goal is as follows:

1) *AB1632 reports are delivered to the IPRP and NRC (this is coming soon)*
2) *The IPRP perform an initial review of the AB1632 reports (approx. 3 weeks)*
3) *The SSHAC TI Team and PG&E Geosciences hold a 1-day meeting with the IPRP (+/- members of the PPRP?) to discuss:*
    a. *The SSHAC process and the Role of the AB1632 program in the process*
    b. *The SSHAC SSC Model (update from Workshop 3; almost final)*
    c. *How the AB1632 reports have been reviewed, considered, and integrated by the TI Team for the SSC Model*
    d. *Any initial comments or questions the IPRP have about how the AB1632 results have been or will be incorporated into the SSC model*
4) *The IPRP complete their review of the AB1632 reports and draft a letter recommending how AB1632 information should be incorporated into the SSC Model*
5) *The SSHAC TI Team and PPRP review the IPRP letter. The SSHAC TI Team considers the letter, makes modifications to the SSC as deemed appropriate, and addresses the IPRP letter in the SSHAC SSC Final Report.*

The main action for the TI Team now is to understand this may be coming up, and to know whether you are available for a one-day meeting during the OCTOBER 1-3 WINDOW.

For Rich, Kent, and Stu, please let me know your general thoughts on the plan outlined above, and your availability the Oct. 1-3 window. Bill Lettis and Norm Abrahamson have indicated their availability those days.

Thanks,
-steve[63]

The PG&E data responses do not indicate what *"general thoughts"* Mr. Klimczak, Mr. Ferre, Dr. Nishenko, or anyone else at PG&E may have conveyed in response to Dr. Thompson's

[63] A4NR-00255, included in Appendix B as Ex. 31.

September 2 proposal, but the conference call Dr. Thompson scheduled the morning of September 4, 2014 between the TI Team and Mr. Ferre includes an agenda item "*-IPRP*"[64] and Ms. Post calendared a conference call with Mr. Ferre, Mr. Klimczak, and PG&E legal counsel William Manheim to discuss "*Implementing IPRP Provisions in GRC Decision*" for 3 p.m. on September 9, 2014.[65] At 3: 38 p.m. on September 9, 2014, Dr. Thompson emails Mr. Ferre, Mr. Klimczak, Dr. Nishenko and the TI Team:

> *Hi Kent, Rich, and Stu,*
>
> *I just spoke with Kent about meeting as a group at PG&E to discuss the process of the IPRP review of the AB1632 studies and their scope to review how the reports are being implemented in the SSHAC model. The agenda would include:*
>
> 1. *Update on understanding between PG&E and IPRP concerning scope of review*
> 2. *Discuss possible scope and schedule of review*
> 3. *Discuss current SSHAC TI Team observations, interpretations, and strategies for incorporating AB1632 report content*
> 4. *Outline next steps.*[66]

On September 11, 2014 Dr. Lettis sends the following email from his mobile phone to Mr. Ferre and Dr. Thompson:

> *Hi Kent and Steve*
>
> *I just attended the CGS*[67] *mapping committee meeting in Sacramento chaired by Chris Wills. In a side bar hallway conversation, Chris indicated that he, Gordon Seitz, and Tim Dawson would like to meet informally 'any time next week' to discuss how we are using AB 1632 in our SSHAC deliberations, if possible. Chris has some personal issues that will prevent him from meeting later until later in October.*
> *Chris indicated that their committee received the ab 1632 reports yesterday, and it would be good to have an idea of how we are using the data so they can consider this in their review.*

[64] A4NR-00170, included in Appendix B as Ex. 32.
[65] A4NR-00252, included in Appendix B as Ex. 33.
[66] A4NR-00249, included in Appendix B as Ex. 34.
[67] I believe this reference is to the California Geological Survey.

The meeting would be informal non public.

Is this possible? Anyway, this will be good to discuss when we meet on Monday (or Friday? Has a meeting time been set up?).

Thanks
Bill[68]

The following Monday, September 15, 2014, Mr. Wills engages CPUC staff Eric Greene and PG&E in an effort to obtain a missing reference document relied upon by the CCCSIP Report:

Hi Eric

In skimming through the report, I've found that the studies for slip-rate on the Hosgri fault refer to a previous report by PG&E that has not been provided. Since that report describes the way PG&E has determined the ages of sediments, it's critical to the evaluation of slip-rate. If it's OK, I'll send an email to PG&E asking for that report.

Chris[69]

Mr. Greene responds:

Sure. Please include your e-mail below so PG&E will know I'm aware of the request and would also want to see PG&E's response. It is possible that it is something internal that PG&E does not want released. Thanks.

Eric[70]

And Mr. Wills transmits his request to Ms. Winn and Dr. Nishenko:
Hi Valerie and Stu

In beginning our review of the reports last week, I've noted that discussion of the ages of sediments and channels offset by the Hosgri and Shoreline faults refer to a 2013 report

[68] A4NR-00246, included in Appendix B as Ex. 35.
[69] A4NR-00786, included in Appendix B as Ex. 36.
[70] *Id.*

by PG&E. I do not find that report with the reports released last week and do not think we've been provided a copy previously. Since the age of the offset features is a critical aspect of any determination of slip rate, we need that report to review the slip-rate estimates. Please send a copy of the 'Stratigraphic Framework' report referenced below to me as soon as possible.

Thank you

Chris[71]

At the end of the day on September 15, 2014, Dr. Thompson sends his follow-up to the prior week's hallway conversation between Mr. Wills and Dr. Lettis:

Dear Chris,

Following up on our conversation earlier, we invite you, Tim, and Gordon over to LCI Friday to discuss the current SSHAC SSC model and our progress to date incorporating the results from the AB1632 studies. As mentioned, Friday is the earliest day we can meet; we understand Gordon cannot attend, but perhaps we can mitigate this another way. The goal is to keep this to a high-level discussion of the SSC model, parts of the SSC model relevant to the AB1632 program, and our approach and findings for incorporating the data and interpretations into our logic trees. It is unlikely we will have time to delve into the seismic data volumes, but perhaps we will be able to show you and Tim an example or two.[72]

On September 17, 2014 Dr. Lettis invites PPRP Chair Kevin Coppersmith to join the meeting with CGS personnel:

I know that it is short notice, but we just found out this schedule and talked with PG&E. No other IPRP member will attend, and this meeting is informal (I.e., not public). If you are available, it would be great to have you attend – especially to provide support for our approach in utilizing the data and proponent interpretations from AB 1632, as well

[71] *Id.*

[72] A4NR-00576, included in Appendix B as Ex. 37.

as the [3]*role*[2] [sic] *that the IPRP has within the SSHAC process (I.e., no formal role but we will consider their comments in our assessment process).*[73]

A slide presentation dated September 19, 2014, the day Dr. Thompson had scheduled the CGS visit to LCI, purports to reflect prior communication with Mr. Wills. The initial slide is entitled:

SSHAC Implementation of
AB1632 Results

SSHAC SSC TI Team
Presenting to CGS/IPRP reviewers
9/19/2014
SSC working meeting 35[74]

The 61st slide contains the following:

Wrap-up Notes

- *SSHAC Deadline – end of October is drop-dead*
    - *Approx. Oct. 10 deadline to get input from C. Wills*
    - *Next*
- *IPRP/C. Wills Plan*
    - *Focus on Hosgri slip rate – Gordon/Dawson lead*
    - *Know Estero Bay study is key; initial question is about eastern channel uncertainty*
    - *Goal – have done right studies to constrain Hosgri slip rate*
    - *Secondary goals – ibid on Shoreline slip rate, other items (e.g., Gibson meetings)*
    - *Regarding Hosgri, Shoreline slip rate*
        - *Intent to give verbal feedback by early October from CGS/IPRP staff.*
        - *Working backwards, arrange meetings with interpreters prior to Early October.*
        - *Chris gone October 8th.*
    - *Wills – comment that initial IPRP report (#3) appears to have been fulfilled*

---

[73] A4NR-00244, included in Appendix B as Ex. 38.
[74] A4NR-00657, included in Appendix B as Ex. 39.

- *Cannot see any hazard-significant parameter that PG&E has not investigated*
- *Cannot foresee conclusion that SSHAC should not have considered AB1632 along with other data*
- *Anticipates IPRP stating that AB1632 has fulfilled recommendations and performed what they set out to do.*[75]

And the 62nd slide states:

> *Add'l notes*
>
> - *IPRP/AB1632 review schedule*
>   - *Chris anticipates schedule faster than stated 6-8 months*
>   - *October – meeting on slip rates*
>   - *November – meeting on tectonic models*
>   - *December – meeting on Site conditions/site amplification*
>
>   - *Three reports. Does not anticipate a lot of depth.*
>   - *Goal is to have first two reports by end of this year.*
>   - *Hope its relevant to the SSHAC process as it's being done.*
>
>   - *Once SSHAC report is done, anticipates CPUC wanting IPRP to look over the SSHAC process and report.*[76]

Dr. Thompson's later characterization of his several interactions with CGS is consistent with the IPRP role envisioned in the September 19 slides. On October 9, 2014, he writes the TI Team, with copies to Mr. Ferre, Dr. Abrahamson, and the members of the PPRP:

> *Incorporation of AB1632 work and IPRP review: We have had two meetings with Chris Wills and his staff (Tim, Gordon) to discuss the AB1632 reports and how the SSHAC TI Team is evaluating and incorporating the information. In a phone call Tuesday, Chris gave us an update on their progress and thoughts. One possible action item is that Tim and/or Gordon may be calling to set up another meeting to review data at LCI's office prior to the Oct. 23th* [sic] *IPRP/AB1632 meeting at the CPUC. This activity is not central*

[75] *Id.*
[76] *Id.*

to the SSHAC work and schedule, but communicating with the CGS has been helpful to understand their initial thoughts and logic in digesting the AB1632 results and their relevance to the SSC.[77]

By the time the IPRP turned its attention to the onshore aspects of the CCCSIP Report, PG&E's Chief of State Agency Relations, Valerie Winn, is discouraging attendance by Coastal Commission staff

... you may want to touch base with Chris Wills at CA Geological Survey on whether you should participate or perhaps Chris can provide a report to your agency after the 11/17 meeting.... You are always welcome to attend, although I expect with Mark [Johnsson] *out of the office, you have a number of issues you are trying to cover!*[78]

And neglecting altogether to invite the California Energy Commission's IPRP representatives:

Hi Valerie

Hey, Danielle and I got dropped from your email list.

I just received notification of tomorrow's meeting from Bruce Gibson and noticed Danielle and I were not on the list.
Please add us back on.

Thanks,

Casey[79]

Q17: After the concerns expressed in IPRP Report No. 6 and NRC Research Information Letter 12-01 ("RIL 12-01") about PG&E's reliance on only two local earthquakes in its Diablo Canyon

[77] A4NR-00230, included in Appendix B as Ex. 40.
[78] A4NR-00799, included in Appendix B as Ex. 41.
[79] A4NR-00780, included in Appendix B as Ex. 42.

ground motion assessments, do PG&E's data responses identify any 2014 change in the number of local earthquakes used in PG&E's evaluation?

A17: No. As indicated in the minutes of a December 9, 2014 meeting between PG&E and its Fugro consultants regarding the 3D velocity model, "*San Simeon (2006) and Parkfield (2004) nothing else triggered the system at DCPP.*"[80] The minutes of a follow-up meeting on December 18, 2014 attribute the following observation to University of Texas civil engineering professor Ellen Rathje: "*3D Vs model was developed solely from geophysics, are there boring data available for ground trothing?*"[81] The minutes record Dr. Abrahamson's response as, "*No geotechnical information available.*"[82]

The limitations in recorded earthquake data used to establish Diablo Canyon site-specific terms for the CCCSIP Report are described in Calculation Document GEO.DCPP.14.03 prepared by Dr. Abrahamson, independently verified by two other Geosciences employees, and approved by Mr. Klimczak. Of the two free-field recording sites at Diablo Canyon, ESTA27 (with two profiles, A1200 and B1200) and ESTA28 (with one profile, A100), only ESTA27 was installed at the time of the San Simeon earthquake. Despite this longer history and the presence of two profiles rather than one, PG&E selected ESTA28 as the reference free-field station for analytic purposes because "*(t)he deeper part of the velocity profile at Station ESTA28 is more consistent with deeper parts of the velocity profile for the power block and turbine building than station ESTA27.*"[83] Consequently, an *"amplification factor"* is applied to data from ESTA27, with the expected difference between ESTA27 and ESTA28 computed using the NGA-W2 GMPEs for a

[80] A4NR-00996, included in Appendix B as Ex. 43. The San Simeon earthquake took place in 2003.
[81] A4NR-00997, included in Appendix B as Ex. 44.
[82] *Id.*
[83] A4NR-00831, included in Appendix B as Ex. 45.

magnitude 6 strike-slip earthquake at a distance of 30 km – "*This distance and magnitude is selected to capture the linear site amplification and be in the center of the data range where the GMPEs are most accurate."*[84] Although the velocity profile for ESTA28 is similar at depth to that used in NRC RIL 12-01, Dr. Abrahamson acknowledges that *"it has deeper soil ... which will tend to affect the low frequency amplification"*[85] and so *"(a)n additional factor is developed to account for this difference in soil depth."*[86] Finally, in *"smoothing"* the Diablo Canyon site term derived from the two earthquakes, Dr. Abrahamson notes the contrast between similar within-event residuals at high frequencies and *"a wider range"* at low frequencies, "*indicating that path effect differences are being seen in addition to site term."*[87] He concludes, "*This is consistent with the observation that the low frequency ground motion from the San Simeon earthquake is controlled by late arriving surface waves"*[88] without repeating that San Simeon was not recorded at ESTA28.

Q18: Couldn't PG&E's ocean-bottom seismometers, approved by the CPUC in 2010 for the AB 1632 Seismic Studies program, have provided useful data on small-magnitude earthquakes closer to Diablo Canyon than San Simeon (35 km) or Parkfield (85 km)?

A18: Apparently not. According to the final CCCSIP Report,

> *PG&E installed an array of four three-component broadband ocean bottom seismometers and accelerometers in the region offshore of the DCPP in 2013. The objective of the OBS array is to improve earthquake detection capability and location accuracy for earthquakes on the continental shelf adjacent to the Hosgri and Shoreline fault zones as well as constrain the path effects from these offshore events to the DCPP. Data are streamed in real time to the PG&E Central Coast Seismic Network for*

---

[84] *Id.*
[85] *Id.*
[86] *Id.*
[87] *Id.*
[88] *Id.*

distribution to the U.S. Geological Survey (USGS) and the California Integrated Seismic Network.[89]

However, PG&E's data responses offer a different perspective. An undated *"Request for Major Project Contingency Release"* states,

> *The OBS system, soon after deployment in late 2013, stopped functioning due to underwater cable damage. To mitigate this problem, four temporary OBS units were deployed on November 4, 2014. The cost for the temporary units is covered under warranty. The longer term mitigation is to redesign the OBS system using an enhanced (thicker and more armored) cable to withstand sea floor abrasions. The preliminary costs for the enhanced OBS system will be shared by the manufacturer of the OBS system, Guralp (under warranty) and PG&E from this contingency request.*[90]

The *"Lessons Learned/Corrective Action"* identified in the "*Request for Major Project Contingency Release"* are:

> *Do not rely on designs by others/establish a design review process for third party designs. Guralp is providing various options for the proposed cable with associated costs-benefits. A formal design review will be conducted using outside experts, PG&E personnel, and Guralp to select the optimum product considering various criteria such as cost, ruggedness, flexibility, ease of deployment, etc.*[91]

A January 22, 2015 internal email from PG&E's Environmental Management provides additional detail:

> *The existing OBS is inoperable due to a failed power/data cable. PG&E needs to replace the power/data cable and re-calibrate the four long-term units. Environmental Mgmt worked with the regulatory agencies to identify that repair of the system would require amendments to existing permits and require a minimum six-month process. Environmental Mgmt obtained necessary approvals to allow deployment of temporary*

[89] CCCSIP Report, Technical Summary, p. 3.
[90] A4NR-0168, included in Appendix B as Ex. 46.
[91] *Id.*

units so that data could be collected until the 'fix' was deployed. Temp OBS units were effectively deployed on November 3, 2014. Environmental Mgmt Vetted proposed 'fix' with NGOs and the permitting agencies. Targeting submittal of the first application by January 30, 2015 with all permits obtained in time to accommodate a September/October 2015 deployment of the 'fix'.[92]

Q19: How did PG&E's CCCSIP Report address the criticisms in IPRP Report No. 6 of the utility's shear wave velocity estimates for the Diablo Canyon site?

A19: An October 20, 2014 email from Mr. Ferre to media spokesperson Blair Jones (with copies to Dr. Abrahamson, Dr. Nishenko, and Mr. Summy) suggesting responses to newspaper comments attributed to former State Senator Sam Blakeslee emphasizes Chapter 10 of the report:

Blair: Below are my proposed responses.

*****

In his own early assessment, Blakeslee said he has concerns about PG&E's conclusions, specifically about the way in which PG&E interpreted ground-motion levels. His concerns fell on many of the same issues the IPRP discussed in its last report, issued about one year before PG&E went public with its final conclusions. (emphasis in original)

<u>PG&E Response:</u> Since the issuance of IPRP Report #6, Site shear wave velocity at Diablo Canyon, PG&E developed a comprehensive 3-D velocity model using thousands of data points obtained during the onshore seismic studies (summarized in CCCSIP Report #10). This extensive data set was used to estimate ground motions in-lieu of the generic shear wave values proposed in the IPRP Report #6, or shear wave values from the on-site borehole data used in the 2011 Shoreline Report...[93]

While PG&E would ultimately revert to a "*generic*" approach in its March 11, 2015 SSHAC submittal to the NRC, Mr. Ferre's suggested response does not include the following disclaimers identified in Chapter 10 (aka "*CCCSIP Report #10")*:

[92] A4NR-02287, included in Appendix B as Ex. 47.
[93] A4NR-00611, included in Appendix B as Ex. 48.

- *This seismic-reflection data-acquisition geometry is not optimal to estimate shallow geotechnical 3D velocity structure, particularly velocities to depths of approximately 33 feet (~10m) or less below surface topography.*[94]

- *Thus, the 3D tomography does not constrain shallow (20—40 feet, 6—12 m) 3D velocities within this central portion of the DCPP foundation.*[95]

- *The irregular source-receiver geometry within the DCPP area required to accommodate large structures, security zones, and other restricted entry areas produces data gaps in source-receiver offset. These gaps cause large zones where first breaks cannot be picked; the automated first-break-detecting algorithm is designed for regular binned-offset (conventional) 2D and 3D seismic-reflection acquisition geometries*.[96]

- *Some areas of the DCPP contain substantial thicknesses of foundation concrete that produce fast, near-offset first breaks. In these areas, the first breaks reflect the as-built conditions, not conditions on natural ground.*[97]

- *The Vp-depth conversion compensates for the extensive distribution of higher velocity construction materials (e.g., pavement, concrete blocks, piping) that were encountered at the surface and to depths of up to approximately 30 feet during the 2012 data acquisition within the DCPP foundation area, and in areas where receiver offsets were too large to resolve Vp at depths less than 30 feet.*[98]

- *It is difficult to find a set of parameters that both produces near zero velocity bias across all six sites and also minimizes the maximum range of bias observed at any one site.*[99]

- *An additional parameter to represent a horizontal gradient in Vp/Vs was evaluated but there is not a sufficient distribution of sites to realistically constrain this additional parameter.*[100]

Q20: Has PG&E incorporated the hypothesis offered by Dr. Douglas Hamilton regarding a San Luis Range/Inferred Offshore Fault into the three fault geometry tectonic models used in its 50.54(f) submittal?

---

[94] CCCSIP Report, Chapter 10, p. 10 of 33.
[95] *Id.,* p. 11 of 33.
[96] *Id.,* p. 12 of 33.
[97] *Id.*
[98] *Id.,* p. 20 of 33.
[99] *Id.,* p. 21 of 33.
[100] *Id.*

A20: Yes, although the language used in the CCCSIP Report to suggest this is a bit grudging:

Whereas the specific SLRF 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 DCPP. We note that the interpretations by Hamilton (2012a, 2012c) are being considered for evaluation and integration with other available data following the SSHAC Level 3 process. The SSHAC program for the DCPP, which is being performed under regulatory review by the NRC, is creating a new SSC model.[101]

Three and a half months previously, on May 20, 2014, the assigned PG&E author (William Page) began preparing this section of the CCCSIP Report and emails Dr. Abrahamson (with copies to Mr. Klimczak and Dr. Nishenko) with his conclusion already established:

Norm

As you know from the meeting you had last Thursday with Stu and Rich, I am preparing the response to Douglas Hamilton's Testimony for 1632. I need your help in preparing a Report Section that shows that the potential ground motions calculated using his projected San Luis Range fault beneath the DCPP are enveloped by the ground motions used for the plant.

Draft conclusions are

Using both the San Luis Bay fault and Hamilton's postulated San Luis Range thrust fault as a potential seismic sources [sic]*, the calculated ground motions are enveloped by the DCPP ground motions, and hence do not present an issue from seismic ground motions.*

Let me know what you need to complete this section of the report. I'm

Bill[102]

---

[101] CCCSIP Report, Chapter 12, p. 74 of 82.
[102] A4NR-00065, included in Appendix B as Ex. 49.

On June 12, 2014, Dr. Thompson emails Mr. Page, Mr. Klimczak, Dr. Nishenko, and Dr. Abrahamson (with a copy to Ms. Post):

PROPOSED RESPONSE STRATEGY

I am working on text for the response report. The approach will include what we've written in the executive summary, namely

- *we collected 2D and 3D seismic data using the best available sources, receivers, and processing (fulfilling the commitment PG&E made at the hearing, correct?).*
- *we don't see a moderately NE-dipping fault in the 2D or 3D data beneath the Irish Hills.*
- *However, the data have insufficient depth penetration to evaluate Hamilton's model as stated in his testimony and workshop presentation (we should check this one more time with ONSIP teams)*
- *his general solution of a moderately north to northeast dipping ramp explaining uplift of the Irish Hills and San Luis Range is being considered as part of the SSHAC process, as was presented at Workshop 3.*

*****

To wrap up, I propose to state that the appropriate arena for incorporating Hamilton's SLRF model into hazard is through the SSHAC:

- *The efforts of the SSHAC are giving full consideration to the specific elements of Hamilton's SLRF model (e.g., exact length, dip, and location as indicated in his testimony)*
- *As well as general elements of Hamilton's model (consistency with seismicity, moderate dip, primary uplift rate boundary for the Irish Hills on a northwest to north-dipping fault as opposed to a south or southwest-dipping fault).*
- *The SSHAC process and PSHA approach allow for alternative models to be evaluated, integrated, and weighed based on their relative merits and consistency with all the available data.*
- *The SLBF model proposed by Hamilton cannot be considered a unique or preferred solution based on the discussion above, and thus it is inappropriate to consider it in a deterministic hazard assessment.*

CLOSURE:

I will continue to work on edits and language for this draft report with Bill Page. In the meantime, I welcome comments and thoughts about this strategy. I think the wrong strategy is to go down a road of performing additional analyses now to try and answer an RAI[103]*that has not materialized. It absolutely does seem worthwhile to discuss and*

[103] I believe this reference is to a Request for Additional Information, a procedural tool used by the NRC.

create an internal list of additional analyses and their relative merits that we can perform if an RAI on the topic does arise.

Thanks,
-steve[104]

Mr. Klimczak quickly emails his concurrence[105] and, several hours later, Mr. Page emails draft language that includes the following:

In addition the ongoing seismic source characterization efforts for the SSHAC are considering a moderately north-to northeast dipping reverse fault beneath the southwestern margin of the Irish Hills similar to the geometry being proposed by Dr. Hamilton as an alternative fault geometry that may explain the current tectonic uplift beneath the DCPP.[106]

Six days later, Mr. Page and Dr. Thompson exchange emails:

Steve
Based in discussion with Stu, Norm and Rich yesterday, I'm working on beefing up the seismicity section (with Marcia) and adding the LCI interpretation of the geophysics that helps constrain an east dipping fault near the DCPP. The section on deterministic is deleted. Will have a draft of this late today or first thing tomorrow. Will be adding several figures.

How goes your parts?

Let's talk this afternoon.

Bill

Hi Bill,

I had Matt evaluate where Hamilton's San Luis Range thrust would intersect the ONSIP

[104] A4NR-00054, included in Appendix as Ex. 50.
[105] *Id.*
[106] A4NR-00743, included in Appendix as Ex. 51.

2D line 112-140 – the line from San Luis Hill to Tidewater well that crosses the San Luis Bay fault.

The attached figure shows the result, and it's not promising. The upper map shows the seismic line in red, and two reference dip lines (purple and brown) oriented perpendicular to the Shoreline fault. The lower cross section has two black stars plotted in the lower left corner. These stars show where a 35 degree dipping fault that strikes parallel to the Shoreline fault and impinges on it at 1 km depth would intersect the seismic line. Only the more southerly of the two points plots on depth extent shown by the ONSIP team, but you can imagine a line connecting the two stars that would traverse the lower-left corner of the profile. The deep corners of 2D seismic profiles are commonly inferred to be of the poorest interpretability based on low fold. Thus, I don't think there is a basis to say we 'don't interpret' Hamilton's San Luis Range fault on this 2D seismic line. The more accurate statement is that the data are not of high enough quality at the depths proposed by Hamilton to warrant an evaluation.

Thanks,

-steve[107]

Q21: Did the IPRP express a view on Dr. Hamilton's hypothesis?

A21: Yes, IPRP Report No. 8 contains an extended discussion, including:

The model explaining the tectonic uplift of the Irish Hills hypothesized by Dr. Hamilton consists of a low-angle northeast-dipping thrust fault, the SLRF (Figure 6-12), underlying the Irish Hills with a postulated surface trace almost entirely offshore. This inferred fault, would have a length of 60-80 km extending from an intersection with the Hosgri fault, about 8 km south of Point Estero in the north, to the onshore mapped Wilmar Ave fault to the south (Figure 6-21). The SLRF proposed by Dr. Hamilton appears to be a variation of the Inferred Offshore Fault of Nitchman and Slemmons (1994), Figure 6-23 in Chapter 12. Along the central portion this inferred fault is coincident with the mapped Shoreline fault. The SLRF is interpreted by Dr. Hamilton to be a thrust fault dipping to the northeast that intersects the Shoreline fault at a depth of 1 to 2 km. He hypothesizes that this is the main structure accommodating regional northeast to southwest compression, which ultimately results in uplift of the Irish Hills.

***

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

[107] A4NR-00551, included in Appendix B as Ex. 52.

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.

*****

The assertion by Dr. Hamilton that seismicity beneath the Irish Hills shows an alignment that indicates the SLRF location and activity at depth is not confirmed by the more rigorous seismicity analysis performed by Hardebeck (2010, 2013, 2014a, 2014b). Hardebeck has shown convincingly that these data do not allow a unique interpretation and clearly do not strongly favor any Irish Hills uplift model. However, as previously implied, the interpretation of microseismicity has clear limitations in mapping faults and in this case also cannot be used to rule out the existence of the proposed SLRF.

*****

As presented by Dr. Steve Thompson at the November 17, 2014 IPRP meeting, the SSHAC process is considering an alternative model that includes northeast-dipping thrust faults to explain the uplift of the Irish Hills which largely encompasses the hazard implications of the SLRF model.[108]

Q22: Is there any indication in the PG&E data responses as to how the company responded to Dr. Thompson's discussion of the fault geometry models at the November 17, 2014 IPRP meeting?

A22: Yes. That same afternoon, Dr. Abrahamson emailed Mr. Ferre — *"Kent: I have been listening to the IPRP comments. Their basic comments seem to be that seismic data allow for a wide range of models beyond the range that were presented int he* [sic] [CCCSIP] *report. I think that these are reasonable comments ..."* Mr. Ferre responded:

Norm:

[108] IPRP Report No. 8, pp. 9 – 10.

Steve presented the three fault geometry models in the morning...and Chris Wills asked him if he did the hazard sensitivity by giving full weight to each model. Steve answered in the affirmative and that Nick presented these at SSC SSHAC WS#3. We may want to expand or repeat some of Nick's presentation at the next IPRP meeting.[109]

A month later, Mr. Ferre transmitted IPRP Report No. 8 to Mr. Summy (enthusing, perhaps without reading it closely: "*Overall a very positive report for PG&E.*"[110]) with the observation,

They do however recognize the challenges of imaging the complex geology in the Irish Hills and the difficulty of constraining geometry of the faults at depth. But they do give credit to the 3 tectonic models, developed in the SSHAC seismic source characterization study, as capturing the range of values and kinematics to explain uplift in the Irish Hills.[111]

Q23: Was PG&E committed to affording equal weight to each of the three models?

A23: This question featured prominently in a May 16, 2014 written exchange between the SSC TI Team and the SSC PPRP after SSC Workshop No. 3. The PPRP's formal written comments to the TI Team identified the following as the final item on a list of eight action items for the TI Team:

Documentation of Hazard Sensitivity to Fault Models. The three primary fault models could represent different hazard levels at DCPP. It will be important to document the hazard sensitivity of these various models to establish whether one model represents a substantially higher level of hazard than others, and to be sure that all assumptions are well-founded and applicable uncertainties incorporated.[112]

This evoked the following response from Dr. Lettis on behalf of the SSC TI Team:

[109] A4NR-00289, included in Appendix B as Ex. 53.
[110] A4NR-01444, included in Appendix B as Ex. 54.
[111] *Id.*
[112] A4NR-00070, included in Appendix B as Ex. 55.

The documentation will include hazard sensitivity analyses comparing each alternative tectonic model, and elements within each model. The assumptions and technical bases for each model will be described in the SSC report. The epistemic weighting given to each model, and elements within each model, however, will be based solely on the technical assessments and not on the level of hazard that each model represents.[113]

Some nine months later, although it is not clear from the PG&E data responses what prompted the exchange (it may have been Mr. Halpin's planned presentation to the PG&E Board), the question of weighting the tectonic models prompted a chain of emails stretching from Mr. Halpin through Mr. Strickland and Mr. Ferre to Dr. Nishenko. It starts with Mr. Strickland on February 16, 2015 at 5:30 p.m.:

The IPRP does not see a strong reason to favor the single tectonic model presented in the CCCSIP report over the two alternative models presented by Dr. Thompson at the IPRP meeting on November 17, 2014. The Dr. Thompson approach is used in the SSHAC.[114]

Mr. Halpin responds at 7:12 a.m. the following morning, February 17, with a subject line reading *"Re: Board Meeting",* to Mr. Strickland: *"I will need to really understand this one:"*[115] Mr. Strickland forwards Mr. Halpin's email to Mr. Ferre at 8:23 a.m. on February 17, with the request, *"Can you give a one paragraph explanation that I can us* [sic] *in a call at 0900?"*[116] Mr. Ferre responds to Mr. Strickland at 8:39 a.m. on February 17, with a copy to Dr. Nishenko:

Jearl:

Three faults [sic] *models were developed by the TI team to explain the uplift of the Irish Hills: 1) outward vergent (most similar to the LTSP model) 2) southeast vergent (shallow dipping San Luis bay) and 3) northeast vergent (shallow dipping los osos); this is*

[113] *Id.*
[114] A4NR-01582, included in Appendix B as Ex. 56.
[115] *Id.*
[116] *Id.*

intended to capture the center, body, and range. There is no preferred model based on available data.
Kent[117]

And Dr. Nishenko responds to both Mr. Halpin and Mr. Strickland at 8:55 a.m. on February 17:

Ed
Here's my take –
The three SSHAC models (outward vergent, SE vergent, and NE vergent) are all variations on the same theme. The basic Outward Vergent models [sic] *contains both SE and NE vergent faults and the CCSIP* [sic] *Report further refined the subsurface mapping and identification of the Los Osos and San Luis Bay faults. The role or activity that each one of these individual faults plays varies according to the model (e.g., SE vergent – San Luis Bay fault is dominant while in the NE vergent – the Los Osos is dominant). As Kent said, at this point there is no preferred model based on available data.*

Stu[118]

By the morning of Saturday, February 28, 2015 Mr. Halpin's concern has shifted to understanding why the annual hazard contribution from the Irish Hills he had told the PG&E Board was 1 to 2 percent less than a fortnight earlier had suddenly climbed to 10 to 15 percent. He emails his deputy, Barry Allen, and Mr. Strickland: "*I'm not picking on anyone. I just need to be able to explain it. By Monday please.*"[119]

By 6:05 p.m. that evening, Mr. Ferre has an explanation for Mr. Strickland:

Jearl:

The GMRS[120] *presented a couple of weeks ago was preliminary and did not have the final seismic source characterization model as an input. The biggest change between the GMRS shown a couple of weeks ago and now is the greater contribution from the*

[117] *Id.*
[118] *Id.*
[119] A4NR-01559, included in Appendix B as Ex. 57.
[120] I believe this reference is to ground motion response spectra.

background source in the Irish Hills. This background source now contributes ~5-15%, depending on the frequency range and the hazard level. For example, as shown in Figure 2.2.2-1 of the SPID[121] *report (Reference Rock Hazard by Source for 1 Hz Spectral Acceleration) the background source contributes about 8% to the total hazard at a 10-4 annual hazard. In Figure 2.2.2-2, in a similar curve except that it is for 10Hz, the background contribution contributes ~15% at 10-4 annual hazard. The latest GMRS exceeds the Hosgri at 1.3Hz (by a few percent). At 10 Hz, Hosgri bounds the GMRS. The Technical Integrator team used the best scientific method to characterize the background source. Their method was presented and accepted by the PPRP. It is a technically defensible approach. The background source model from the Shoreline study resulted in a lesser contribution to hazard, but the model did not reflect the current technical approach. Since the AB1632 report is based on a deterministic comparison, a background source is not applicable.*

Keep in mind, the GMRS in the SPID is not final. Norm will rerun the hazard with the final WAACY Magnitude-Distribution model. Norm has said that based on his preliminary runs, the WAACY will result is [sic] *a slight increase in the high frequency range (~1-2% increase) but a negligible change in the low frequency. The final GMRS is expected to be completed mid next week.*

Kent[122]

Monday morning, March 2, 2015, at 6:41 a.m., Mr. Strickland provides a response to Mr. Halpin, augmenting Mr. Ferre's explanation somewhat:

- he deletes the examples drawn from the SPID report.
- he deletes the reference to background sources being inapplicable to a deterministic comparison like the CCCSIP report.
- he deletes the reference to the WAACY Magnitude-Distribution model, and the prediction of a ~1-2% increase in the high frequency range with negligible change in the low frequency.
- he revises the final GMRS completion from *"mid next week"* to "*tomorrow."*

[121] I believe this reference is to PG&E's Seismic Hazard Screening Report, the primary 50.54(f) document submitted to the NRC on March 11, 2015, whose name derives from an EPRI document entitled *"Seismic Evaluation Guidance: Screening, Prioritization, and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic."*

[122] A4NR-01559, included in Appendix B as Ex. 57.

- he adds the explanation that "*Norm used the contribution for the Irish hills that he used in previous hazard evaluations. He revised his model when he received the final input from the Seismic Source team.*"

- he adds the observation that *"Completion of the SSHAC seismic source should have been completed late last year to avoid last minute changes like this."*

- and he expands the description of the background source approach to include, "*It consider* [sic] *three postulated (different) models for the Irish Hills while the AB 1632 studies only consider one. The CPUC IPRP noted in their comments that there was no strong evidence to prefer the model that was used in the AB 1632 studies and that the uncertainty of the three models should be considered."*[123]

And the tectonic models for the Irish Hills play a prominent role some two weeks later, on March 19, eight days after submittal of PG&E's SSHAC report, when media spokesperson Blair Jones finalizes talking points for a SLO Tribune article. Mr. Jones has assembled a number of rebuttal arguments to claims he says former State Senator San Blakeslee and IPRP member Bruce Gibson have made regarding the content of the SSHAC report.[124] Soliciting input from Mr. Ferre, Mr. Strickland, Dr. Nishenko, Regulatory Services Manager Thomas Jones, and Mr. Halpin, the final question posed is whether the SSHAC seismic hazard re-evaluation was "*at all altered based on feedback from the IPRP?"* The carefully crafted answer:

> *... An example of how IPRP feedback was incorporated had to do with the Irish Hills. The* [AB 1632] *seismic studies identified a single preferred fault model for the Irish Hills. The IPRP, after receiving additional insight from the SSHAC team, supported that multiple models be utilized. The SSHAC accepted the IPRP's input and utilized three separate, equally weighted models to characterize faults in the Irish Hills...*[125]

Q24: So, the SSHAC report submitted to the NRC uses three equally weighted models?

[123] A4NR-01881, included in Appendix B as Ex. 58.
[124] A4NR-02004, included in Appendix B as Ex. 59.
[125] A4NR-01870, included in Appendix B as Ex. 60.

A24: No. As explained in Chapter 7 of the SSC SSHAC report, the Outward Vergent and the Southwest Vergent models are each weighted at 0.4, while the Northeast Vergent model is weighted at 0.2.[126]

Q25: What is the hazard sensitivity of that unequal weighting?

A25: As explained in Chapter 14 of the SSC SSHAC report, at the 5 Hz spectral frequency the different models "*correspond to noticeable differences in hazard*" the Outward Vergent resulting in ground motion ratios slightly less than unity, the Southwest Vergent yielding ground motion ratios near unity, and the Northeast Vergent yielding ground motion ratios slightly in excess of unity. There is less difference at the 0.5 Hz spectral frequency.[127]

Q26: Do the PG&E data responses indicate any obvious omissions from the CCCSIP Report?

A26. Yes, two in particular do. One is Mr. Klimczak's July 18, 2014 email to Dr. Abrahamson, Dr. Nishenko, and Ms. Post providing his suggested response to the CEC's original 2008 recommendation concerning an earthquake directly beneath the plant. First he frames the issue:

> *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.*[128]

Then he provides the desired response:

---

[126] SSC SSHAC Report, Rev. A, pp. 7-23 – 7-25.
[127] *Id.,* p. 14-5.
[128] A4NR-00546, included in Appendix B as Ex. 61.

The Shoreline fault report (2011) included a San Simeon-type earthquake beneath the Irish Hills and DCPP where the San Luis Bay fault (50° - 80° north) and the Los Osos fault (45° to 75° Southwest) intersect at depth. The SSC SSHAC logic trees will consider various fault models to explain the uplift of the Irish Hills, including a San Simeon-type earthquake model.[129]

Both of Mr. Klimczak's paragraphs made it into the CCCSIP Report essentially intact.[130] By misstating the original CEC request, which specifically discounted probabilistic assessments, PG&E's answer is substantively unresponsive.

The 2008 CEC report emphasized *"an earthquake directly beneath the plant"* and not simply one beneath the Irish Hills:

Another potential seismic hazard at Diablo Canyon occurs from the possibility of an earthquake directly beneath the plant. Based on seismologic interpretations and conclusions from investigations of the 2003 San Simeon earthquake (magnitude 6.5) that occurred approximately 35 miles north of the Diablo Canyon site, the tectonic (geologic plate) setting where this earthquake occurred appears similar to the local tectonic setting of Diablo Canyon. The deep geometry of faults that bound the San Luis-Pismo structural block, where Diablo Canyon sits, is not understood sufficiently to rule out a San Simeon-type earthquake directly beneath the plant.[131]

And the CEC-prescribed analysis was also clear:

PG&E has considered a San Simeon-type earthquake scenario within probabilistic seismic hazard assessments for Diablo Canyon. However, further studies that consider such an earthquake from a deterministic basis (i.e., using a probability of 1) are recommended to evaluate the full implications of this earthquake, particularly for non-safety related plant components and reliability.[132]

---

[129] *Id.*
[130] CCCSIP Report, Chapter 14, p. 3 of 5, makes minor typographical changes to the second paragraph.
[131] CEC, An Assessment of California's Nuclear Power Plants: AB 1632 Report, November 2008, p. 5.
[132] *Id.,* p. 7, footnote 6.

The second PG&E data response which points to a significant omission in the CCCSIP Report is the "*DCPP Seismic Hazard Update Summary"* which is identified as "*Results from a 12/6/13 CNO Seismic Update meeting."*[133] This meeting occurred during the mid-2013 to mid-2014 period when there was virtually no communication between the IPRP and PG&E and the document describes the anticipated content of a final report then planned for completion in June 2014:

> *The June 2014 report will also have deterministic ground motion spectra plots for the Hosgri, Los Osos, San Luis Bay and Shoreline faults based on multiple faults linkage.*[134]
>
> *i. Hosgri will be linked to faults up to Mendocino Triple Junction (located offshore N. California)*
> *ii. Los Osos linked to Hosgri*
> *iii. San Luis Bay linked to Hosgri*
> *iv. Shoreline linked to Hosgri*
> *v. Linkage of faults allows for larger magnitude earthquake possibilities that have low probability of occurrence*
>   *1. Deterministic plots are <u>not</u> based on earthquake recurrence rates*
>   *2. A hybrid approach, deterministic criteria with probabilistic earthquake magnitude recurrence consideration, will be taken in that our plots will be based on magnitudes at 10-6 annual recurrence rate. This approach addresses fault linkage that is acknowledged by the technical community as possible based on the analysis of earthquake data without overly penalizing ourselves with large magnitude earthquake possibilities with very low probability of occurrence.*
>   *a. Justification of the use of 10-6 would be it is a reasonable cutoff for deterministic analysis, less than 1 in a million chance of exceeding the selected magnitude of an earthquake on each fault. PRA group (Nathan) has provided justification for the use of 10-6 as follows:*

---

[133] A4NR-00660, included in Appendix B as Ex. 62.

[134] An exchange one month later between Mr. Klimczak and Dr. Carola DiAlessandro, Project Manager for the SWUS GMC SSHAC process, identifies the degree to which the severe potential of these joint rupture cases is diminished by probabilistic analyses when run at 10-4. Dr. DiAlessandro: "*The relative change in predicted spectral ordinates in* [sic] *around 150%! That's why we refer at* [sic] *the change as LARGE."* Mr. Klimczak: *"I understand that the spectral accelerations significantly increase from a rupture on the SLB or LO when they are linked to the Hosgri/San Sim but, when the contribution of each fault and the low rate of occurrence for these linked ruptures are accounted for in the development of the hazard the impact is small."* A4NR-00098, included in Appendix B as Ex. 63.

A recent reference that defines design basis accident scope can be found in INL/EXT-10-19521 "Next Generation Plant Licensing Basis Event Selection White Paper". This paper describes the frequency based categories for licensing basis events (LBEs). These categories are anticipated operational occurrences (AOOs), infrequent design basis events (DBEs) and beyond design basis events (BDBEs).

- *AOOs - greater than 10^{-2} per plant-year*
- *DBEs - < 10^{-2} and > 10^{-4} per plant-year*
- *BBDEs - < 10^{-4}*

For seismic events, definition of a lower limit on BDBE's can be aligned with the concept of the 'maximum credible earthquake' or MCE (NUREG-0800 Rev. 2). The MCE represents the level of ground motion for which a nuclear power plant must be designed to safely shut down and is defined as the 'largest earthquake that can be reasonably expected to occur on a geologic structure in the current tectonic region'. An accepted quantitative measure of the credibility or reasonableness of severe accident consequences has been established as a frequency of core damage of less than 10^{-6} per year (Regulatory Guide 1.174). This criterion can be conservatively applied to the frequency of earthquake occurrence for the purposes of identifying the characteristics of the MCE. Also supporting the determination of a 10^{-6} per year frequency of occurrence criterion for the MCE is PRA scoping guidance from Regulatory Guide 1.200 which states that an external event can be screened from a plant probabilistic risk assessment (PRA) if a conservative analysis shows that the event's contribution to CDF is less than 10^{-6} per year. Therefore, a seismic hazard frequency of 10^{-6} per year conservatively meets the RG 1.200 external event screening criterion.

b. Plots at magnitudes based on 10^{-7} annual recurrence rate will also be developed but, not included in the report

c. The report will also note that there is a probabilistic seismic hazard update in process that considers all possible magnitudes of earthquakes at any annual recurrence rate.

The "*Results from a 12/6/13 CNO Seismic Update meeting"* document also identifies the logical inconsistency of confining PG&E's linkage-based update to the NRC's RIL 12-01 to only the greater capability of the Shoreline Fault:

> *The RIL letter requires an update to the NRC if the Shoreline Fault is found to be more capable. Linking the Shoreline Fault (SLF) to the Hosgri will allow for a higher magnitude earthquake on the SLF and thus be more capable. The other three faults in the SLF report will also be more capable due to linkage. Need to decide how this information is to be passed on to the NRC with Regulatory Services and the Law department.*[135]

Finally, the *"Results from a 12/6/13 CNO Seismic Update Meeting"* document suggests a deterministic evaluation requested by the previous Chief Nuclear Officer, John Conway, will also be kept out of the CCCSIP report:

> *J. Conway's M8 deterministic request:*
>
> i. *Norm has provided plots of M8 earthquakes on the Hosgri, SLB, Los Osos and Shoreline.*
> ii. *It was decided to only evaluate the 'critical' SSCs in any frequencies of exceedance ranges to show they can perform their safety function. Action by Seismic Projects.*
> iii. *This is an internal evaluation only.*[136]

Q27: Is A4NR prepared to make a ratemaking recommendation with regard to the DCSSBA?

A27: Not at this point. PG&E has not yet responded to significant A4NR data requests, and our specific proposals will have to be deferred to the briefing stage of this proceeding.

---

135 *Id.*

136 *Id.*

Appendix A

Professional Qualifications of John Geesman

PROFESSIONAL QUALIFICATIONS OF JOHN GEESMAN

John Geesman is an attorney with the Oakland law firm, Dickson Geesman LLP. He was a member of the California Energy Commission from 2002 to 2008, and its Executive Director from 1979 to 1983. Between his two tours at the Commission, Mr. Geesman spent 19 years as an investment banker focused on the US bond markets.

He has previously served as

- Co-Chair of the American Council on Renewable Energy,
- Chairman of the California Power Exchange,
- President of the Board of Directors of TURN,
- a Board Member of the California ISO,
- and Chairman of the California Managed Risk Medical Insurance Board.

He is a graduate of Yale College and the UC Berkeley School of Law.

Appendix B

PG&E Data Responses

Exhibit 1

A4NR-00348

From: Summy, Jeff <J51D@pge.com>
Sent: Wednesday, June 25, 2014 10:04 PM
To: Klimczak, Richard <RLK1@pge.com>
Cc: Post, Jennifer (Law) <JLKm@pge.com>; Jones, Thomas P. <TPJ2@pge.com>; Cuddy, Thomas <TNCS@pge.com>; Jahangir, Nozar <NxJ1@pge.com>
Subject: Upcoming Meetings (Privileged and Confidential)

Rich,
Ed asked me to meet with him today. He had a few requests that I will follow-up on but I wanted you to know so you can understand what he is looking for since after Friday I will be out of the country in Italy, Greece, Turkey for 2 weeks. I will be connected via text, phone, and limited emails so please don't hesitate to contact me to discuss.

The first is he reviewed the Executive Summary that was presented in the recent webcast. I think John really alerted him to it but it is important for all of us to understand. He specifically asked about the last set of ground motion curves in the presentation where it shows us using the 86th percentile for a deterministic evaluation that links Hosgris, San Simeon, and Shoreline and shows exceedance both at low frequency and high frequency. He is asking why are we even including that. I said I thought it was because state of the art would require us to link these so the IPRP would expect this combination. I also said the NRC would not worry about this (since they actually told us they will not expect us to link faults until we do the Seismic PRA) but he said (and he is likely right) that our opponents will challenge us on this. I responded that Nozar could demonstrate this is not really a safety challenge for the plant especially for how the NRC is treating eastern and Midwest plants. However his challenge is why do we need to include it at all? So can you sort that out so we can address it with Ed.

The next request he had was for us to conduct another webcast for him so he can have an opportunity to ask questions on the Executive Summary slides so he has a good understanding and be able to speak to each. He asked that Tom Jones be there to capture key talking points for him. He asked for that to be setup for next week. So I will work with Karen on Thursday to set that up. I will ask her to work with you and Tom for date / time.

The third request was for us to setup a briefing for Chris and Tony prior to the release of the report. He has a good point we likely did not address that level in our briefing plans. Again I'll ask Karen to try to set that up either the week 7/14 or the following week for whatever day she can make that happen. That should ensure we are far enough along with the review and approval process that we can be sure what we tell Tony / Chris is pretty close to what will be released. If possible can you have someone start putting together a power point for this briefing. Also who would we want at that meeting?

Tom Jones he also asked that for the external briefing plan we published we fill in the TBD's.

Please let me know if anyone see's a problem with this plan.

Thanks
Jeff S

Exhibit 2

A4NR-00999

From: Halpin, Ed <E1H8@pge.com>
Sent: Thursday, July 3, 2014 6:57 PM
To: Jones, Thomas P. <TPJ2@pge.com>
Cc: Klimczak, Richard <RLK1@pge.com>; Strickland, L Jearl <LJS2@pge.com>; Jahangir, Nozar <NxJ1@pge.com>; Nishenko, Stuart <SPN3@pge.com>; Abrahamson, Norman <NAA2@pge.com>
Subject: Advanced Seismic Studies

Privileged and Confidential

Tom -my fundamental conclusions are at the end (1-8). We need to work on these.

Thanks for the help

Ed

Seismic

Privileged and confidential

A. Background

Started additional surveying in 2009.

Triple play boomer. Like a car horn over ocean. On land you use thumpers...accelerated weight drop for shallow ...vibazized piston. Dow to KM deep.

3-4 KM on land

500 m. Over ocean

B. Tornado-represents uncertainty

Sensitivity done using a probabilistic approach...1 x 10-4. 2 g at 5k hz

IPRP-agreed clear coordination

Conclusions

1. Hosgri Fault Slip Rate

1.8-1.9 mm/ yr. which is less than the 2.25 mm/y used in 2011. Only a player in probabilistic

2. Hosgri Fault. Dip

Tried to use the high energy air guns....denied...looked at previously collected data as well as additional data ...all data is consistent with a steep vertical (greater than 75 degrees). Can't dip under plant and cause a large ground motion. Dip of Hosgri in 1988 was an outstanding issue. Used gravity and magnetics. High energy seismic only goes to 3-4 km. Earthquakes happen at 12 km so you would not be able to see it. Not invasive. Earthquake locations is consistent with magnetic and gravity...land and 4 seismometers. USGS data. High confidence. Consensus with IPRP. Completely different it's a strike slip fault...subduction zone was

Fukushima.

State did not provide guidance on high or low.   Blakslee wanted high energy...

3. Shoreline Fault Slip Rate

We had assumed 1mm/y....it's actually .1 mm/y. Good resolution. 3D was a big success using low energy.

Probablistic. Shoreline contributes 20 percent to CDF ...now with this data it's 2 -3percent.

Conclusion is that the Hosgri is the predominant fault which is what the plant is designed to

4. Step over Hosgri (eastern end) and San Simeon.

You can have step over resulting in 7.1 to 7.3. Hosgri is more capable and longer. Ground motion is bounded. Conservative approach. We assumed it linked. We are now considering larger earthquakes. Address critism we are looking at more conservative.

5. Los solos fault dip.

Steeper dips north eastern front of Irish hills. Steeper dips reduce ground motion

It's 55 to 82. We conservatively model 45-75. Seismicity continues to get clearer. Was 30, 45 and now 55. Making continuous progress.

6. Los solos fault sense slip

The data supports it is reverse slip as compared to strike slip. No evidence to support strike slip.

7. Hosgri shoreline rupture

High energy may or may not have given us info. We assumed they connected-conceding the point that they link.

9. Shoreline southern end.....22 km vs 10 km. 2D 3d

10 Shoreline is increased from 23 km to 45 km

Interacts with smaller faults

1. Ocean bottom seismometers others array in 2013. Shoreline and Hosgri   Point Bucheon.

High energy seismic survey

No need to pursue....we are using gravity magnetic fields......

DCPP shear Wave Velocity model-

Previously we had 4 bore holes and used 1200 m per sec...higher value means less. Slower is worse.

3D.

Coming up through the rock

Most eastern plants assume a constant value for the entire sight. Our data is unprecedented.

3D tomographic image. Like a cat scan. Vs a bore hole.

Not available in the world.

Vs30 power block

1260....power block. What we assumed

Go further west vs 30 gets lower

Intake structure

It's our way of verifying the site geological condition. It's variable across the site

Site response eval

More amplification at low freq.....less at higher

Most sites average. Ours is customized.

Response spectra-deterministic........

Power block/turbine building ok

Now add in shoreline/Hosgri and San Simeon.....

We touch at low freq and high freq but we are still bounded deterministic ally

Hamilton Testimony

Geesman claims we are Not paying attention to the Diablo cove fault....Irish hills uplifting .1. Because there is an inferred offshore fault....

Diablo cove fault-fault is dead...inactive...has not moved in 100,000 years

Does it touch shoreline or Hosgri. We don't see that it extends....or touches.

San Luis Range inferred offshore fault and how it effects Irish hills-our seismic data in the plant does not show it as a shallow feature....seismicity is much too diffuse to define fault planes as Hamilton infers.

Because we recognize the hills are uplifting we have proposed an alternate model that's driving the Irish hills. This has to be addressed further.

Hamilton has created one model but it falls apart...

Conclusions

1. The PGE team has met our commitment to fully understand the seismicity surrounding DCPP in accordance with AB 1632 following the events of Fukushima.

1. Our efforts as a part of our LTSP and this commitment have brought greater clarity, reduced uncertainty and confirmed our conclusions that DCPP is seismically bounded, safe and a reliable asset that can serve California for decades to come.

2. We have an unprecedented view of the seismic picture surrounding DCPP based on the data collected. We believe our final report will solidify the robustness of our design and will help to put to rest any doubts external key stakeholders have in regard to seismic safety at DCPP. We believe we have answered all of the questions posed by the IPRP of the PUC but will work with them to answer additional questions throughout the summer once the report is issued.

3. The advanced studies will feed the new Senior Seismic Hazard Analysis which is the new probabilistic method for evaluating seismic hazards. This is a shift from the current deterministic modeling to probabilistic. For PGE we have had a seismic PRA since the early 1990s unlike other stations. This information and the SHAC process will continue to inform that analysis as has all data taken over the last 25 years.

4. We learned new things...we have a longer, more capable shoreline fault but nothing that challenges our design margin

5. We have a Better understanding site amplification. Specifically we have gathered unprecedented information in regard to shear velocity through the rock under the site. This will lead to better overall modeling when evaluating critical components using the new probabilistic process.

6. Even with linkage of faults, which is not usually considered or required to be factored into a deterministic model, we are bounded.

7. Slip rates for key faults are now measured as opposed to inferred. Dip angle and slip rates are less than what was previously assumed thus allowing for more margin.

8. The data that we have gathered coupled with our previous modeling, sophisticated seismic PRA and continued modeling of seismicity surrounding the plant equips us to be aware of changing conditions yet at the same time proves our design and the associated plant margin to multiple significant earthquake scenarios is excellent.

Sent from my iPad

Exhibit 3

A4NR-01000

From: William Lettis <lettis@lettisci.com>
Sent: Tuesday, July 15, 2014 8:58 AM
To: Norm Abrahamson <abrahamson@berkeley.edu>; Abrahamson, Norman <NAA2@pge.com>
Subject: FW: Final Briefing

Hi Norm

I need to have an urgent discussion with you early next week. Please see email from Steve below.

In terms of the SSHAC schedule, I need you to know that the earliest we can probably? get a final SSC model to you for the PSHA is in late September to late October time frame. Steve (in particular) and Hans have been tied up almost full time with the AB1632 study, which is in very sad state (this is another issue that I would like to discuss with you, in terms of PG&E Geosciences credibility).

Thus, everything is on hold, pretty much, for development of the SSHAC SSC model. We urgently need feedback from you, Katie, and Nick on the sensitivity analyses, and how to build the Mmax MFD.

At this point in time, I think it would be wise for PG&E to talk with the NRC about a 3 to 6 month delay in submitting the 50.54f response. We can offer the NRC many reasons, but the fundamental reason is the completion of ongoing new studies (AB1632, USGS CRADA, etc) that we would like to incorporate into the model.

Please let me know when we can discuss next week, and then I would like to follow up with Kent and Rich.

THANKS
BILL

From: Steve Thompson <thompson@lettisci.com>
Date: Tuesday, July 15, 2014 at 8:47 AM
To: William Lettis <lettis@lettisci.com>, Hans AbramsonWard <abramsonward@lettisci.com>
Subject: RE: Final Briefing

Bill and Hans,

Things are going horribly.

Next week's meeting should in no way be called a final briefing meeting. If our goal is to show major progress towards the final model, we are not on track to do so. We are not getting the needed input from others (e.g., Katie, Norm, and Nick) and we are not completing the work ourselves (Me and Hans).

AB 1632 continues to be a major major distraction for me. I am working on the Hamilton report all this week and probably most of next. I am being asked to review all AB1632 reports late this week and next. Last night I reminded Rich and Stu that we have this meeting the 24th and 25th and there is little to no recognition of any urgency for the SSHAC to stay on track. Their focus is completely on getting the AB1632 reports finished. From what I have read (parts of PR-21, PR-22), or have learned from others (Unruh's PR-21 review, Hans' LESS review), these reports are in bad shape and will be a blight on PG&E if they go out as is.

I brought up the subject of requesting a delay with Kent; it was immediately rejected. My impression is that you have to take the lead in that type of discussion, and perhaps get Norm on board first.

We need a major shift in focus and priorities if we are going to complete this project.

-steve

Lettis Consultants International, Inc. (LCI)
1981 N Broadway, Suite 330
Walnut Creek, CA 94596
Main: (925) 482-0360
Direct: (925) 482-0363, x203

Stephen C. Thompson, PhD
Principal Geologist
thompson@lettisci.com * mobile - (510) 919-7465

From: William Lettis [mailto:lettis@lettisci.com]
Sent: Tuesday, July 15, 2014 8:32 AM
To: Steve Thompson; Hans AbramsonWard
Subject: Final Briefing

Hi Steve and hans

How are you doing? I know that everything is hectic. Please let me know if our meeting with the PPRP is still going to occur next week, and if so, is this meeting still a "Final Briefing" or are we going to call it another Working Meeting. What are your thoughts. I am currently spending mornings on Chapter 3 of the report; but if you have anything for me to review on the final model or to weigh in on any modeling decisions in prep for the Final Briefing, please let me know.

Steve – if you want me to participate in a phone call with Rich about schedule delay for SSHAC and to encourage PG&E to discuss with NRC, please let me know

Thanks
Bill

Exhibit 4

A4NR-02215

From: Strickland, Jearl </O=PG&E/OU=CORPORATE/CN=RECIPIENTS/CN=LJS2>
Sent: Tuesday, March 10, 2015 7:02 PM
To: Baldwin, Thomas (DCPP) <TRB1@pge.com>
Subject: Re: Seismic Submittal

Yes.

On Mar 10, 2015, at 6:37 PM, "Baldwin, Thomas (DCPP)" <TRB1@pge.com> wrote:

Jearl
Based on your description it looks like the outgoing requires the following:
1) Use attached cover letter
2) Insert the revised enclosure page 5 and remove old
3) Attach the three letters that you sent here as two files (18_SWUS_AppendixB_ rev 2) and (Appendix C – PPRP letters) in enclosure 1, Att C.

And that is all – correct? Chuck Mackey gets here before everybody, so if this is accurate can you let him know? He said he saw the updated files in the location Danielle had been saving them.

Thomas R Baldwin, P. E.
Director, Site Services
Pacific Gas & Electric Company
Diablo Canyon Power Plant

Office: 805.545.6060| Cell: 805-441-3227| email: trb1@pge.com

From: Strickland, Jearl
Sent: Tuesday, March 10, 2015 6:02 PM
To: Allen, Barry; Halpin, Ed
Cc: Jones, Thomas P.; Strickland, Jearl; Baldwin, Thomas (DCPP)
Subject: Seismic Submittal

Barry, Ed:
The issue that we have been addressing today is associated with the review of the work performed associated the Ground Motion Characterization (GMC) performed by the SSHAC Technical Integration team. According to Norm, Kent and Nozar, the impact of additional analysis only deals with low frequencies (less than 2.0hz) and that the additional confirmatory analysis will not change the conclusions presented in the report. The information offered about the plant being seismically safe is not affected by this issue.
I've attached a copy of the revised submittal letter. The change is as follows: "The GMC closure letter found that the DCPP SSHAC meets the expectations for a SSHAC Level 3 study but requested that additional technical justification be provided regarding the application of the directivity component of the GMC model to the DCPP site. The SSHAC Technical Integration team provided a response to the PPRP request (see Enclosure 1 Appendix C). PG&E will submit the resolution of the PPRP identified request as soon as it is completed."
The Same language was added within the text of the submittal. We will update the SAPN to reflect the regulatory commitment.
Below are the specifics:
PPRP Issue:

The GMC PPRP noted that the Technical Integration (TI) team's evaluation of the two considered directivity

models had limitations. Directivity affects the GMRS at lower frequencies, < 2 Hz, by adding a slight amplitude (due to a pulse) to the GMRS. The two models are the unpublished Watson-Lamprey (WL) model and a published Chiou-Youngs (CY14) model. The WL model was given 100% weight given its computational efficiency (a simple hazard run with the CY14 model for one test case takes four days to run) . The PPRP felt that within the GMC SSHAC report, the WL model, because it is not yet published, needed more rigor justify its weighting in the SSC model. They noted that model comparisons were not 1) sufficiently explained; 2) explored beyond the single fault case; and 3) quantified in terms of equal hazard spectra at hazard levels 10E-5 and lower.

<u>Technical Integration Team response:</u>
The TI team agrees that the limitation is valid from a science view point, but that they have demonstrated the range of differences between the two models is well within the broad ranges of uncertainty use for the total standard deviation in the GMC model. The TI team has discussed the differences between the two models in the SSHAC report. For DCPP, using either approach leads to a small effect on the hazard at 10E-4 (the hazard level for the GMRS). Bottom line, This limitation does not significantly affect the ground motion model for DCPP given in this report.
<u>Actions to modify the submittal:</u>
<!--[if !supportLists]-->1) <!--[endif]-->Appendix C of the SPID (Screening, Prioritization and Implementation Details) shall include both the GMC closure letter and TI response…plus the SSC closure letter.
<!--[if !supportLists]-->2) <!--[endif]-->The body of the SPID and cover letter should include high level language to note the PPRP limitations
<u>Commitments to additional work after submittal:</u> For completeness of the SSHAC and addressing the PPRP noted limitations.
<!--[if !supportLists]-->1) <!--[endif]-->Norm recommends having the Pacific Earthquake Engineering Research Center (PEER) establish a review panel to evaluate the issue and develop recommendations going forward. The panel would <u>not</u> include members of the TI team and PPRP to provide further independence and rigor to the process.
<!--[if !supportLists]-->2) <!--[endif]-->Perform additional runs comparing results from both models on different fault scenarios, including reverse faults. This would be performed by the TI team and a Hazard Analyst
<!--[if !supportLists]-->3) <!--[endif]-->Conduct formal research on a directivity model that is consistent with the median and standard deviation of the industry approved ground motion prediction equations. This would be conducted through PEER and/or the Sothern California Earthquake Center (SCEC)
Each of these commitments would have a different time frame for completion. The research would be tied to the LTSP. Performing the additional runs and the PEER review panel should be able to be conducted in a couple of months.
Based on our earlier discussion, The process used to manage the SSHAC process will be evaluated in detail and a lessons learned developed with specific actions to improve the performance of the Geosciences department.
Tom Jones and I are driving home from Sacramento tonight. We will be in the car for the next 6 hours so you can call me on the cell for more information. Tom will provide a media perspective in the morning.
Please let me know if you need additional information.
…Jearl
Ps…I also attached copies of the PPRP letters for your reference

Exhibit 5

A4NR-00263

	A	B	C	D	E	F
1	**DCPP Seismic Report Rollout Outreach -- All time Pacific Standard Time**					
2	**Updated 7/30/14: TPJ2 - DRAFT - NOT APPROVED**		**Date**	**Owner**	**Resources**	**Status**
3		**Geosciences Report Preparation Current to August**				
4	**1**	14 of 15 reports available for review on SharePoint (all but #12)	7/17/14	Klimczak	Geosciences Team	In Progress
5						
6	**2**	Review Reports	7/17-7/22/2014	Jones	Parker, B. Jones, T. Cuddy	
7						
8	**3**	Deadline for comments on reports 1-14	7/23/14	Klimczak	Corp Affairs, Law	
9						
10	**4**	Schedule Halpin phone update for NRC	7/25/14	Baldwin	Karner	
11						
12	**5**	Report #12 (Hamilton) Available on SharePoint for review	7/26/14	Klimczak		
13						
14	**6**	Deadline for comments on #12	7/30/14	Klimczak	Corp Affairs, Law	
15						
16	**7**	Update report comments to geosciences team	8/1/14	Jones	Klimczak	
17						
18	**8**	Geosciences Incorporates Comments	8/1/14	Klimczak	Geosciences	
19						
20	**9**	Meet on Roll Out Plan	8/1/14	Halpin	Geosciences	
21						
22	**10**	Geosciences to deliver reports to DCPP	8/4/14	Klimczak	Geosciences	
23						
24	**11**	Create Executive Summary of Outreach Efforts	8/4/14	Jones	B. Jones	
25						
26	**12**	Halpin/Team review go/no go on report release	8/7/14	Halpin	Geosciences, Law	
27						
28	**13**	Beginning physical production	8/8/14	Klimczak	Geosciences team	
29						
30	**14**	Distribute physical materials to external teams	8/20/14	Klimczak	Geosciences, Corp Affairs, Reg Rel	
31		**Outreach Actions**	**Time**	**Owner**	**Resources**	**Status**
32		**August 1-25**				
33	**1**	Ed Halpin to update NRC (Kris Kennedy)	8/10/14	Halpin	Baldwin, Geosciences	TBD based on Aug 4
34						
35	**2**	Eric Jacobson to schedule CPUC meetings T-14	8/10/14	Jacobson	Geosciences, Corp Affairs	
36						
37	**3**	Schedule external training on seismic report	8/10/14	Jones	Geosciences, Law	
38						
39	**4**	Drop in visit with NRC - Dan Dorman, et al	8/21/14	Baldwin, Summy		

	G
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	

	A	B	C	D	E	F
40						
41	**5**	Place Holder				
42						
43		**August 27 Confidential Pre-Briefings**				
44	**1**	Just in time/refresh training for external teams	9:00:00	T. Jones	All external, Geosciences - conference call training	
45						
46	**2**	County Briefing (County CAO Buckshi, Supervisor Hill, Sheriff Parkinson, Ron Alsop OES)	13:00:00	T. Jones	Halpin, Strickland, Shoals	
47						
48	**3**	Reg Rel CPUC Outreach	13:00:00	E, Jacobson	Klimczak	
49						
50	**4**	Governor's Office Outreach	13:00:00	K. Kauss	Geosciences if needed	
51						
52	**5**	State Agency - CEC, Coastal Commission	13:00:00	M. Krausse	Geosciences if needed	
53						
54	**6**	Federal Outreach	13:00 Pacific	J. Hogle	Geosciences by phone	
55						
56	**7**	Resident, Region 4 and NRR Phone Briefing	13:00:00	Baldwin, Summy	Geosciences	
57						
58	**8**	Advanced Embargoed Briefing for Tribune	15:00:00	Blair Jones	Ed Halpin, Strickland	
59						
60	**9**	Place Holder				
61		**August 28 - Submit Report to NRC & CPUC IPRP at 11:00 AM**				
62	**1**	Send Update to Officers & Directors	9:00:00	K. Stephens	T. Jones, T. Cuddy	
63						
64	**2**	Contact Balance of CPUC	10:00:00	Eric Jacobson	Talking Points	
65						
66	**3**	Contact San Luis Obispo County Officials	10:00:00	T. Jones	J. Shoals, Talking Points	
67						
68	**4**	Contact Federal Offices	10:00:00	Jessica Hogle	Talking Points	
69						
70	**5**	Contact State Assembly & Senate Offices	10:00:00	Kent Kauss	Talking Points	
71						
72	**6**	Send note/launch internal plan to DCPP Employees	10:30:00	T. Cuddy	Note from Halpin, other items per plan.	
73						
74	**7**	Place Holder				
75						
76	**8**	Submit Report to NRC & CPUC (IPRP), NRC Cover Letter from Halpin, IPRP cover letter from inviting their comments for specified period in accordance with rate case	11:00:00	J. Summy	Geosciences, Letter, Report	
77						

	G
40	
41	
42	
43	
44	
45	
46	
47	
48	
49	
50	
51	
52	
53	
54	
55	
56	
57	
58	
59	
60	
61	
62	
63	
64	
65	
66	
67	
68	
69	
70	
71	
72	
73	
74	
75	
76	PUBLIC LAUNCH
77	

	A	B	C	D	E	F
78	**9**	Los Padres DLT Update	11:00:00	Jones	Email Talking Points, Schedule	
79						
80	**10**	Contact Local Government Officials (In SLO County and SB County)	11:00:00	Shoals	Talking Points, Blast Email	
81						
82	**11**	Contact State Agencies	11:00:00	M. Krausse	Talking Points, Geoscience team member if needed	
83						
84	**12**	Outreach to Community Stakeholders	11:00:00	L. Miller	DCPP Corp Affairs	
85						
86	**13**	Issue news release, post to website, Currents	11:00:00	Blair Jones	News Release	
87						
88	**14**	Halpin Brown Bag at DCPP/employee briefing at lunch	11:00:00	Cuddy	Note from Corp Affairs	
89						
90	**15**	Place Holder				
91		**Pre Outreach Production, Corp Affairs (July/August)**	**Date**	**Owner**	**Resources**	**Status**
92						
93	**1**	Compose/Manage Outreach Plan	ongoing	T. Jones	DCPP Corp Affairs, Geosciences, CNO,	First Draft
94						
95	**2**	Review Seismic Report & Create Main theme and speaking points	ongoing	T. Jones	T. Cuddy, B. Jones, Geosciences	first draft complete
96						
97	**3**	Develop PG&E internal communications plan		T. Cuddy	Energy Supply, Geosciences, Law	open
98						
99	**4**	Develop external talking points, media outreach & webpage update		B. Jones	Energy Supply, Geosciences, Law	first draft complete
100						
101	**5**	Secure Sr. Management Messaging Approval	August 20 lockdown	T. Jones	Fitzpatrick, Pruett, Halpin Conway, B. Jones, K Stephens, Bedwell	
102						
103	**6**	Draft Officer & Director Note		T. Cuddy	Energy Supply, Law	open
104						
105	**7**	Create All Employee Communication for Chris Johns		K. Stephens, Castagnola	Energy Supply, Law	
106						
107	**8**	Organizer Reviewers for product walkthrough		T. Jones	Corp Affairs, Reg Rel, Law, Geosciences, Energy Supply	

	G
78	
79	
80	
81	
82	
83	
84	
85	
86	
87	
88	
89	
90	
91	
92	
93	
94	
95	
96	
97	
98	
99	
100	
101	
102	
103	
104	
105	
106	
107	

	A	B	C	D	E	F
108						
109	**9**	Review Seismic Report & Create Main theme and speaking points		T. Jones	T. Cuddy, B. Jones	in progress
110						
111	**10**	Create Investor Relations information		Post	Energy Supply, Geosciences, Law	in progress
112						
113	**11**	Create finalized cover letter for reports	8/15/14	T. Jones/T. Baldwin	DCPP Corp Affairs, Energy Supply, Geosciences, Law	
114						
115	**12**	Finalize all target audiences for outreach	8/15/14	T. Jones		
116						
117	**13**	Seismic Training for Outreach Team		T. Jones	Klimczak, Norm A. Stu N.	
118		**Post Outreach Activity (Mid - Late August)**	**Date**	**Owner**	**Resources**	**Status**
119	**1**	Teams report back feedback from outreach efforts	august 13-14	T. Jones	All forward facing teams	
120						
121	**2**	Create follow up messages and update audiences as needed	Open	T. Jones	Energy Supply, Law, Corp Affairs, Procurement	
122						
123	**3**	Public Meeting with NRC	3 weeks after	T. Baldwin	T. Jones (note meeting must be after 9:00 AM pacific)	
124						
125	4	PG&E Seismic Workshop	September	T. Jones, R Klimczak	Geosciences, Corp Affairs	Not Approved
126						
127	5	Place Holder				

Exhibit 6

A4NR-00264

From: Summy, Jeff <J51D@pge.com>
Sent: Friday, August 1, 2014 7:58 AM
To: Klimczak, Richard <RLK1@pge.com>
Cc: Ferre, Kent S <KSF1@pge.com>
Subject: RE: Seismic Advanced Studies

Rich,
Sounds good. I attached the proposed agenda for the meeting. I'm only giving you a short time since I think Ed is really just looking to hear you are done and ready to proceed. Most of the meeting will be Tom Jones talking about how we get people ready for the issuance.

Thanks
Jeff S

From: Klimczak, Richard
Sent: Friday, August 01, 2014 7:39 AM
To: Summy, Jeff
Cc: Ferre, Kent S
Subject: RE: Seismic Advanced Studies

Jeff,

Based on Ed's request for "finished product highlights" I would summarize the Ex. Summary, whose conclusions have not changed since the last time we talked with Ed on July 2nd. I will also send the tornado plot, updated. Anything else?

Rich

From: Summy, Jeff
Sent: Wednesday, July 30, 2014 1:58 PM
To: Robinson, Kelly (DCPP)
Cc: Klimczak, Richard; Ferre, Kent S; Jones, Blair; Jones, Thomas P.; Strickland, L Jearl
Subject: Re: Seismic Advanced Studies

Thanks

Sent from my iPad

On Jul 30, 2014, at 1:58 PM, "Robinson, Kelly (DCPP)" <KNHi@pge.com> wrote:

> Calendared for Friday at 1130.
>
> **Kelly Robinson**
> Executive Assistant
>
> **P: 805.545.3368 | C: 805.416.4076 | F: 805.545.4234**
>
> ---
>
> **From:** Summy, Jeff
> **Sent:** Wednesday, July 30, 2014 1:27 PM
> **To:** Robinson, Kelly (DCPP)

Cc: Klimczak, Richard; Ferre, Kent S
Subject: Fwd: Seismic Advanced Studies

Kelly,
Can we get on Ed's calendar for a call in for Friday. Need a half hour. Can we do it at lunch time 11:30 to 12:30 if possible to fit my schedule with ISS presentations.

Will need Kent (Rich as optional on the invite). Also need Tom Jones, Blair Jones, and Jearl.
Thanks,
Jeff S

Sent from my iPad

Begin forwarded message:

> **From:** "Halpin, Ed" <E1H8@pge.com>
> **Date:** July 30, 2014 at 12:09:05 PM PDT
> **To:** "Jones, Blair" <BXJk@pge.com>, "Jones, Thomas P." <TPJ2@pge.com>, "Strickland, L Jearl" <LJS2@pge.com>, "Summy, Jeff" <J51D@pge.com>
> **Subject: Seismic Advanced Studies**
>
> I'd like to review where we are with this effort and talk through the finished product highlights and our refined communication efforts. Can we meet this week?
>
> Thanks
>
> Ed
>
> Sent from my iPad

Exhibit 7

A4NR-00331

From: Klimczak, Richard <RLK1@pge.com>
Sent: Monday, August 25, 2014 9:02 AM
To: Jones, Blair <BXJk@pge.com>; Nishenko, Stuart <SPN3@pge.com>; Ferre, Kent S <KSF1@pge.com>
Cc: Summy, Jeff <J51D@pge.com>; Jahangir, Nozar <NxJ1@pge.com>; Post, Jennifer (Law) <JLKm@pge.com>
Subject: Privileged and Confidential: Please review ASAP

Privileged and Confidential

Blair,

I agree with your statements in the article. I have not seen M. Peck's 42 page confidential report and cannot comment on the accuracy of its portrayal in the article. I am not privy to the NRC's internal review of M Peck's issue and cannot comment on this topic.

Rich

From: Jones, Blair
Sent: Monday, August 25, 2014 8:44 AM
To: Nishenko, Stuart; Ferre, Kent S; Klimczak, Richard
Subject: Please review ASAP

AP Exclusive: Expert Calls for Nuke Plant Closure
By Michael R. Blood
Associated Press, August 25, 2014

LOS ANGELES (AP) — A senior federal nuclear expert is urging regulators to shut down California's last operating nuclear plant until they can determine whether the facility's twin reactors can withstand powerful shaking from any one of several nearby earthquake faults.

Michael Peck, who for five years was Diablo Canyon's lead on-site inspector, says in a 42-page, confidential report that the Nuclear Regulatory Commission is not applying the safety rules it set out for the plant's operation.

The document, which was obtained and verified by The Associated Press, does not say the plant itself is unsafe. Instead, according to Peck's analysis, no one knows whether the facility's key equipment can withstand strong shaking from those faults — the potential for which was realized decades after the facility was built.

Continuing to run the reactors, Peck writes, "challenges the presumption of nuclear safety."

Peck's July 2013 filing is part of an agency review in which employees can appeal a supervisor's or agency ruling — a process that normally takes 60 to 120 days, but can be extended. The NRC, however, has not yet ruled. Spokeswoman Lara Uselding said in emails that the agency would have no comment on the document.

The NRC, which oversees the nation's commercial nuclear power industry, and Diablo Canyon owner Pacific Gas and Electric Co., say the nearly three-decade-old reactors, which produce enough electricity for more than 3 million people annually, are safe and that the facility complies with its operating license, including earthquake safety standards.

PG&E spokesman Blair Jones said the NRC has exhaustively analyzed earthquake threats for Diablo Canyon and demonstrated that it "is seismically safe." **Jones** said in an email that the core issue involving earthquake

ground motions was resolved in the late 1970s with seismic retrofitting of the plant.

The disaster preparedness of the world's nuclear plants came into sharp focus in 2011, when the coastal Fukushima Dai-ichi plant in Japan suffered multiple meltdowns after an earthquake and tsunami destroyed its power and cooling systems. The magnitude-9 earthquake was far larger than had been believed possible. The NRC has since directed U.S. nuclear plants to reevaluate seismic risks, and those studies are due by March 2015.

The important of such an analysis came into sharp focus on Sunday when a magnitude 6.0-earthquake struck in Northern California's wine country, injuring scores of residents, knocking out power to thousands and toppling wine bottles at vineyards.

Environmentalists have long depicted Diablo Canyon — the state's last nuclear plant after the 2013 closure of the San Onfore reactors in Southern California — as a nuclear catastrophe in waiting. In many ways, the history of the plant, located halfway between Los Angeles and San Francisco on the Pacific coast and within 50 miles of 500,000 people, has been a costly fight against nature, involving questions and repairs connected to its design and structural strength.

What's striking about Peck's analysis is that it comes from within the NRC itself, and gives a rare look at a dispute within the agency. At issue are whether the plant's mechanical guts could survive a big jolt, and what yardsticks should be used to measure the ability of the equipment to withstand the potentially strong vibrations that could result.

The conflict between Peck and his superiors stems from the 2008 discovery of the Shoreline fault, which snakes offshore about 650 yards from the reactors. A larger crack, the Hosgri fault, had been discovered in the 1970s about 3 miles away, after the plant's construction permits had been issued and work was underway. Surveys have mapped a network of other faults north and south of the reactors.

According to Peck's filing, PG&E research in 2011 determined that any of three nearby faults — the Shoreline, Los Osos and San Luis Bay — is capable of producing significantly more ground motion during an earthquake than was accounted for in the design of important plant equipment. In the case of San Luis Bay, it is as much as 75 percent more.

Those findings involve estimates of what's called peak ground acceleration, a measurement of how hard the earth could shake in a given location. The analysis says PG&E failed to demonstrate that the equipment would remain operable if exposed to the stronger shaking, violating its operating license.

The agency should shut the facility down until it is proven that piping, reactor cooling and other systems can meet higher stress levels, or approve exemptions that would allow the plant to continue to operate, according to Peck's analysis.

Peck disagreed with his supervisors' decision to let the plant continue to operate without assessing the findings. Unable to resolve his concerns, Peck in 2012 filed a formal objection, calling for PG&E to be cited for violating the safety standards, according to his filing. Within weeks, the NRC said the plant was being operated safely. In 2013 he filed another objection, triggering the current review.

The NRC says the Hosgri fault line presents the greatest earthquake risk and that Diablo Canyon's reactors can withstand the largest projected quake on it. In his analysis, Peck wrote that after officials learned of the Hosgri fault's potential shaking power, the NRC never changed the requirements for the structural strength of many systems and components in the plant.

In 2012, the agency endorsed preliminary findings that found shaking from the Shoreline fault would not pose any additional risk for the reactors. Those greater ground motions were "at or below those for which the plant was evaluated previously," referring to the Hosgri fault, it concluded.

Peck, who holds a doctorate in nuclear engineering and is now a senior instructor at the NRC's Technical Training Center in Tennessee, declined to comment on the filing.

Earthquake faults and nuclear power plants have been uneasy neighbors in the state for decades. The Humboldt Bay plant in Northern California, which was within 3,000 yards of three faults, was shut down in 1976 to refuel and reinforce its ability to withstand possible earthquakes.

Restarting it became more difficult and costly than projected — it never reopened.

Exhibit 8

A4NR-00115

From: Abrahamson, Norman </O=PG&E/OU=CORPORATE/CN=RECIPIENTS/CN=NAA2>
Sent: Thursday, September 4, 2014 12:19 PM
To: Klimczak, Richard <RLK1@PGE.COM>
Subject: RE: Advanced Studies-Confidential

Rich:

The comparisons in table 1 of the executive summary can be put into two main categories:
1. Increase in the maximum magnitude on the Shoreline and Hosgri faults.
2. Change in geometry and slip rates of faults

For #1, the increase in the maximum magnitudes will probably be the focus for the public. A key issue to communicate is that for site a close distances to the earthquakes, the high frequency ground motions do not increase much with increasing magnitude once the magnitude reaches M6.5. I attached a copy of what I sent to Blair Jones to explain this. So the level of the ground motion is not sensitive to these changes in the magnitudes. The maximum magnitude remains an topic of ongoing scientific study, but the seismic hazard as DCPP is not sensitive to this uncertainty. This is good. Our evaluation of the ground motion is robust in terms of influence of the magnitudes used for the faults.

For #2, the changes in the geometries and slip rates were all in the direction of reducing the probabilistic risk compared to the values used in 2011. All else being the same, using this new information will lead to a reduced hazard (and reduced CDF) compared to the 2011 evaluation.

Norm

-----Original Message-----
From: Klimczak, Richard
Sent: Wednesday, September 03, 2014 1:07 PM
To: Norman A Abrahamson; Abrahamson, Norman
Cc: Manheim, William (Law); Halpin, Ed; Jones, Blair; Karner, Karen C.
Subject: FW: Advanced Studies-Confidential

Norm,

As we discussed, develop a response to Ed's questions about the comparison table in the Executive Summary. I will pass it on to Ed.

>>> Rich-as I retread the executive summary section of the report and go to the last page that summarizes old vs new data/assumptions, it seems the majority of the data has worsened and not improved. The optics look bad . If I was to color code the summary sheet and show all data in red that's worse in regard to assumptions it would not look good. I wonder how do I express that those areas that have worsened are low contributors to overall impact? How are they weighted in a deterministic calc and where is that weighting explained?
>>>

Ed,

Once you get Norm's response, we can make ourselves available to discuss it with you if necessary.

Rich

-----Original Message-----

From: Halpin, Ed
Sent: Wednesday, September 03, 2014 7:21 AM
To: Klimczak, Richard
Cc: Jones, Blair; Manheim, William (Law); Karner, Karen C.
Subject: Re: Advanced Studies-Confidential

I meant thanks Rich....Rich-should we carve out a time to discuss ?

Sent from my iPad

> On Sep 2, 2014, at 2:35 PM, "Halpin, Ed" <E1H8@pge.com> wrote:
>
> thanks Rick
>
>> On Sep 2, 2014, at 2:24 PM, "Klimczak, Richard" <RLK1@pge.com> wrote:
>>
>> Ed
>>
>> I want to check my responses to your comments on the old/new comparison table with Norm tomorrow. Then I will provide responses to you.
>>
>> Rich
>>
>> Sent from my iPad
>>
>>> On Sep 2, 2014, at 7:58 AM, "Halpin, Ed" <E1H8@pge.com> wrote:
>>>
>>> Team
>>>
>>> I'm looking for talking points I will be using next week. Blair can you also send me editorials and press releases?
>>>
>>> Tom-have we heard any word in the 10th. please resolve today.
>>>
>>> Rich-as I retread the executive summary section of the report and go to the last last page that summarizes old vs new data/assumptions, it seems the majority of the data has worsened and not improved. The optics look bad . If I was to color code the summary sheet and show all data in red that's worse in regard to assumptions it would not look good. I wonder how do I express that those areas that have worsened are low contributors to overall impact? How are they weighted in a deterministic calc and where is that weighting explained?
>>>
>>> Thanks
>>>
>>> Ed

Exhibit 9

A4NR-00529

From: Greene, Eric <eric.greene@cpuc.ca.gov>
Sent: Wednesday, March 12, 2014 3:28 PM
To: Nishenko, Stuart <SPN3@pge.com>
Subject: next IPRP meeting

Stu:

Would sometime later this month be a good time for your team to meet with the IPRP for an update on the seismic studies? Thanks.

Eric

Exhibit 10

A4NR-00520

From: Greene, Eric <eric.greene@cpuc.ca.gov>
Sent: Thursday, April 3, 2014 9:36 AM
To: Nishenko, Stuart <SPN3@pge.com>
Subject: RE: next IPRP meeting

We haven't yet. I was envisioning a brief update from PG&E on the status of the seismic studies, remaining work, schedule, etc, and then a short presentation by Chris et al on the seismic hazards information from the recent SSHAC meetings. I think 2 hours should be sufficient.

Eric

From: Nishenko, Stuart [mailto:SPN3@pge.com]
Sent: Thursday, April 03, 2014 9:14 AM
To: Greene, Eric
Subject: RE: next IPRP meeting

Good Morning Eric –
Have you and Chris Wills developed a draft agenda for this meeting?
Stu

From: Greene, Eric [mailto:eric.greene@cpuc.ca.gov]
Sent: Wednesday, April 02, 2014 3:41 PM
To: Nishenko, Stuart
Subject: RE: next IPRP meeting

Stu:

I'm hearing that Commissioner Magwood can be in San Francisco on May 21. Chris Wills is suggesting we meet from 3:00 – 5:00 on May 21. Will this work for PG&E? Thanks.

Eric

From: Nishenko, Stuart [mailto:SPN3@pge.com]
Sent: Wednesday, April 02, 2014 2:51 PM
To: Greene, Eric
Subject: RE: next IPRP meeting

Eric –
Thanks for the notice. We'll get back to you shortly
Stu

From: Greene, Eric [mailto:eric.greene@cpuc.ca.gov]
Sent: Wednesday, April 02, 2014 10:13 AM
To: Nishenko, Stuart
Cc: Abrahamson, Norman
Subject: next IPRP meeting

I was thinking of having our next IPRP meeting mid to late April, but now I hear that NRC Commissioner Magwood would like to attend. The IPRP meeting would be here in San Francisco. Commissioner Magwood is going to be in San Luis Obispo May 19 – 23. I do not know if he will actually be at DCPP or the vicinity for his meetings. If we had an IPRP meeting scheduled for May 23 would you be able to attend? Keep in mind that May 26 is Memorial Day holiday and many folks might be going away for the holiday weekend. Please let me know your schedule so we can plan an IPRP

meeting. I am also not sure if Commissioner Magwood would be able to come to an IPRP meeting in San Francisco on May 23. Thanks.

Eric

PG&E is committed to protecting our customers' privacy.
To learn more, please visit http://www.pge.com/about/company/privacy/customer/

Exhibit 11

A4NR-00721

From:	Nishenko, Stuart </O=PG&E/OU=CORPORATE/CN=RECIPIENTS/CN=SPN3>
Sent:	Thursday, April 3, 2014 9:15 AM
To:	Post, Jennifer (Law) <JLKM@PGE.COM>
Subject:	RE: next IPRP meeting

I'll inquire – no details yet

From: Post, Jennifer (Law)
Sent: Thursday, April 03, 2014 9:11 AM
To: Nishenko, Stuart
Subject: Re: next IPRP meeting

What is the agenda for the meeting ?

Typo Exception Applies
Sent from my iPhone

On Apr 3, 2014, at 8:38 AM, "Nishenko, Stuart" <SPN3@pge.com> wrote:

Your response ?

From: Greene, Eric [mailto:eric.greene@cpuc.ca.gov]
Sent: Wednesday, April 02, 2014 3:41 PM
To: Nishenko, Stuart
Subject: RE: next IPRP meeting

Stu:

I'm hearing that Commissioner Magwood can be in San Francisco on May 21. Chris Wills is suggesting we meet from 3:00 – 5:00 on May 21. Will this work for PG&E? Thanks.

Eric

From: Nishenko, Stuart [mailto:SPN3@pge.com]
Sent: Wednesday, April 02, 2014 2:51 PM
To: Greene, Eric
Subject: RE: next IPRP meeting

Eric –
Thanks for the notice. We'll get back to you shortly
Stu

From: Greene, Eric [mailto:eric.greene@cpuc.ca.gov]
Sent: Wednesday, April 02, 2014 10:13 AM
To: Nishenko, Stuart
Cc: Abrahamson, Norman
Subject: next IPRP meeting

I was thinking of having our next IPRP meeting mid to late April, but now I hear that NRC Commissioner Magwood would like to attend. The IPRP meeting would be here in San Francisco. Commissioner Magwood is going to be in San Luis Obispo May 19 – 23. I do not know if he will actually be at DCPP or the vicinity for his meetings. If we had an IPRP meeting scheduled for May 23 would you be

able to attend? Keep in mind that May 26 is Memorial Day holiday and many folks might be going away for the holiday weekend. Please let me know your schedule so we can plan an IPRP meeting. I am also not sure if Commissioner Magwood would be able to come to an IPRP meeting in San Francisco on May 23. Thanks.

Eric

Exhibit 12

A4NR-00517

From: Greene, Eric <eric.greene@cpuc.ca.gov>
Sent: Friday, April 4, 2014 1:32 PM
To: Nishenko, Stuart <SPN3@pge.com>
Subject: RE: next IPRP meeting

Stu:

Please let me know if PG&E can meet with the IPRP on May 21 from 10:00 – 12:00? We would only discuss the status of the seismic studies, schedule, remaining work, etc. The IPRP would like the opportunity to review any data, analyses, drafts before PG&E submits to the NRC so that our comments and suggests might be incorporated. Thanks.

Eric

From: Greene, Eric
Sent: Thursday, April 03, 2014 2:49 PM
To: 'Nishenko, Stuart'
Subject: RE: next IPRP meeting

Stu:

Slight change. Can the IPRP meet with PG&E May 21 from 10:00 – 12:00? We would discuss an update on PG&E's seismic studies, remaining work, schedule, etc. I'm hearing that PG&E plans on submitting a report of its results and findings to the NRC in June 2014. The IPRP would like to see a draft before then … the sooner the better … so that any comments or suggestions we might have could be incorporated into your report. The NRC would not be present at this meeting.

Separately in the afternoon, the IPRP would meet amongst ourselves with the NRC Commissioner attending to discuss seismic hazards and the SSHAC data. Thanks.

Eric

Exhibit 13

A4NR-00719

From: Unspecified Sender
Sent:
To: Klimczak, Richard <RLK1@PGE.COM>
Subject: RE: next IPRP meeting

Just so happens :
IPRP Meetings

August 31, 2010 (Public)
February 18, 2011(Public)
May 3, 2011 (Public)
July 20, 2011 (CEC- Public)
January 23, 2012 (Public)
February 6, 2012 (Public)
February 21, 2012 (Public)

June 29,2012 (Public)
January
March 29, 2013 (Working Meeting)
June 6, 2013 (Working Meeting)
July 11, 2013 (Public)

From: Klimczak, Richard
Sent: Friday, April 04, 2014 2:53 PM
To: Nishenko, Stuart
Subject: FW: next IPRP meeting

FYI. Do you have a list of all IPRP meetings?

From: Summy, Jeff
Sent: Friday, April 04, 2014 2:30 PM
To: Klimczak, Richard; Strickland, L Jearl
Subject: RE: next IPRP meeting

Good discussion. Thanks for getting us on the phone. Please give some thoughts as to the times we have interacted with the IPRP over the past as we will want to weave that into our meeting on site on May 20th with Magwood.
Thanks
Jeff S

From: Klimczak, Richard
Sent: Friday, April 04, 2014 7:59 AM
To: Summy, Jeff; Strickland, L Jearl
Subject: FW: next IPRP meeting

Latest info for 2:00 call today.

From: Nishenko, Stuart
Sent: Thursday, April 03, 2014 3:09 PM
To: Klimczak, Richard; Post, Jennifer (Law)
Subject: FW: next IPRP meeting

!!

From: Greene, Eric [mailto:eric.greene@cpuc.ca.gov]
Sent: Thursday, April 03, 2014 2:49 PM
To: Nishenko, Stuart
Subject: RE: next IPRP meeting

Stu:

Slight change. Can the IPRP meet with PG&E May 21 from 10:00 – 12:00? We would discuss an update on PG&E's seismic studies, remaining work, schedule, etc. I'm hearing that PG&E plans on submitting a report of its results and findings to the NRC in June 2014. The IPRP would like to see a draft before then … the sooner the better … so that any comments or suggestions we might have could be incorporated into your report. The NRC would not be present at this meeting.

Separately in the afternoon, the IPRP would meet amongst ourselves with the NRC Commissioner attending to discuss seismic hazards and the SSHAC data. Thanks.

Eric

From: Greene, Eric
Sent: Thursday, April 03, 2014 9:36 AM
To: 'Nishenko, Stuart'
Subject: RE: next IPRP meeting

We haven't yet. I was envisioning a brief update from PG&E on the status of the seismic studies, remaining work, schedule, etc, and then a short presentation by Chris et al on the seismic hazards information from the recent SSHAC meetings. I think 2 hours should be sufficient.

Eric

From: Nishenko, Stuart [mailto:SPN3@pge.com]
Sent: Thursday, April 03, 2014 9:14 AM
To: Greene, Eric
Subject: RE: next IPRP meeting

Good Morning Eric –
Have you and Chris Wills developed a draft agenda for this meeting?
Stu

From: Greene, Eric [mailto:eric.greene@cpuc.ca.gov]
Sent: Wednesday, April 02, 2014 3:41 PM
To: Nishenko, Stuart
Subject: RE: next IPRP meeting

Stu:

I'm hearing that Commissioner Magwood can be in San Francisco on May 21. Chris Wills is suggesting we meet from 3:00 – 5:00 on May 21. Will this work for PG&E? Thanks.

Eric

From: Nishenko, Stuart [mailto:SPN3@pge.com]
Sent: Wednesday, April 02, 2014 2:51 PM
To: Greene, Eric

Subject: RE: next IPRP meeting

Eric –
Thanks for the notice. We'll get back to you shortly
Stu

From: Greene, Eric [mailto:eric.greene@cpuc.ca.gov]
Sent: Wednesday, April 02, 2014 10:13 AM
To: Nishenko, Stuart
Cc: Abrahamson, Norman
Subject: next IPRP meeting

I was thinking of having our next IPRP meeting mid to late April, but now I hear that NRC Commissioner Magwood would like to attend. The IPRP meeting would be here in San Francisco. Commissioner Magwood is going to be in San Luis Obispo May 19 – 23. I do not know if he will actually be at DCPP or the vicinity for his meetings. If we had an IPRP meeting scheduled for May 23 would you be able to attend? Keep in mind that May 26 is Memorial Day holiday and many folks might be going away for the holiday weekend. Please let me know your schedule so we can plan an IPRP meeting. I am also not sure if Commissioner Magwood would be able to come to an IPRP meeting in San Francisco on May 23. Thanks.

Eric

PG&E is committed to protecting our customers' privacy.
To learn more, please visit http://www.pge.com/about/company/privacy/customer/

Exhibit 14

A4NR-00772

From: Klimczak, Richard <RLK1@pge.com>
Sent: Monday, May 12, 2014 8:22 AM
To: Summy, Jeff <J51D@pge.com>; Halpin, Ed <E1H8@pge.com>; Strickland, L Jearl <LJS2@pge.com>
Cc: Baldwin, Thomas (DCPP) <TRB1@pge.com>
Subject: RE: Commissioner Magwood Visit May 20

Ed,

I revised the slide deck last week and included a slide (#4) on the Advanced Seismic Studies and IPRP. Not sure if you have seen it. It is attached.

Rich

From: Summy, Jeff
Sent: Sunday, May 11, 2014 9:19 AM
To: Halpin, Ed; Strickland, L Jearl
Cc: Baldwin, Thomas (DCPP); Klimczak, Richard
Subject: RE: Commissioner Magwood Visit May 20

Ed,
I'll get you a revised presentation before Wednesday and will align with Sr Resident.
Thanks
Jeff S

Sent from my Verizon Wireless 4G LTE smartphone

-------- Original message --------
From: "Halpin, Ed"
Date:05/11/2014 8:18 AM (GMT-08:00)
To: "Strickland, L Jearl" ,"Summy, Jeff"
Cc: "Summy, Jeff" ,"Baldwin, Thomas (DCPP)"
Subject: RE: Commissioner Magwood Visit May 20

This is good except he is going to want to understand the advanced studies as well as the role of the IPRP. He will want to be horsed up on their concerns and how we have, or intend to address those concerns.

Jeff-I will need to see the final presentation and agenda before Wednesday. Also-I noted on the agenda you had Tom Hipshman leading several portions of it. I believe this is our visit. Please check with Tom on roles and responsibilities.

Thanks

From: Strickland, L Jearl
Sent: Friday, May 09, 2014 12:03 PM
To: Halpin, Ed
Subject: FW: Commissioner Magwood Visit May 20

From: Klimczak, Richard
Sent: Wednesday, April 30, 2014 7:58 AM

To: Soenen, Philippe R
Cc: Summy, Jeff; Jahangir, Nozar; Abrahamson, Norman; norman abrahamson; Strickland, L Jearl; Post, Jennifer (Law)
Subject: RE: Commissioner Magwood Visit May 20

Philippe,

Nozar and I have developed the following slide deck for the subject visit. Norm will be attending to address the "implementation of the SSHAC process" and to answer other questions. Let us know when there will be a dry run.

Rich

From: Soenen, Philippe R
Sent: Friday, April 25, 2014 1:13 PM
To: Klimczak, Richard
Subject: Commissioner Magwood Visit May 20

Rich,

On May 20 Commissioner Magwood will be visiting DCPP with the Regional Administrator and they have requested a plant tour and discussion on a list of topics. Those topics include a request to discuss unique Diablo Canyon seismic issues and licensee implementation of SSHAC process. We looking for your support during the Commissioners visit to talk to this topic and support any questions on the plant tour specific to Hosgri upgrades. I checked and Nozar is on vacation that week, otherwise I would have included him on the email. I have attached the current draft of the plant visit agenda and the slides on seismic that were prepared for Marc Dapas' visit last year. Jeff Summy has requested that I set up a dry run the week prior to the visit. Would it be possible to get an update on the slides by the end of next week?

Below is the requested information that the Commissioner's office passed on to Tom Hipschman.

Thanks you,

Philippe Soenen

Supervisor, Licensing
Regulatory Services - DCPP
Office - 805.545.6984
Cell - 805.459.3701

	Depart Hotel
7:00 am – 7:15 am	Arrive onsite at Diablo Canyon Nuclear Power Plant
7:15 am – 7:45 am	Meet with Diablo Canyon NRC Resident Inspectors
7:45 am – 11:15 am	Sit Tour Diablo Canyon Nuclear Generating Station Units 1, 2 and 3 - Control Rooms, Auxiliary Buildings, and Turbine Buildings led by licensee with NRC resident staff accompaniment. Focus on: • Accessible areas of interest to demonstrate equipment upgrades related to original construction addressing seismic issues • Emergency diesel generators and ultimate heat sink • Spent Fuel Pool • Auxiliary shutdown panel/related facilities • Control Room • 50.54(hh) strategies flooding mitigation and Fukushima actions including FLEX Building, FLEX equipment, etc.
11:15 am –	Meeting with onsite NAYGN/WIN representatives

12:00 pm	(awaiting licensee confirmation, availability may be limited due to annual NAYGN meeting in Scottsdale, AZ – If this is the case, expand the site tour)
12:00 pm – 1:00 pm	Working lunch with licensee representatives
1:00 pm – 2:00 pm	Meeting with licensee representatives to discuss unique Diablo Canyon seismic issues and licensee implementation of SSHAC process and Observation of HABE
2:00 pm – 2:40 pm	Leave site

	Wednesday, May 21, 2014
Time	**Activities**
6:00 am	Depart Hotel
6:45 am	Arrive at Diablo Canyon
6:45 am – 11:00 am	Observe Diablo Canyon Hostile Action Based Exercise from Simulator/EOF
11:00-11:30 am	leave EOF arrive SBP

Exhibit 15

A4NR-00798

From: Krausse, Mark <MCKd@pge.com>
Sent: Wednesday, March 19, 2014 4:52 PM
To: Winn, Valerie J <VJW3@pge.com>
Subject: RE: IPRP presentation

Why don't you just remind the Dream Team of that representation and see if they have something for you to share. They'll likely say they will get what they get at SSHAC next week, but it's worth a try.

From: Winn, Valerie J
Sent: Wednesday, March 19, 2014 4:24 PM
To: Krausse, Mark
Subject: FW: IPRP presentation

See slide 3 from Feb 2013 presentation that says we're sending draft technical reports on Irish Hills to the IPRP in February 2014. I've rec'd nothing to send to them... but clearly we indicated we were going to share drafts.

From: Nishenko, Stuart
Sent: Friday, February 22, 2013 2:47 PM
To: Klimczak, Richard; Post, Jennifer (Law); Winn, Valerie J; Strickland, L Jearl; Summy, Jeff
Subject: IPRP presentation

All –
Attached is the PowerPoint presentation for the PUC IPRP meeting on Monday Feb 25.
This has benefitted from a thorough review by Rich, Jennifer and Valerie this afternoon.
If you have any questions, feel free to contact Rich or myself.

Stu Nishenko
Senior Seismologist / Geophysicist
Pacific Gas and Electric
245 Market Street
San Francisco, CA 94105
office: 415.973.1213
cell: 415.816.0005
spn3@pge.com

Exhibit 16

A4NR-00729

From: SPN3@pge.com
Sent: Thursday, March 20, 2014 7:18 AM
To: Winn, Valerie J <VJW3@pge.com>
Cc: Post, Jennifer (Law) <JLKm@pge.com>; Klimczak, Richard <RLK1@pge.com>; Strickland, L Jearl <LJS2@pge.com>; Krausse, Mark <MCKd@pge.com>
Subject: Re: IPRP presentation

Valerie et al
Basically, the report is not finished at this time and is now scheduled for release in June
Stu

Sent from my iPhone

On Mar 19, 2014, at 5:55 PM, "Winn, Valerie J" <VJW3@pge.com> wrote:

> All,
>
> In Monday's briefing with John Conway, it was indicated that we were not planning to share the draft technical report with the IPRP before it became public. Just wanted to make folks aware that in a presentation to the IPRP last year, we indicated that we were sending draft technical reports on Irish Hills 2D/3D onshore to the IPRP in February 2014 (see page 3).
>
> Not sure where that leaves us with respect to sharing or not sharing drafts, but wanted to make you aware of earlier communications with the IPRP on the topic.
>
> Thanks!
>
> Valerie
>
> From: Nishenko, Stuart
> Sent: Friday, February 22, 2013 2:47 PM
> To: Klimczak, Richard; Post, Jennifer (Law); Winn, Valerie J; Strickland, L Jearl; Summy, Jeff
> Subject: IPRP presentation
>
> All –
> Attached is the PowerPoint presentation for the PUC IPRP meeting on Monday Feb 25.
> This has benefitted from a thorough review by Rich, Jennifer and Valerie this afternoon.
> If you have any questions, feel free to contact Rich or myself.
>
> Stu Nishenko
> Senior Seismologist / Geophysicist
> Pacific Gas and Electric
> 245 Market Street
> San Francisco, CA 94105
> office: 415.973.1213
> cell: 415.816.0005
> spn3@pge.com<mailto:spn3@pge.com>
> <2013_CCCSIP_IPRP.ppt>

Exhibit 17

A4NR-00516

From:	Halpin, Ed <E1H8@pge.com>
Sent:	Sunday, April 6, 2014 11:50 AM
To:	Klimczak, Richard <RLK1@pge.com>; Soenen, Philippe R <PNS3@pge.com>; Summy, Jeff <J51D@pge.com>; Post, Jennifer (Law) <JLKm@pge.com>
Cc:	Baldwin, Thomas (DCPP) <TRB1@pge.com>; Strickland, L Jearl <LJS2@pge.com>; Nishenko, Stuart <SPN3@pge.com>
Subject:	RE: Privileged and Confidential: Meeting Summary of Seismic Path Forward 3/19/14

Thanks Rich-very good. What about the post June 30th submittal date in regard to IPRP feedback? In other words is the report final once submitted? What is the purpose of the 30 day review by the IPRP?

Thanks

From: Klimczak, Richard
Sent: Friday, April 04, 2014 2:52 PM
To: Soenen, Philippe R; Halpin, Ed; Summy, Jeff; Post, Jennifer (Law)
Cc: Baldwin, Thomas (DCPP); Strickland, L Jearl; Nishenko, Stuart
Subject: RE: Privileged and Confidential: Meeting Summary of Seismic Path Forward 3/19/14

Privileged and Confidential

All,

Below are responses to my two action items (#1 and #3) for your review and comment. Stu provided input for the seismic report review and timeline.

Action Items:

1) Develop a timeline for required reviewers and associated meetings for submittal of the seismic report – R. Klimczak – 4/4/14

<u>Review of Advanced Seismic Studies Report</u>

6/2/14 – Report Provided to DCPP Reviewers with a Presentation by Geosciences
<u>Note</u>: the draft report will contain an Introduction, Summaries of 9 detailed reports on the various studies, Executive Summary of Results and Hazard Conclusions. A single copy of the 9 final draft detailed reports will be made available.
Reviewers- Summy, Jahangir, Strickland, T. Jones, B. Jones, Baldwin
6/9/14 – Comments due

6/2/14 – Draft Report Provided to Geosciences reviewers, Law and a SSC SSHAC member
Notes:
1)To provide additional time for this review, the reviewers will be provided draft copies of the 9 individual reports as they become available (prior to June 2nd).
2) This review will be of the complete report including all 9 detailed reports. Note that an exception will be that the LCI 2011 ONSIP (onshore) report will be a draft (May 16th). Final will be available 6/6.
Reviewers – Abrahamson, Ferre, McLaren, Post, Thompson, Klimczak, Page
6/9/14 – Comments due

6/12/14- Provide draft submittal letter to State Agencies for comment – Post/Winn

6/12/14- Provide draft submittal letter to NRC for comment – Baldwin/Post/Winston and Strawn

6/10 – 6/16/14 – Incorporate comments

6/17/14 – Present Report and draft submittal letters to Senior PG&E Leadership for Review
Note: the report will contain the Introduction, Summaries of 9 detailed reports on the various studies, Executive Summary of Results and Hazard Conclusions. A single copy of the 9 detailed reports will be made available.
Reviewers – Conway, Bottorff, Pruett, Halpin, Manheim
6/23/14 – Comments due

6/24 – 6/25/14 - Incorporate comments

6/26 – 6/29 – Prepare submittals of Final Report

6/30/14 – Submit report to State and NRC

3) Discuss how to prime the NRC on what they may hear on the phone call when the report is finalized – R. Klimczak and J. Summy – 3/28/14

When Report is Final, ~6/26/14, contact NRC. Discuss contents of report.
1) Highlight Shoreline Faults increased capability due to being longer. Explain that the deterministic 84% plot is still enveloped by Hosgri and LTSP.
2) Discuss inclusion of San Simeon/Hosgri/Shoreline "Fault Linkage" case. Reason: The San Simeon/Hosgri and Hosgri/Shoreline linkages potentials were two of the ten objectives of the studies. Although we found no direct evidence of linkage from our studies, we are providing a "what if" deterministic 84% plot in the report. Explain that the "Fault Linkage" (San Simeon/Hosgri/Shoreline) deterministic 84% plot is still enveloped by the Hosgri and LTSP.

Rich

From: Soenen, Philippe R
Sent: Saturday, March 22, 2014 3:23 PM
To: Halpin, Ed; Summy, Jeff; Klimczak, Richard; Post, Jennifer (Law)
Cc: Baldwin, Thomas (DCPP); Strickland, L Jearl
Subject: Privileged and Confidential: Meeting Summary of Seismic Path Forward 3/19/14

All,

Summary of Seismic Path Forward Meeting 3/19/14:

1) It was agreed upon that conclusions on the Shoreline Faults potential capabilities cannot be determined until the review process for the seismic report are complete. Once the seismic report has been reviewed and signed off, and if it is determined that Shoreline Fault is more capable than previously believed, then the condition will be entered into the corrective action program and the NRC Project Manager and resident inspectors will be notified.

2) It was agreed upon that once the seismic report is finalized that it will be sent out enclosed to two different letters. One letter will be sent to the State with a copy to the ASLB and the other letter will be sent to the NRC. The cover letters will be written to specifically address the commitments to and concerns of the receiving party.

3) It was agreed upon that if it is determined that the Shoreline Fault is more capable that it would be evaluated in the following manner:

> Plant seismic safety would be assessed via 50.54(f) SSHAC process.

- Write SAPN for the concern
- Evaluate plant safety
- Determine whether condition is a non-conforming condition
- Non-conforming requires entry into operability/reportability determination

If we conclude we meet the HE+LTSP as stated in the RIL basis of acceptance we would continue to be conforming and not require an operability assessment.

Action Items:

1) Develop a timeline for required reviewers and associated meetings for submittal of the seismic report – R. Klimczak – 4/4/14

2) Develop a draft agenda for the IPRP follow up meeting and include required stakeholders – J. Post – COMPLETE

3) Discuss how to prime the NRC on what they may hear on the phone call when the report is finalized – R. Klimczak and J. Summy – 3/28/14

Plus/Deltas for the Meeting:

Plus
1) Good meeting facilitation
2) Ended slightly early

Delta
1) Not all the required stakeholders were invited to the meeting

Philippe Soenen

Supervisor, Licensing
Regulatory Services - DCPP
Office - 805.545.6984
Cell - 805.459.3701

Exhibit 18

A4NR-00108

From: Greene, Eric <eric.greene@cpuc.ca.gov>
Sent: Tuesday, April 15, 2014 10:25 AM
To: Stu Nishenko <s_nishenko@msn.com>
Cc: Klimczak, Richard <RLK1@pge.com>; Nishenko, Stuart <SPN3@pge.com>
Subject: RE: IPRP Workshop dates and agenda

The IPRP group is holding May 21 from 10:00 – 12:00 for a meeting with you and the PG&E team. We need o meet on this date because we are having a session to review the SSHAC information with NRC Commissioner Magwood later in the afternoon of this same date. Since most of the IPRP members are coming from Sacramento, we prefer to meet on the same date. Commissioner Magwood was not available on May 23, so we are trying to have our two meetings both on May 21.

If we do meet with you at PG&E, it would be a closed technical session. Would be preferable if you could provide some our your findings, however preliminary. We recognize that the information is still in draft form and very preliminary, but any insight into the direction you are taking should be beneficial to the IPRP and PG&E.

Thanks for your reconsideration.

Eric

From: Stu Nishenko [mailto:s_nishenko@msn.com]
Sent: Tuesday, April 15, 2014 9:54 AM
To: Greene, Eric
Cc: Richard Klimczak; Stuart Nishenko
Subject: IPRP Workshop dates and agenda
Importance: High

Eric:

Due to scheduling conflicts at PG&E, I am writing to propose Friday May 23rd as an alternate date for the IPRP Technical Workshop.

Please advise if that date is acceptable for you and the members of the IPRP.

While we are not going to present our findings at this time, our presentation of the report outline at the May Workshop will provide opportunity for dialog about the report, our schedule to issue the final results report to the IPRP in June, coordination for a public meeting later in July, and the IPRP review schedule.

The report outline will address the topics identified in the Aug 2011 *Response to IPRP Request for Hazard Sensitivity for Targets for the DCPP Geophysical Surveys* (PG&E, 2011) and ranked in the *IPRP Evaluation of Proposed Seismic Hazard Studies at Diablo Canyon* (IPRP, 2012). In addition, we will discuss our plans for addressing the questions raised in IPRP Report #6 about Vs30 and kappa.

I'll be happy to help you develop an agenda for the meeting.

Regards,

Stu Nishenko
(as from PG&E)

Exhibit 19

A4NR-00404

From: RLK1@pge.com
Sent: Saturday, March 22, 2014 6:52 AM
To: Doyle, Conor <JCDt@pge.com>
Subject: Re: REMINDER: cNet Item #7566 is Due in 5 Days

No meeting is currently scheduled. We are issuing a final report June 30th. I expect meetings after we issue the report based on when the CPUC/IPRP requests them. If a meeting is scheduled for any reason, I will let you know.

Rich

Sent from my iPad

On Mar 21, 2014, at 3:16 PM, "Doyle, Conor" <JCDt@pge.com> wrote:

> Rich,
>
> Remind me, when is the next meeting ?
>
> -----Original Message-----
> From: Svc REGREL
> Sent: Friday, March 21, 2014 4:00 AM
> To: Klimczak, Richard
> Cc: Doyle, Conor
> Subject: REMINDER: cNet Item #7566 is Due in 5 Days
>
> PLEASE DO NOT REPLY TO THIS MESSAGE - This notification is automatically generated.
>
>
> Assigned Person for cNet Item 7566,
>
> The compliance item referenced below is Due in 5 Days:
>
> The Energy Division Director will coordinate with the California Energy Commission, the California Geologic Survey, the California Coastal Commission, the California Emergency Management Agency, and the California Seismic Safety Commission, as well as outside experts, to review and provide written comments on the study plans prior to implementation and to conduct a review and provide written comments on the findings and/or results of the studies. The Energy Division Director shall periodically hold publicly noticed workshops, and post relevant materials on the Commission's website.
>
> <http://wwwregrel/cnet/search/details.aspx?CompId=7566>
>
>
>
> Upon completing this compliance item, please send a request to mark the item as completed (instructions below).
>
>
> Instructions
> 1. Click link to cNet homepage: <http://wwwregrel/cnet>
> 2. Enter the compliance item number (number referenced further above) in the "View Compliance Item by Number" box and click "Go."
> 3. Click "Request to Mark Item as Completed," complete the page and click "Send Email."
>
> To extend the due date for your compliance item, please contact the individual listed as the Reg Affairs Contact.

Exhibit 20

A4NR-00377

From: Summy, Jeff <J51D@pge.com>
Sent: Sunday, April 6, 2014 12:08 PM
To: Halpin, Ed <E1H8@pge.com>; Klimczak, Richard <RLK1@pge.com>; Soenen, Philippe R <PNS3@pge.com>; Post, Jennifer (Law) <JLKm@pge.com>
Cc: Baldwin, Thomas (DCPP) <TRB1@pge.com>; Strickland, L Jearl <LJS2@pge.com>; Nishenko, Stuart <SPN3@pge.com>
Subject: RE: Privileged and Confidential: Meeting Summary of Seismic Path Forward 3/19/14

Ed,
We discussed that to a certain extent in a call we had Friday to discuss a request from IPRP to have a meeting with us before they meet with Magwood while he is here. Our sense is they will not be happy not getting an advanced review before we issue but we really have no choice at this point. I suspect if they come back with substantive comments that we agree with we could see a way to revise but not if they are just providing comments that express their general disagreement with our approach or things to that affect.

Rich/Stu would you agree with that?
Thanks
Jeff S

From: Halpin, Ed
Sent: Sunday, April 06, 2014 11:50 AM
To: Klimczak, Richard; Soenen, Philippe R; Summy, Jeff; Post, Jennifer (Law)
Cc: Baldwin, Thomas (DCPP); Strickland, L Jearl; Nishenko, Stuart
Subject: RE: Privileged and Confidential: Meeting Summary of Seismic Path Forward 3/19/14

Thanks Rich-very good. What about the post June 30th submittal date in regard to IPRP feedback? In other words is the report final once submitted? What is the purpose of the 30 day review by the IPRP?

Thanks

From: Klimczak, Richard
Sent: Friday, April 04, 2014 2:52 PM
To: Soenen, Philippe R; Halpin, Ed; Summy, Jeff; Post, Jennifer (Law)
Cc: Baldwin, Thomas (DCPP); Strickland, L Jearl; Nishenko, Stuart
Subject: RE: Privileged and Confidential: Meeting Summary of Seismic Path Forward 3/19/14

Privileged and Confidential

All,

Below are responses to my two action items (#1 and #3) for your review and comment. Stu provided input for the seismic report review and timeline.

Action Items:

1) Develop a timeline for required reviewers and associated meetings for submittal of the seismic report – R. Klimczak – 4/4/14

<u>Review of Advanced Seismic Studies Report</u>

-
6/2/14 – Report Provided to DCPP Reviewers with a Presentation by Geosciences

Note: the draft report will contain an Introduction, Summaries of 9 detailed reports on the various studies, Executive Summary of Results and Hazard Conclusions. A single copy of the 9 final draft detailed reports will be made available.
Reviewers- Summy, Jahangir, Strickland, T. Jones, B. Jones, Baldwin
6/9/14 – Comments due

6/2/14 – Draft Report Provided to Geosciences reviewers, Law and a SSC SSHAC member
Notes:
1)To provide additional time for this review, the reviewers will be provided draft copies of the 9 individual reports as they become available (prior to June 2nd).
2) This review will be of the complete report including all 9 detailed reports. Note that an exception will be that the LCI 2011 ONSIP (onshore) report will be a draft (May 16th). Final will be available 6/6.
Reviewers – Abrahamson, Ferre, McLaren, Post, Thompson, Klimczak, Page
6/9/14 – Comments due

6/12/14- Provide draft submittal letter to State Agencies for comment – Post/Winn

6/12/14- Provide draft submittal letter to NRC for comment – Baldwin/Post/Winston and Strawn

6/10 – 6/16/14 – Incorporate comments

6/17/14 – Present Report and draft submittal letters to Senior PG&E Leadership for Review
Note: the report will contain the Introduction, Summaries of 9 detailed reports on the various studies, Executive Summary of Results and Hazard Conclusions. A single copy of the 9 detailed reports will be made available.
Reviewers – Conway, Bottorff, Pruett, Halpin, Manheim
6/23/14 – Comments due

6/24 – 6/25/14 - Incorporate comments

6/26 – 6/29 – Prepare submittals of Final Report

6/30/14 – Submit report to State and NRC

3) Discuss how to prime the NRC on what they may hear on the phone call when the report is finalized – R. Klimczak and J. Summy – 3/28/14

When Report is Final, ~6/26/14, contact NRC. Discuss contents of report.
1) Highlight Shoreline Faults increased capability due to being longer. Explain that the deterministic 84% plot is still enveloped by Hosgri and LTSP.
2) Discuss inclusion of San Simeon/Hosgri/Shoreline "Fault Linkage" case. Reason: The San Simeon/Hosgri and Hosgri/Shoreline linkages potentials were two of the ten objectives of the studies. Although we found no direct evidence of linkage from our studies, we are providing a "what if" deterministic 84% plot in the report. Explain that the "Fault Linkage" (San Simeon/Hosgri/Shoreline) deterministic 84% plot is still enveloped by the Hosgri and LTSP.

Rich

From: Soenen, Philippe R
Sent: Saturday, March 22, 2014 3:23 PM
To: Halpin, Ed; Summy, Jeff; Klimczak, Richard; Post, Jennifer (Law)
Cc: Baldwin, Thomas (DCPP); Strickland, L Jearl
Subject: Privileged and Confidential: Meeting Summary of Seismic Path Forward 3/19/14

All,

Summary of Seismic Path Forward Meeting 3/19/14:

1) It was agreed upon that conclusions on the Shoreline Faults potential capabilities cannot be determined until the review process for the seismic report are complete. Once the seismic report has been reviewed and signed off, and if it is determined that Shoreline Fault is more capable than previously believed, then the condition will be entered into the corrective action program and the NRC Project Manager and resident inspectors will be notified.

2) It was agreed upon that once the seismic report is finalized that it will be sent out enclosed to two different letters. One letter will be sent to the State with a copy to the ASLB and the other letter will be sent to the NRC. The cover letters will be written to specifically address the commitments to and concerns of the receiving party.

3) It was agreed upon that if it is determined that the Shoreline Fault is more capable that it would be evaluated in the following manner:

Plant seismic safety would be assessed via 50.54(f) SSHAC process.

- Write SAPN for the concern
- Evaluate plant safety
- Determine whether condition is a non-conforming condition
- Non-conforming requires entry into operability/reportability determination

If we conclude we meet the HE+LTSP as stated in the RIL basis of acceptance we would continue to be conforming and not require an operability assessment.

Action Items:

1) Develop a timeline for required reviewers and associated meetings for submittal of the seismic report – R. Klimczak – 4/4/14

2) Develop a draft agenda for the IPRP follow up meeting and include required stakeholders – J. Post – COMPLETE

3) Discuss how to prime the NRC on what they may hear on the phone call when the report is finalized – R. Klimczak and J. Summy – 3/28/14

Plus/Deltas for the Meeting:

Plus
1) Good meeting facilitation
2) Ended slightly early

Delta
1) Not all the required stakeholders were invited to the meeting

Philippe Soenen

Supervisor, Licensing
Regulatory Services - DCPP
Office - 805.545.6984
Cell - 805.459.3701

Exhibit 21

A4NR-00142

Subject: IPRP Meeting

Location: Call in: 1-866-341-1830 Pcode: *4159736423*

Start: 4/17/2014 3:30 PM

End: 4/17/2014 4:00 PM

Show Time As: Tentative

Recurrence: (none)

Meeting Status: Not yet responded

Organizer: Klimczak, Richard

Required Attendees: Strickland, L Jearl; Summy, Jeff; Nishenko, Stuart; Abrahamson, Norman; norman abrahamson; Post, Jennifer (Law)

Resources: Call in: 1-866-341-1830 Pcode: *4159736423*

Discuss CPUC/IPRP response (below) to our request to move the meeting. Notice reference to SSHAC….

Exhibit 22

A4NR-00773

Privileged and Confidential

2014 Rollout Plan - Central Coastal California Seismic Imaging Project (CCCSIP) Report

1. June 4th - Draft executive summary with hazard impact conclusion (w/ plots) and access to draft seismic studies reports will be provided via SharePoint to:

   DCPP – Halpin, Summy, Strickland, Jahangir, Baldwin
   Law – Post
   Geosciences – Abrahamson, Ferre, McLaren, Klimczak, Page, Nishenko
   Energy Supply – Jones (Tom and Blair)
   Reg/Rel – Winn, Krausse, Jacobson

2. June 6th - Draft report made available to Conway, Manheim, Bottorf and Pruett for their review via SharePoint

3. June 10th, 1:00 pm to 2:30 pm – Geosciences Video Conference Presentation of report to all reviewers

4. June 12th Close of Business - Comments due from reviewers

5. June 13th to June 18th - Geosciences addresses and incorporates comments

6. June 20th - All documents that make up the report are ready for final review in SharePoint

7. June 23rd - Final review comments due

8. June 24th to 25th - Incorporate comments

9. June 25th – State Agencies Transmittal Letter prepared– Valerie Winn

10. June 25th – NRC Transmittal Letter prepared – Tom Baldwin, Michael Richardson

11. June 26th – Ed's approval decision to release report

12. June 26th to June 30th - Report production for distribution –Hardcopies and CDs

13. June 26th - NRC discussion

14. June 26th - Document results of NRC discussion in CAP

15. June 27th - Meeting with CPUC Energy Director

16. June 30th - Submit to NRC and CPUC/IPRP/CEC w/ Ed's approval

17. July 1st – Start 30 day IPRP review. Need to discuss, IPRP indicated they need ~ 6 months for their review

18. Mid July – Public meeting arranged thru CPUC/IPRP for PG&E presentation of report. Needs further discussion. IPRP suggested 4 meetings
    a. Prior to meeting, Geosciences to establish an agreement with the IPRP on how to address public comments during the public presentation.

19. August 1st thru August 31th – Geosciences responds to IPRP comments

Exhibit 23

A4NR-00364

From: Summy, Jeff <J51D@pge.com>
Sent: Friday, May 30, 2014 8:52 AM
To: Klimczak, Richard <RLK1@pge.com>
Subject: RE: Privileged and Confidential: CCCSIP Report Plan

Thanks

From: Klimczak, Richard
Sent: Friday, May 30, 2014 8:51 AM
To: Summy, Jeff
Subject: RE: Privileged and Confidential: CCCSIP Report Plan

Jeff,

I will send out an Outlook meeting notification for the 10th with a schedule for review. We are going to make the presentation via video conference as Ed suggested.

Rich

From: Summy, Jeff
Sent: Friday, May 30, 2014 8:41 AM
To: Klimczak, Richard
Cc: Nishenko, Stuart; Stu Nishenko (s_nishenko@msn.com); Abrahamson, Norman; norman abrahamson; Strickland, L Jearl; Post, Jennifer (Law)
Subject: RE: Privileged and Confidential: CCCSIP Report Plan

Rich,
Thanks! As we have discussed in the past the IPRP will be what it will be and we will have to deal with it as it occurs. It would be nice if it was clearly defined and played by some fixed set of rules but it doesn't. With respect to the review and issuance of the report. Please go ahead and get the 6/10 presentation on people's calendars. Do you plan to do this in person from DCPP? I'd also like to suggest we get the review and presentation schedule out to those we are looking for review and comment from so they begin to understand their role in making sure we can issue the report by end of June.

Jeff S

From: Klimczak, Richard
Sent: Thursday, May 29, 2014 11:22 AM
To: Summy, Jeff
Cc: Nishenko, Stuart; Stu Nishenko (s_nishenko@msn.com); Abrahamson, Norman; norman abrahamson; Strickland, L Jearl; Post, Jennifer (Law)
Subject: RE: Privileged and Confidential: CCCSIP Report Plan

Privileged and Confidential

Updated attachment. I noticed I did not include the latest version with typos corrected.

From: Klimczak, Richard
Sent: Thursday, May 29, 2014 10:32 AM
To: Summy, Jeff
Cc: Nishenko, Stuart; Stu Nishenko (s_nishenko@msn.com); Abrahamson, Norman; 'norman abrahamson'; Strickland, L

Jearl; Post, Jennifer (Law)
Subject: Privileged and Confidential: CCCSIP Report Plan

Privileged and Confidential

Jeff,

Yesterday, we had a Central Coast California Seismic Imaging Project (CCCSIP) schedule meeting and I met separately with Stu and Norm to update our plan for issuing the subject report. I have attached a revised report plan based on our last meeting with Ed and the latest schedule update from my team. Let me know if you have any questions or comments.

New Items

1. Since our meeting with the IPRP on 5/21 we learned that they want about ~ 6 months to respond to our report and to hold ~4 public meetings. We did not agree with this, but asked them to revisit this topic after they get the report for review. We will need to discuss and agree upon our position on IPRP review time and public meetings.

2. Erik Jacobson (Reg/Rel) wants to setup a meeting with Ed Randolph, CPUC Energy Division Director (IPRP reports to him), and possibly other CPUC Commissioners to let them know what will be in the report. Also, Erik feels we will need to address questions about license renewal. I told Erik that we have to clear this with Ed and that we should discuss his request after the 6/10 presentation.

Note: the 6/10 presentation date seems to work best for the major reviewers. Conway is available and Ed is traveling that day so we need to check that he can participate via video conference or we can give him a special session.

Rich

Exhibit 24

A4NR-00279

From: Jones, Blair <BXJk@pge.com>
Sent: Monday, July 7, 2014 2:14 PM
To: Ferre, Kent S <KSF1@pge.com>
Subject: RE: Schedule

Thank you Kent

From: Ferre, Kent S
Sent: Monday, July 07, 2014 2:10 PM
To: Jones, Blair
Subject: RE: Schedule

Blair, I just spoke to Norm, and he said that for the site response and sensitivity studies, they need final models no later than October 15. Working backwards, the TI team would therefore need the IPRP input no later than October 1 to make final tweaks to the source model. This establishes a last date for the AB1632 final report transmittal to the IPRP at mid to late August, depending on the amount of time allowed for their review and comment.

Kent

From: Ferre, Kent S
Sent: Monday, July 07, 2014 1:28 PM
To: Jones, Blair
Subject: Schedule

Blair:

I have a call into Norm but have not heard back. I spoke to Steve Thompson of LCI regarding the seismic source model, and he feels September 1 is when the model needs to be completed. He did leave the door open for subsequent minor tweaks. It is really Norm to establish the final date since he does much of the downstream work.

If Norm calls back I will give you an update.

Kent Ferre, S.E.
Manager | Geosciences Department
Pacific Gas & Electric Company | 245 Market St, MC N4C | San Francisco, CA 94105
T: 415.973.5291 | M: 415.308.3627
KSF1@pge.com

Exhibit 25

A4NR-00231

From: Ferre, Kent S <KSF1@pge.com>
Sent: Monday, July 14, 2014 10:50 AM
To: Klimczak, Richard <RLK1@pge.com>
Cc: Nishenko, Stuart <SPN3@pge.com>; McLaren, Marcia K <MKM2@pge.com>; Kwok, Debbie K <DKK1@pge.com>; Fukuda, Jennifer Kim <J2KM@pge.com>
Subject: AB1632 Cost Plan - Actuals thru June with end-of-project forecast

---

Rich:

Attached for your information is the AB1632 Cost Plan with actual costs through June.

- Costs through June 2014 since project inception - $49.796 million
- 2014 year-to-date costs through June 2014 - $2.845 million
- Current end-of-project forecast - $51.596 million (includes 4 new contracts (highlighted in yellow) for the SLR/IOF/DCF interpretation – new subtotal on spreadsheet, and the LESS report writing)

Note that there are authorized amounts (of generally completed work) that have not yet been invoiced. I will follow-up with the contractors and technical coordinators on this. These amounts may reduce the end-of-project forecast costs:

- LESS - $371.7k unspent
- ONSIP - $191.2k unspent
- OBS - $13.9k unspent
- Project Management - $86.7k unspent
- IPRP - $720.1k unspent
- Total - $1.383 million unspent

Kent Ferre, S.E.
Manager | Geosciences Department
Pacific Gas & Electric Company | 245 Market St, MC N4C | San Francisco, CA 94105
T: 415.973.5291 | M: 415.308.3627
KSF1@pge.com

Exhibit 26

A4NR-00402

From: RLK1@pge.com
Sent: Thursday, August 21, 2014 11:59 AM
To: Ferre, Kent S <KSF1@pge.com>
Cc: Summy, Jeff <J51D@pge.com>; Jones, Thomas P. <TPJ2@pge.com>; Post, Jennifer (Law) <JLKm@pge.com>
Subject: Re: Privileged and Confidential: Process/Schedule Map Request

---

Kent

High level summary:

As we discussed, to meet March 2015 NRC deadline we need:

1) SSC logic trees with documentation due 10/31/14 to PPRP. To meet this date it requires published AB1632 results to be used as input by the SSC TI team for the logic trees development. It also requires time to allow 30 days for IPRP review and for them to provide comments to the SSC TI team. The SSC TI team needs time to consider integration of IPRP input and still meet the 10/31/14 due date.

2) PPRP (Nov. - Dec) review has been shortened to the minimum amount in order for them to issue their endorsement letter of the SSC logic trees for the NRC report.

3) Site response requires finalized SSC and GMC logic trees on 12/1/15

4) site factors need to be complete by 12/29/15 for input into the probabilistic seismic hazard analysis (PSHA).

5) output of the PSHA are the Ground Motion Response Spectrum (GMRS) and seismic hazard curves. These outputs are required to allow the production of the report due to the NRC March 2015.

Rich

Sent from my iPad

On Aug 21, 2014, at 9:36 AM, "Ferre, Kent S" <KSF1@pge.com> wrote:

> Rich, Jeff:
>
> Attached is a high level SSC SSHAC schedule with the IPRP review and SSC TI team evaluation and integration (of IPRP comments) included (tasks 8c3 and 8c4).
>
> I can complement this table with a gantt chart if needed.
>
> **Kent Ferre, S.E.**
> **Manager | Geosciences Department**
> Pacific Gas & Electric Company | 245 Market St, MC N4C | San Francisco, CA 94105
> T: 415.973.5291 | M: 415.308.3627
> KSF1@pge.com
>
> **From:** Summy, Jeff
> **Sent:** Thursday, August 21, 2014 6:14 AM

To: Klimczak, Richard
Cc: Ferre, Kent S; Jones, Thomas P.; Post, Jennifer (Law)
Subject: Re: Privileged and Confidential: Process/Schedule Map Request

Rich/Kent,
We need to be clear on the potential impact to IPRP's ability to provide input to SSHAC if we delay past August 28.
Thanks
Jeff S

Sent from my iPad

On Aug 21, 2014, at 5:15 AM, "Klimczak, Richard" <RLK1@pge.com> wrote:

> Privileged and Confidential
>
> Kent
>
> I will need your help putting the requested timeline together today has I am traveling to Washington D.C. Put the timeline together based on your SSHAC schedule and send it to me P&C. Show the 30 day IPRP review in the timeline. I will call to talk when I am able.
>
> Thanks,
> Rich
>
> Sent from my iPad
>
> Begin forwarded message:
>
>> **From:** "Jones, Thomas P." <TPJ2@pge.com>
>> **Date:** August 20, 2014 at 6:00:23 PM PDT
>> **To:** "Klimczak, Richard" <RLK1@pge.com>, "Post, Jennifer (Law)" <JLKm@pge.com>
>> **Cc:** "Bedwell, Ed" <ETB1@pge.com>
>> **Subject: Process/Schedule Map Request**
>>
>> Privileged and Confidential
>>
>> Greetings Rich and Jennifer:
>>
>> The Sr. leadership of Corporate Affairs has requested a simple timeline that shows the drop dead dates in sequence to understand the required vs. desired timing for release of the report to address concerns raised on related business matters based on our conversations and emails of yesterday and today. The goal is to understand the due dates for ground motion to NRC in March, and how the intermediate steps are driven by the release on August 28. I need this tomorrow and will help support this in any way you need. I suggest a simple timeline and a reference below for each milestone and its weighted importance to satisfy the March 2015 NRC order for ground motion value.
>>
>> I am available by cell phone tonight after hours at 805 459-4530.
>>
>> Regards,
>> Tom

<SSHAC tasks and timelines.doc>

Exhibit 27

A4NR-00707

From: Nishenko, Stuart </O=PG&E/OU=CORPORATE/CN=RECIPIENTS/CN=SPN3>
Sent: Thursday, August 28, 2014 1:24 PM
To: Klimczak, Richard <RLK1@PGE.COM>; Winn, Valerie J <VJW3@PGE.COM>; Jones, Thomas P. <TPJ2@pge.com>
Cc: Post, Jennifer (Law) <JLKM@PGE.COM>
Subject: PRIVILEGED andCONFIDENTIAL FW: DCPP seismic studies report

---

PRIVILEGED and CONFIDENTIAL
To follow up on my email earlier today – please advise as to response

From: Greene, Eric [mailto:eric.greene@cpuc.ca.gov]
Sent: Thursday, August 28, 2014 1:22 PM
To: Nishenko, Stuart
Subject: DCPP seismic studies report

Is PG&E still on schedule to submit to us your seismic studies report for DCPP by the end of August? If not, do you have a realistic revised delivery date for the report? The IPRP is anxious to begin our review without further delay. Thanks.

Eric

Exhibit 28

A4NR-00584

From: Winn, Valerie J <VJW3@pge.com>
Sent: Thursday, August 28, 2014 1:30 PM
To: Nishenko, Stuart <SPN3@pge.com>
Cc: Klimczak, Richard <RLK1@pge.com>; Jones, Thomas P. <TPJ2@pge.com>; Post, Jennifer (Law) <JLKm@pge.com>
Subject: Re: PRIVILEGED andCONFIDENTIAL FW: DCPP seismic studies report

---

Priv and Conf

Stu, let me give Tom a call to discuss. I would like Eric to poll the IPRP as to what they need in terms of hard copes, CDs, etc and being able to communicate a date (e.g., in or before September 15) would be helpful. It would also be nice, to manage IPRP expectations, to work with Eric to set a date for meeting with the IPRP to discuss. That might help to get them into our court or at least minimize any blow back from the delayed issuance.

Tom, is there a good time to chat today? I am in a CHP meeting from 230 to 5... Cell is best 4157307179. Thanks!

Valerie

Sent from my iPhone

On Aug 28, 2014, at 1:24 PM, "Nishenko, Stuart" <SPN3@pge.com> wrote:

> PRIVILEGED and CONFIDENTIAL
> To follow up on my email earlier today – please advise as to response
>
> **From:** Greene, Eric [mailto:eric.greene@cpuc.ca.gov]
> **Sent:** Thursday, August 28, 2014 1:22 PM
> **To:** Nishenko, Stuart
> **Subject:** DCPP seismic studies report
>
> Is PG&E still on schedule to submit to us your seismic studies report for DCPP by the end of August? If not, do you have a realistic revised delivery date for the report? The IPRP is anxious to begin our review without further delay. Thanks.
>
> Eric

Exhibit 29

A4NR-00800

From: VJW3@PGE.COM
Sent: Monday, September 8, 2014 9:44 AM
To: Greene, Eric <eric.greene@cpuc.ca.gov>
Cc: Jacobson, Erik B (RegRel) <EBJ1@pge.com>
Subject: Re: Diablo Canyon Status Report, June 10, 2014.pdf

Thanks Eric, is the meeting on Thursday just for the CPUC or is it for all of the IPRP? I think it is just CPUC but wanted to confirm.

Thanks for the other info on the IPRP review process. Valerie

Sent from my iPhone

On Sep 8, 2014, at 9:39 AM, "Greene, Eric" <eric.greene@cpuc.ca.gov> wrote:

Ed Randolph set up a meeting for Thurs Sept 11 at 1:30 – 2:30 in Room 5305 at 505 Van Ness Ave.

Because the report is large, the IPRP plans to review the report in sections. The IPRP would hold several public meetings with PG&E to discuss the contents sectionally. The IPRP would also be providing its comments to PG&E sectionally. These meetings, reviews, and reports would occur over the next 6-8 months. I'll let you all know when we can schedule our next IPRP meeting. Thanks.

Eric

From: Jacobson, Erik B (RegRel) [mailto:EBJ1@pge.com]
Sent: Monday, September 08, 2014 8:49 AM
To: Greene, Eric
Cc: Winn, Valerie J
Subject: RE: Diablo Canyon Status Report, June 10, 2014.pdf

Eric,

We are also reaching out to Ed Randolph and Gurbux Kahlon to schedule a briefing for Energy Division regarding the report.

Best regards,

Erik

Erik Jacobson
Director, Regulatory Relations
Pacific Gas and Electric Company
77Beale Street, Rm. 1083
San Francisco, CA 94105
tel: 415-973-4464
cell: 415-310-7617
ebj1@pge.com

-----Original Message-----
From: Winn, Valerie J
Sent: Friday, September 05, 2014 5:29 PM
To: 'Wills, Chris@DOC'; Greene, Eric
Subject: RE: Diablo Canyon Status Report, June 10, 2014.pdf

Hi Chris and Eric,

I just received word that the report will be submitted to the NRC on Wednesday, September 10, at which time the report will become public. While we're working to finalize the report and prepare the hard copies and CDs (no easy feat, it's a big report) and other logistics, we'd be happy to do a pre-brief of the report's findings with the IPRP on Tuesday afternoon, if that is possible. We could do the briefing by phone if you'd like. Please let me know your availability and I'll work to get this set up.

Eric, I know the IPRP is also interested in having a meeting or two once the report is submitted to the NRC. Now that we know the date for the submittal, could you please let me know when/where the IPRP may wish to meet to discuss the report in greater depth? I can then get this on my team's calendars.

Best regards,

Valerie Winn
Chief, State Agency Relations
Pacific Gas and Electric Company
415.973.3839 (o)
415.730.7179 (m)

-----Original Message-----
From: Wills, Chris@DOC [mailto:Chris.Wills@conservation.ca.gov]
Sent: Thursday, September 04, 2014 2:00 PM
To: Winn, Valerie J; Greene, Eric
Subject: RE: Diablo Canyon Status Report, June 10, 2014.pdf

Hi Valerie

Any update on the schedule?

Chris

Chris Wills
Supervising Engineering Geologist
California Geological Survey
801 K Street, ms 12-32
Sacramento, CA 95814

-----Original Message-----
From: Winn, Valerie J [mailto:VJW3@pge.com]
Sent: Tuesday, August 5, 2014 2:17 PM
To: Wills, Chris@DOC; Greene, Eric
Subject: RE: Diablo Canyon Status Report, June 10, 2014.pdf

Hi Chris and Eric,

Sorry for the delay in communicating to you. As I understand the current schedule submitted to the ASLB, it looks like a late August release date. I'll check in with the team on the other dates for finalizing the seismic hazard model inputs and let you know.

Thanks!

Valerie

-----Original Message-----
From: Wills, Chris@DOC [mailto:Chris.Wills@conservation.ca.gov]
Sent: Tuesday, August 05, 2014 2:07 PM
To: Winn, Valerie J; Greene, Eric
Subject: RE: Diablo Canyon Status Report, June 10, 2014.pdf

Hi Valerie

Since I haven't heard anything, I assume that the reports for NRC and ASLB are still not quite done. Can you give me a date when we might expect to receive them? I need to plan for staff time to review them. I also need to know the dates when PG&E expects to finalize their seismic hazard model inputs, so we can try to provide our review comments before then.

Chris

Chris Wills
Supervising Engineering Geologist
California Geological Survey
801 K Street, ms 12-32
Sacramento, CA 95814

-----Original Message-----
From: Winn, Valerie J [mailto:VJW3@pge.com]
Sent: Wednesday, June 11, 2014 2:40 PM
To: Greene, Eric
Cc: Wills, Chris@DOC
Subject: FW: Diablo Canyon Status Report, June 10, 2014.pdf

Hi Eric (and Chris),

I wanted to provide this month's report to the ASLB on various DCPP issues. Please note that for the item "Issue Final Seismic Report to the NRC and ASLB", we had previously indicated submittal in June 2014. That date has now slipped to July 2014.

While I don't have a precise date today for when the report will be submitted to the NRC (and the IPRP) in July, I expect the submittal will now be made in late July. I'll be in touch as I know more.

Please don't hesitate to call if you have any questions.

Best regards,

Valerie Winn
Chief, State Agency Relations
Pacific Gas and Electric Company
415.973.3839 (o)

415.730.7179 (m)

PG&E is committed to protecting our customers' privacy.
To learn more, please visit http://www.pge.com/about/company/privacy/customer/

PG&E is committed to protecting our customers' privacy.
To learn more, please visit http://www.pge.com/about/company/privacy/customer/

Exhibit 30

A4NR-00256

From: Steve Thompson <thompson@lettisci.com>
Sent: Tuesday, September 2, 2014 8:26 AM
To: Ferre, Kent S <KSF1@pge.com>
Subject: Meet this morning?

Hi Kent,

Bill Lettis and I are coming in to 245 Market today to meet with Norm. Are you free to talk briefly about implications of new IPRP scope?

We will be in around 9:00; our meeting with Norm is at 10:00.

Thanks,

-steve

Sent from my iPhone

Exhibit 31

A4NR-00255

From: Steve Thompson <thompson@lettisci.com>
Sent: Tuesday, September 2, 2014 5:29 PM
To: William Lettis <lettis@lettisci.com>; Hans AbramsonWard <abramsonward@lettisci.com>; Glenn Biasi (glenn@seismo.unr.edu); John Caskey (caskey@sfsu.edu); Kathryn Hanson (Kathryn.Hanson@amec.com)
Cc: Ferre, Kent S <KSF1@pge.com>; Klimczak, Richard <RLK1@pge.com>; Nishenko, Stuart <SPN3@pge.com>
Subject: DCPP SSHAC: Possible meeting with IPRP to discuss implementation of AB1632 in SSC model

---

SSC TI Team plus Kent, Rich, and Stu:

We understand that the IPRP – a review board working on behalf of the California PUC to review the AB1632 program – has new scope to explore how the results of the AB1632 program are being used in the SSHAC for the SSC model. As such, we are just beginning to figure out how we can accommodate this change. A proposed approach for interacting with the IPRP to help them achieve their goal is as follows:

1) AB1632 reports are delivered to the IPRP and NRC (this is coming soon)
2) The IPRP perform an initial review of the AB1632 reports (approx. 3 weeks)
3) The SSHAC TI Team and PG&E Geosciences hold a 1-day meeting with the IPRP (+/- members of PPRP?) to discuss:
    a. The SSHAC process and the Role of the AB1632 program in the process
    b. The SSHAC SSC Model (update from Workshop 3; almost final)
    c. How the AB1632 reports have been reviewed, considered, and integrated by the TI Team for the SSC Model
    d. Any initial comments or questions the IPRP have about how the AB1632 results have been or will be incorporated in the SSC model
4) The IPRP complete their review of the AB1632 reports and draft a letter recommending how AB1632 information should be incorporated into the SSC model
5) The SSHAC TI Team and PPRP review the IPRP letter. The SSHAC TI Team considers the letter, makes modifications to the SSC as deemed appropriate, and addresses the IPRP letter in the SSHAC SSC Final Report.

The main action for the TI Team now is to understand this may be coming up, and to know whether you are available for a one-day meeting during the OCTOBER 1-3 WINDOW.

For Rich, Kent, and Stu, please let me know your general thoughts on the plan outlined above, and your availability the Oct. 1-3 window. Bill Lettis and Norm Abrahamson have indicated their availability those days.

Thanks,
-steve

Lettis Consultants International, Inc. (LCI)
1981 N Broadway, Suite 330
Walnut Creek, CA 94596
Main: (925) 482-0360
Direct: (925) 482-0363, x203

Stephen C. Thompson, PhD
Principal Geologist
thompson@lettisci.com * mobile - (510) 919-7465

Exhibit 32

A4NR-00170

From:	Steve Thompson <thompson@lettisci.com>
Sent:	Thursday, September 25, 2014 9:41 AM
To:	Hanson, Kathryn <Kathryn.Hanson@amec.com>; William Lettis <lettis@lettisci.com>; Glenn Biasi (glenn@seismo.unr.edu); John Caskey (caskey@sfsu.edu); Ferre, Kent S <KSF1@pge.com>
Subject:	Status update, DCPP SSC model

SSC TI Team:

In lieu of a call, here is a run-down of what is going on:

1. Project plan: I've updated the project plan and it is ready for Bill to review, then Kent. It updates the TI Team (adding Kathryn) and updates the schedule.

2. SSC Contribution to GMC Technical Report: Bill Lettis revised text of the tectonic setting for Carola/SWUS GMC report. Hans and LCI graphics are working to provide figures for the section as requested by GMC team. This should be submitted to Carola/Norm today or tomorrow morning.

3. Incorporation of AB1632 work and IPRP review: Tomorrow we are holding our second meeting with Chris Wills of the IPRP to discuss the AB1632 reports and how the SSHAC TI Team is evaluating and incorporating the information. The focus tomorrow is on the Hosgri slip rate, and the interpretation of a sequence stratigraphy in the offshore seismic data that is key to establishing ages. The goal is to inform the IPRP (Chris, Gordon, Tim) of both the proponent models (e.g., Hans' stratigraphic framework and correlated offset channels) and our TI Team evaluation and integration (e.g., considering San Simeon, Cross-Hosgri Slope, LESS sites, GPS constraints, UCERF numerical modeling, etc.)

4. HID: I'm working through the final model HID, noting all places where there are still gaps. Unfortunately, there are still a lot of gaps. THIS MODEL NEEDS TO BE DONE BY OCTOBER 24TH!!!!!!! I'll run through our model "elements" and status:

    a. Fault Geometry Models: Hans, Bill, and I are making tweaks to the model geometries. The intersection of Los Osos with Hosgri is moving slightly north; The Edna and onshore San Miguelito are deleted (now part of Areal source zone). The most important change is that, in the Southwest Vergent Model, The San Luis Bay fault source Crosses the Shoreline fault source, with the San Luis Bay fault source now terminating to the west against the Hosgri fault. The OV and NE Models are keeping the prior geometric relation whereby the San Luis Bay fault terminates against the Shoreline fault.
    b. Fault Slip Rate Models: Hans and Kathryn are continuing to pour through the LESS data for Pt. Sal and San Luis Obispo Bay; the slip rates for the Hosgri, Shoreline, and Oceano faults are still a bit in flux but need to be finished quickly
    c. Rupture Model: I've proposed some minor changes to the rupture models based on eliminating the Edna and San Miguelito in the OV model. Also, the rupture sources that include splay ruptures along the SWBZ, all south of the plant, are being simplified as there is no change to hazard whether they splay or not.
    d. Slip Rate Allocation Model: This needs to be redone after (b) and (c) are finished.
    e. Magnitude Distribution Model: I'm meeting Norm Friday morning to go over the first WAACY results. His first attempt hit some coding snags; these are the re-runs. Next week should be the first change to really incorporate the WAACY model.
    f. Time Dependency Model: The final implementation of this for the Hosgri fault depends on the outcome of (b)
    g. SAN ANDREAS AND OTHER ONLAND SOURCES: Glenn has resumed discussion with Nick Gregor regarding how best to use the UCERF3 event sets.

h. Other offshore sources: Kathryn added a source for the 1927 Lompoc earthquake; the others remain unchanged following WS3
i. Areal Source Zone: I presented a logic tree last week for the San Luis-Pismo block and Estero Bay areal source zone. We need to give weights to logic tree branches then hand it over to Nick for review, incorporation, and hazard sensitivity
j. Background Source Zones: Norm is reviewing some edits to the background sources he sent me; He and I will discuss those Friday.

5. Reporting: I understand that Hans and Kathryn are writing up slip rates as they go through them. Bill is working on the Tectonic Setting chapter following the hand-off from John. I need to finish the HID and write the chapter on our SSC model approach and elements. THE DEADLINE FOR THIS REPORT IS OCTOBER 31ST. WE NEED TO BE WRITING AND REVIEWING.
6. Second PPRP Final Briefing: This is scheduled for Friday, October 31st, pending Tom Rockwell's response. A back-up date is Thursday, November 6th.

Please respond to the group if there is another activity I'm not aware of.

Thanks,
-steve

Lettis Consultants International, Inc. (LCI)
1981 N Broadway, Suite 330
Walnut Creek, CA 94596
Main: (925) 482-0360
Direct: (925) 482-0363, x203

Stephen C. Thompson, PhD
Principal Geologist
thompson@lettisci.com * mobile - (510) 919-7465

From: Hanson, Kathryn [mailto:Kathryn.Hanson@amec.com]
Sent: Thursday, September 25, 2014 8:57 AM
To: Steve Thompson; William Lettis; Glenn Biasi (glenn@seismo.unr.edu); Hanson, Kathryn; John Caskey (caskey@sfsu.edu); Ferre, Kent S
Subject: RE: Conference call this morning

Are we on for this call today?

From: Steve Thompson [mailto:thompson@lettisci.com]
Sent: Thursday, September 04, 2014 9:01 AM
To: William Lettis; Glenn Biasi (glenn@seismo.unr.edu); Hanson, Kathryn; John Caskey (caskey@sfsu.edu); Ferre, Kent S
Subject: Conference call this morning

All,

Let's hold a brief check-in call. Now ok?

We can discuss

-background source

-LESS summary

-writing assignments and outline

-IPRP

-WAACY progress

Conference Dial-In number: +1 209 255 1000
Host AccessCode: 849507#
Participant AccessCode: 728601#

-steve

Lettis Consultants International, Inc. (LCI)
1981 N Broadway, Suite 330
Walnut Creek, CA 94596
Main: (925) 482-0360
Direct: (925) 482-0363, x203

Stephen C. Thompson, PhD
Principal Geologist
thompson@lettisci.com * mobile - (510) 919-7465

Exhibit 33

A4NR-00252

Subject: Implementing IPRP Provisions in GRC Decision

Location: Bill's Office or Call-in: (866)779-0774 *4159739809*

Start: 9/9/2014 3:00 PM

End: 9/9/2014 4:00 PM

Show Time As: Busy

Recurrence: (none)

Organizer: Post, Jennifer (Law)

Required Attendees: Ferre, Kent S; Klimczak, Richard; Manheim, William (Law)

Resources: Bill's Office or Call-in: (866)779-0774 *4159739809*

Exhibit 34

A4NR-00249

From: Steve Thompson <thompson@lettisci.com>
Sent: Tuesday, September 9, 2014 3:38 PM
To: Ferre, Kent S <KSF1@pge.com>; Klimczak, Richard <RLK1@pge.com>; Nishenko, Stuart <SPN3@pge.com>; Kathryn Hanson (Kathryn.Hanson@amec.com); Hans AbramsonWard <abramsonward@lettisci.com>
Cc: William Lettis <lettis@lettisci.com>
Subject: Meeting to discuss IPRP review process

Hi Kent, Rich, and Stu,

I just spoke with Kent about meeting as a group at PG&E to discuss the process of the IPRP review of the AB1632 studies and their scope to review how the reports are being implemented in the SSHAC model. The agenda would include:

1. Update on understanding between PG&E and IPRP concerning scope of review
2. Discuss possible scope and schedule of review
3. Discuss current SSHAC TI Team observations, interpretations, and strategies for incorporating AB1632 report content
4. Outline next steps.

I have two alternative meeting times.

1. Next Monday at 9:00 am
2. This Friday at 9:30 am

Please let me know if you can make either time; Monday works best for some of the TI Team representatives. Please also let me know if there are any questions or suggestions about the agenda.

Thanks,
-steve

Exhibit 35

A4NR-00246

From: William Lettis <lettis@lettisci.com>
Sent: Thursday, September 11, 2014 3:38 PM
To: Steve Thompson <thompson@lettisci.com>; Ferre, Kent S <KSF1@pge.com>
Subject: IPRP Meeting

Hi Kent and Steve

I just attended the CGS mapping committee meeting in Sacramento chaired by Chris Wills. In a side bar hallway conversation, Chris indicated that he, Gordon Sietz and Tim Dawson would like to meet informally "anytime next week" to discuss how we are using AB 1632 in our SSHAC deliberations, if possible. Chris has some personal issues that will prevent him from meeting later until later in October.

Chris indicated that their committee received the ab 1632 reports yesterday, and it would be good to have an idea of how we are using the data so they can consider this in their review.

The meeting would be informal non public.

Is this possible? Anyway, this will be good to discuss on Monday when we meet (or Friday? Has a meeting time been set up?).

Thanks
Bill

Sent from mobile phone

Exhibit 36

A4NR-00786

From: Nishenko, Stuart <SPN3@pge.com>
Sent: Tuesday, September 16, 2014 9:26 AM
To: Winn, Valerie J <VJW3@pge.com>; Wills, Chris@DOC <Chris.Wills@conservation.ca.gov>
Cc: Greene, Eric <eric.greene@cpuc.ca.gov>
Subject: RE: Diablo Canyon Reports to IPRP, September 10, 2014, follow up

---

All-
Found a smaller, more compact, version of the subject report and just mailed it to Chris via HighTail – should be in Chris' inbox by now!
Stu

From: Winn, Valerie J
Sent: Monday, September 15, 2014 3:44 PM
To: Wills, Chris@DOC; Nishenko, Stuart
Cc: Greene, Eric
Subject: RE: Diablo Canyon Reports to IPRP, September 10, 2014, follow up

Hi Chris,

Stu is going to get a copy of the document to me tomorrow and we'll overnight mail it to you for receipt on Wednesday. I understand it is about 300 MB so I can't send it via email.

Eric, please let me know if you would like a copy of the report as well or if we should mail USBs with the document to other IPRP members.

Thanks,

Valerie Winn
Chief, State Agency Relations
Pacific Gas and Electric Company
415.973.3839 (o)
415.730.7179 (m)

From: Wills, Chris@DOC [mailto:Chris.Wills@conservation.ca.gov]
Sent: Monday, September 15, 2014 2:41 PM
To: Winn, Valerie J; Nishenko, Stuart
Cc: Greene, Eric
Subject: FW: Diablo Canyon Reports to IPRP, September 10, 2014, follow up

Hi Valerie and Stu

In beginning our review of the reports released last week, I've noted that discussion of the ages of sediments and channels offset by the Hosgri and Shoreline faults refer to a 2013 report by PG&E. I do not find that report with the reports released last week and do not think we've been provided a copy previously. Since the age of the offset features is a critical aspect of any determination of slip rate, we need that report to review the slip-rate estimates. Please send a copy of the "Stratigraphic Framework" report referenced below to me as soon as possible.

Thank you

Chris

Pacific Gas and Electric Company (PG&E), 2013. *Stratigraphic Framework for Assessment of Fault Activity Offshore of the Central California Coast Between Point San Simeon and Point Sal*: PG&E Technical Report GEO.DCPP.TR.13.01.

Chris Wills
Supervising Engineering Geologist
California Geological Survey
801 K Street, ms 12-32
Sacramento, CA 95814

From: Greene, Eric [mailto:eric.greene@cpuc.ca.gov]
Sent: Monday, September 15, 2014 2:26 PM
To: Wills, Chris@DOC
Subject: RE: Diablo Canyon Reports to IPRP, September 10, 2014, follow up

Sure. Please include your e-mail below so PG&E will know I'm aware of the request and would also want to see PG&E's response. It is possible that it is something internal that PG&E does not want released. Thanks.

Eric

From: Wills, Chris@DOC [mailto:Chris.Wills@conservation.ca.gov]
Sent: Monday, September 15, 2014 2:11 PM
To: Greene, Eric
Subject: Diablo Canyon Reports to IPRP, September 10, 2014, follow up

Hi Eric

In skimming through the report, I've found that the studies for slip-rate on the Hosgri fault refer to a previous report by PG&E that has not been provided. Since that report describes the way PG&E has determined the ages of sediments, it's critical to the evaluation of slip-rate. If it's OK, I'll send an email to PG&E asking for that report.

Chris

Chris Wills
Supervising Engineering Geologist
California Geological Survey
801 K Street, ms 12-32
Sacramento, CA 95814

Exhibit 37

A4NR-00576

From: Steve Thompson <thompson@lettisci.com>
Sent: Monday, September 15, 2014 4:43 PM
To: Wills, Chris (Chris.Wills@conservation.ca.gov); Timothy Dawson (Timothy.Dawson@conservation.ca.gov); Seitz, Gordon <Gordon.Seitz@conservation.ca.gov>; Klimczak, Richard <RLK1@pge.com>; Nishenko, Stuart <SPN3@pge.com>; Ferre, Kent S <KSF1@pge.com>
Cc: William Lettis <lettis@lettisci.com>; Hans AbramsonWard <abramsonward@lettisci.com>
Subject: Friday informal meeting at LCI to discuss SSHAC SSC implementation of AB1632 reports

---

Dear Chris,

Following up on our conversation earlier, we invite you, Tim, and Gordon over to LCI Friday to discuss the current SSHAC SSC model and our progress to date incorporating the results from the AB1632 studies. As mentioned, Friday is the earliest day we can meet; we understand Gordon cannot attend, but perhaps we can mitigate this another way. The goal is to keep this to a high-level discussion of the SSC model, parts of the SSC model relevant to the AB1632 program, and our approach and findings for incorporating the data and interpretations into our logic trees. It is unlikely we will have time to delve into the seismic data volumes, but perhaps we will be able to show you and Tim an example or two.

We would propose an agenda as follows:

9:00 Review agenda and goals for the meeting

9:30 Review SSHAC process and role of AB1632 in that process

10:00 Hosgri characterization
- Slip Rates
- Dip
- Connectivity

12:00 Lunch
12:30 Shoreline characterization
- Slip Rates
- Connectivity

2:00 Los Osos and San Luis Bay characterization
- Dip
- Connectivity

3:30 Other faults, including Diablo Cove fault, Estero Bay lineaments, and Edna fault
- Geometry
- Rate

5:00 Adjourn

Lettis Consultants International, Inc. (LCI)
1981 N Broadway, Suite 330
Walnut Creek, CA 94596
Main: (925) 482-0360
Direct: (925) 482-0363, x203

Stephen C. Thompson, PhD
Principal Geologist
thompson@lettisci.com * mobile - (510) 919-7465

Exhibit 38

A4NR-00244

From: William Lettis <lettis@lettisci.com>
Sent: Wednesday, September 17, 2014 8:57 AM
To: Kevin Coppersmith <kcoppersmith@earthlink.net>
Cc: Steve Thompson <thompson@lettisci.com>; Ferre, Kent S <KSF1@pge.com>
Subject: Re: Any update?

Hi Kevin

We will get back to you later this week with a schedule up date for the PPRP.

In terms of the IPRP review that I mentioned to you, Chris Wills is only available this week. He and Tim Dawson (IPRP Staff support) will come to our office on Friday, beginning at 9 AM, and the TI Team will present our approach for implementing the AB1632 results into SSHAC. I know that it is short notice, but we just found out this schedule and talked with PG&E. No other IPRP member will attend, and this meeting is informal (I.e., not public). If you are available, it would be great to have you attend - especially to provide support for our approach in utilizing the data and proponent interpretations from AB 1632, as well as the ^{3}role^{2} that the IPRP has within the SSHAC process (I.e., no formal role, but we will consider their comments in our assessment process).

In the meantime, we are meeting today (Wednesday) with the AB 1632 technical team to review our assessment of the AB 1632 data and interpretations,and obtain their feedback/comments.

Please let me know if you are available, and I will send you the Friday meeting location (I think it is at LCI) or the call in number if you are available by phone.

Thanks
Bill

On 9/16/14, 3:16 PM, "Kevin Coppersmith" <kcoppersmith@earthlink.net> wrote:

>Bill and Steve,
>
>Any update that you can give us on the schedule. The natives are getting
>restless (myself included) to set our calendars.
>
>Thanks
>Kevin
>
>-----Original Message-----
>From: neal driscoll [https://urldefense.proofpoint.com/v1/url?u=http://mailto:ndriscoll%40ucsd.edu&k=4%2BViHuL0UtSJBpVrYi3EdQ%3D%3D%0A&r=qhe4vKZPSUR3Iq64nzAOKA%3D%3D%0A&m=Z2G%2F%2B%2FE07KRruUPtmJkjpT3s9l9hH3rd5tY233P0aJU%3D%0A&s=bb4166c08841e00e59693d31f33feaab619279b8944836287c8d2329eb853c10]
>Sent: Tuesday, September 16, 2014 1:51 PM
>To: Kevin Coppersmith

>Cc: neal driscoll
>Subject: Any update?
>
>Hi Kevin,
>
>Any update on the "new" schedule?
>
>Best,
>neal
>
>
>

Exhibit 39

A4NR-00657

SSHAC Implementation of AB1632 Results

SSHAC SSC TI Team
Presenting to CGS/IPRP reviewers
9/19/2014
SCC working meeting 35

Attending

- TI Team
  - AbramsonWard
  - Biasi (by phone)
  - Hanson (by phone)
  - Lettis
  - Thompson
- PG&E
  - S. Nishenko
  - R. Klimczak
  - K. Ferre
  - J. Strickland
  - V. Winn
- CGS/IPRP reviewers
  - C. Wills
  - T. Dawson
- Others (by phone)
  - P. Hogan
  - G. Greene

Purpose of Meeting

- Discuss where AB1632 reports fit into SSHAC process
- Inform CGS/IPRP representatives of SSHAC SSC TI Team progress with implementing AB1632 data and interpretations
- Get *initial* feedback from CGS/IPRP representatives
- Discuss process for review of AB1632 reports and their implementation in the SSHAC SSC and PSHA for DCPP

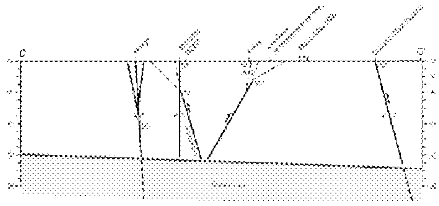
Agenda

- 9:00 Review Agenda and Meeting Goals
- 9:30 Hosgri Characterization
  - slip rate; dip; connectivity
- 12:00 *Lunch*
- 12:30 Shoreline Characterization
  - Slip rate; connectivity
- 2:00 Los Osos and San Luis Bay Characterization
  - Dip; connectivity
- 3:30 Other faults, San Luis-Pismo Block and Estero Bay
  - Diablo Cove fault; geometries and rates of others
- 5:00 Adjourn

Hosgri Slip Rate

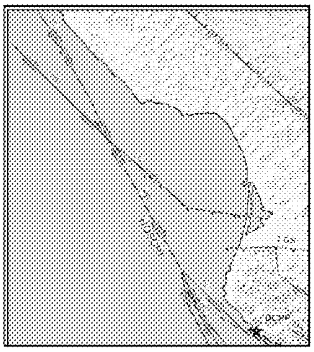
- Hans to go through

Hosgri Dip



- AB1632 activity: CCCSIP Report Chapter 6 (HESS Question)
- SSHAC SSC Approach: Using seismicity analysis of Hardebeck (Workshop 2) and our independent evaluation of:
  - Hardebeck TomoDD locations
  - Gravity and Mag forward modeling (Watt, Workshop 2)
  - Willingham et al. (2013) interpretations
  - USGS single-channel data
  - LESS data
- SSHAC SSC Input: 90, 85, and 75 degrees NE dip from central strand.

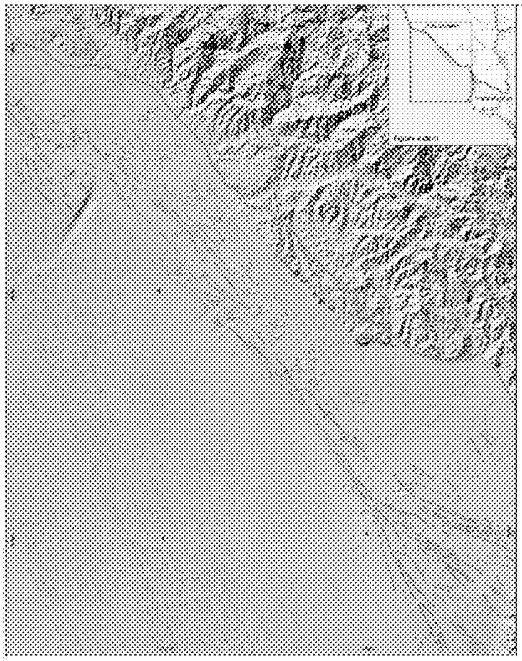
Hosgri Connectivity (Hosgri linkage with San Simeon fault)



- AB1632 activity: CCCSIP Report Chapter 4: Point Buchon to San Simeon Seismic Interpretation
- SSHAC SSC Approach:
  - Evaluate Johnson and Watt, PG&E (2013) Seismic Strat, CCCSIP Report Chapter 4.
  - Consider criteria for segmentation or termination of a fault; mainly Wesnousky (2006) and similar studies; UCERF3 criteria
- SSHAC SSC Interpretation:
  - Investigators interpret either direct continuity of faulting or a stepover of 2-3 km; either permissible for linked rupture
  - Investigators show continuity of Western Hosgri with Piedras Blancas
  - One study (PG&E, 2013) shows much lower rates of activity on western Hosgri relative to Hosgri-San Simeon.

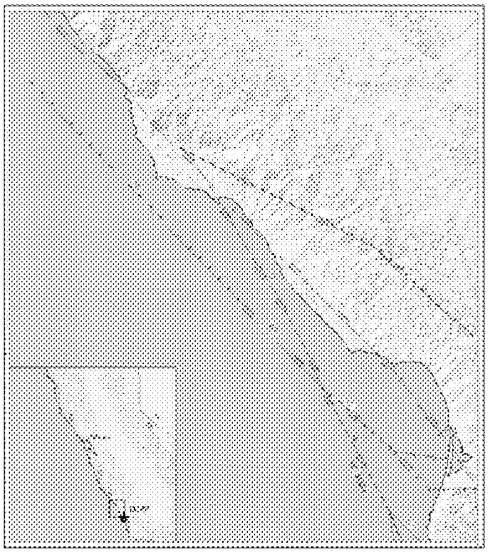
Estero Bay/San Simeon Stepover Report

- San Simeon Stepover Report interprets:
  - Cambria stepover between well defined Hosgri to west and San Simeon fault to east; size of stepover ~2-3 km
  - Faults identified within stepover, including normal faults
  - Northern end of Hosgri fault active; structures present that connect it to Piedras Blancas fold-thrust belt
  - Through-going Hosgri-San Simeon fault trace not supported by direct observations on seismic lines (Cambria Gap)
  - Los Osos fault consists of several strands; north-side down and horst block seen
    - No dip information provided
  - Additional faults imaged south of Los Osos; north of Irish Hills; project to land



SSHAC Implementation Estero Bay/San Simeon Stepover Report

- Hosgri and San Simeon faults allowed to link; contiguous source (preference to interpretation of PG&E, 2013; Johnson and Watt, 2012)
- Proposed stepover offshore Cambria would be considered possible "soft" segmentation point; factored in with magnitude estimates
- Hosgri north of Pt. Estero separated into Western Hosgri and main Hosgri
  - Western Hosgri can link rupture to Piedras Blancas source;
  - Lower slip rate than thru-going Hosgri-San Simeon
- Los Osos offshore allowed to link with Hosgri; location comparable to mapping



A4NR-00657

Notes

- Maximum limit to Hosgri slip rate opposite the plant.
- 1. Need to document carefully the maximum contribution from the Piedras Blancas and west Hosgri. Need to be thorough and explore alternative datasets (terrace uplift, seismicity rate, fold-thrust belt shortening) in a mean-centered way to explore the options.
- 2. Estero Bay reliance is high. Does TI Team need to develop an alternative model at the site?

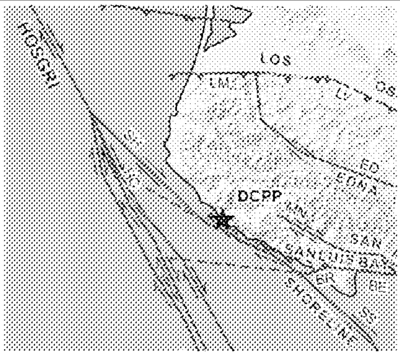
Lunch Break (30 min)

- 9:00 Review Agenda and Meeting Goals
- 9:30 Hosgri Characterization
  - slip rate; dip; connectivity
- 11:30 Response to Dr. Hamilton
- 12:00 *Lunch*
- 12:30 Shoreline Characterization
  - Slip rate; connectivity
- 2:00 Los Osos and San Luis Bay Characterization
  - Dip
- 3:30 Other faults, San Luis-Pismo Block and Estero Bay
  - Geometries and rates of others
- 5:00 Adjourn

Shoreline Slip Rate

- Hans to go through

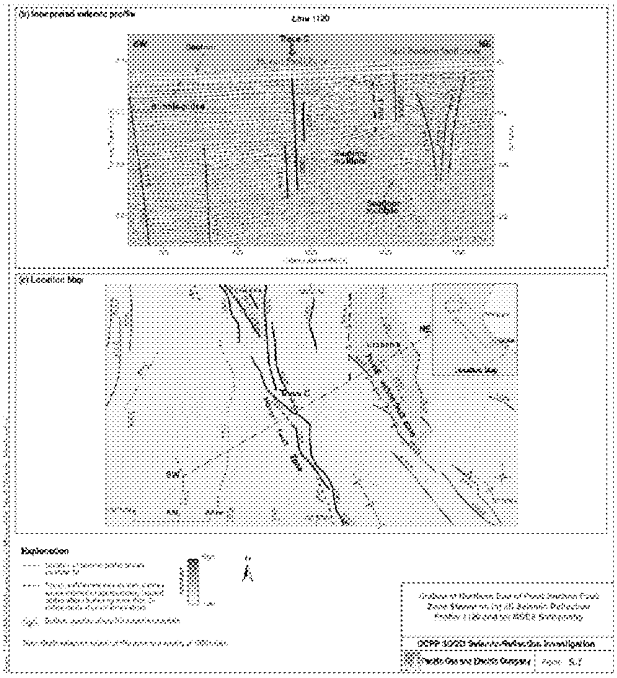
Shoreline Connectivity (Shoreline linkage with the Hosgri and/or faults to the southeast)



- AB1632 activities: CCCSIP Report Chapter 2: Point Buchon Report. CCCSIP Report Chapter 3: LESS Report.
- SSHAC SSC Approach:
  - Evaluate Hardebeck (2010; 2013; workshop presentations); Johnson and Watt, PG&E (2013) Seismic Strat, CCCSIP Report Chapters 2 and 4; PG&E (2011) Shoreline Report.
  - Consider criteria for segmentation or termination of a fault; mainly Wesnousky (2006) and similar studies; UCERF3 criteria.
  - Consider data, methods, models for evaluating linkages (Kame et al; Harris, pers. communication).
- SSHAC SSC Interpretation:
  - Shoreline fault source coincides with Pt. Buchon fault at north end.
  - Linked Shoreline-Hosgri ruptures permissible.
  - Joint (splay) Shoreline-Hosgri ruptures considered.
  - Shoreline-Southwestern boundary zone ruptures permissible.

Connectivity to Hosgri: Pt. Buchon Report

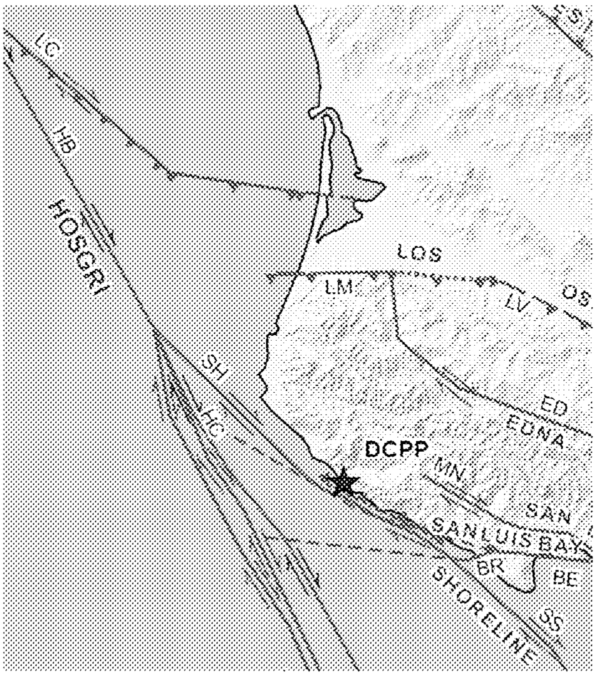
- Pt. Buchon Report Interprets:
  - Main trace, Point Buchon fault intersects Hosgri at small basins
  - East Branch, Point Buchon fault asymptotically approaches Hosgri fault
  - Western splays off Pt. Buchon fault intersect Hosgri
  - Shoreline-Pt. Buchon fault intersection not associated with a clear scarp or trace; probable step
    - "may connect" p. 36.
  - No lateral slip rate
  - Vertical rates from Shoreline fault zone report (PG&E, 2011)
  - No dip information at depth



A4NR-00657

SSHAC Implementation

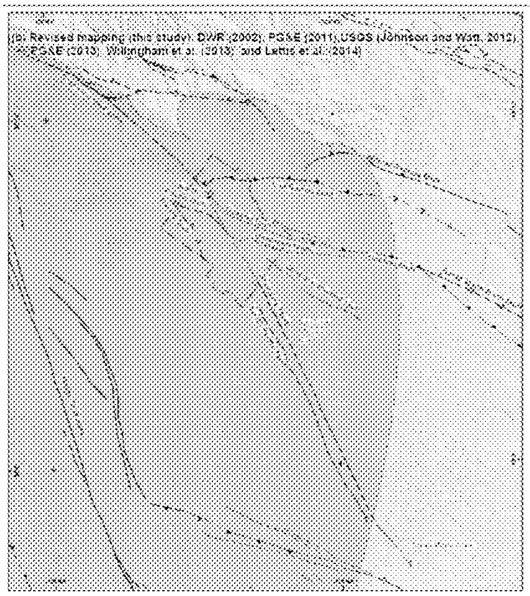
- Shoreline fault source follows main trace, Pt. Buchon fault
- Seismicity interpreted to be on main trace, Pt. Buchon fault
- Shoreline-Hosgri linked ruptures and coincident (splay) ruptures permitted
- No segmentation point between Pt. Buchon and Shoreline fault
- Alternative rupture pathways & lengths of Shoreline fault NW of the DCPP are captured within magnitude variability on Shoreline fault rupture sources



A4NR-00657

Connectivity to the south: LESS Report

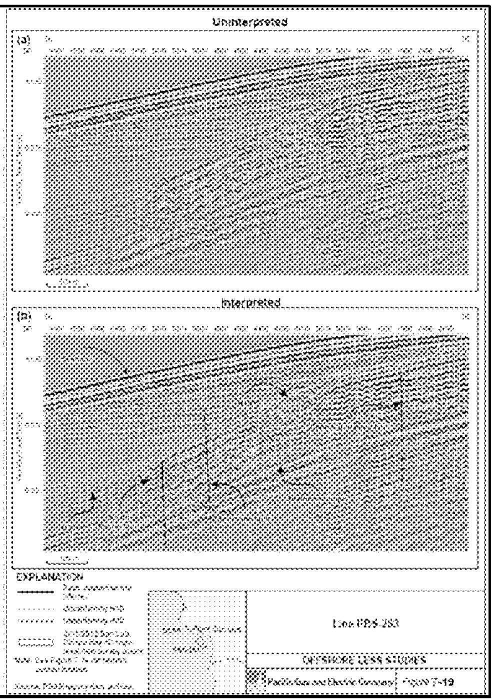
- AB1632 activity: CCCSIP Report Chapter 3: LESS
- AB1632 (LESS) Interprets:
  - Shoreline fault continues to Casmalia
  - Oceano fault intersects Shoreline fault
  - Los Berros, Pecho, and unnamed faults intersect Shoreline fault



A4NR-00657

Southern end of the Shoreline fault

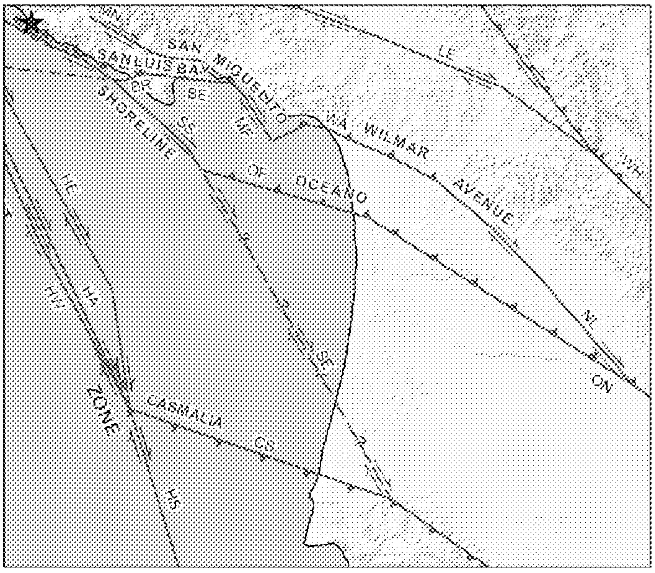
- LESS report shows Shoreline fault continuing to southern end of 3D data volume
- LESS report shows high degree of confidence that Shoreline fault continues to south to ~Casmalia fault (approx. located, no query).
- Multiple 2D lines interpret Shoreline and So. Pecho; locally cutting H10; commonly cutting Quaternary strata



A4NR-00657

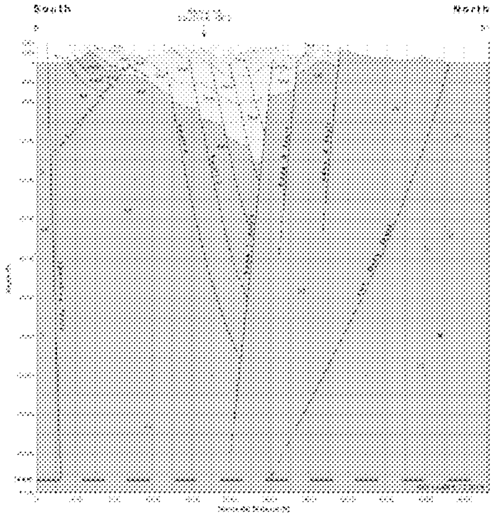
SSHAC Implementation

- Shoreline fault source extends south to Casmalia fault
- Full slip rate does not extend south
- Characteristic ruptures are based on lengths that do and do not include full length
- Longer Shoreline ruptures take pathway to east via Oceano fault; This is a proxy for Oceano OR Los Berros OR others



Los Osos Dip

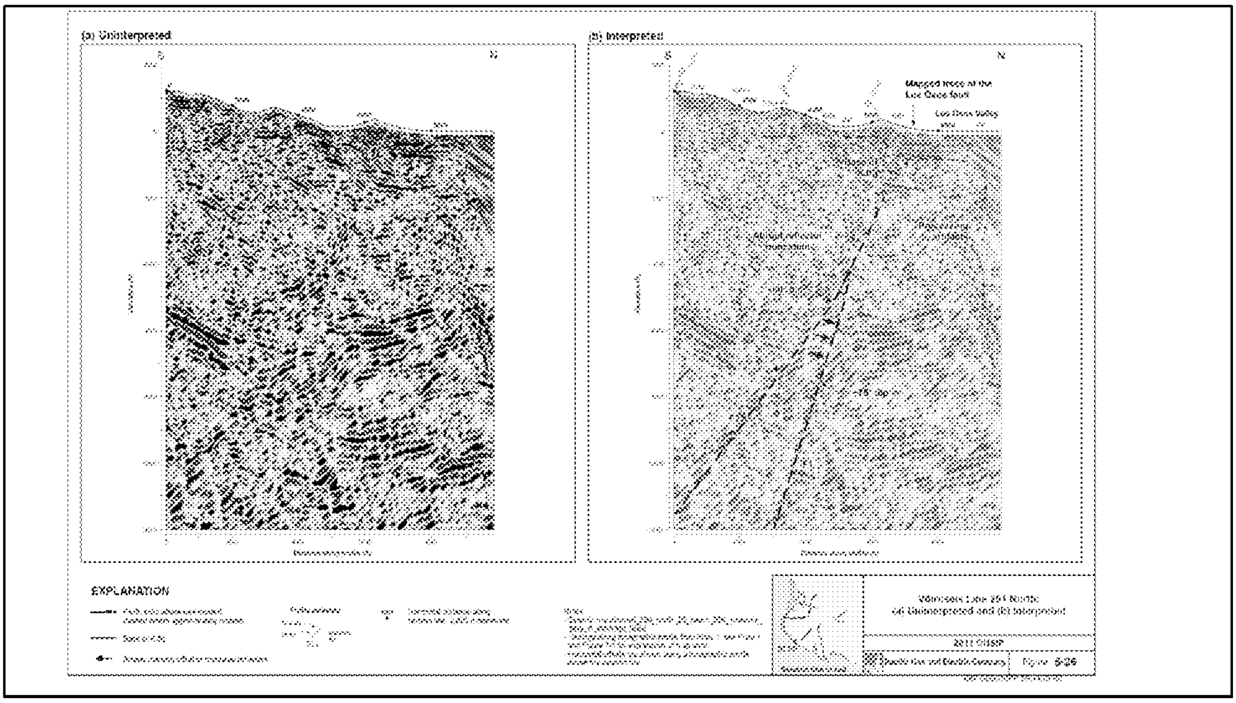
- AB1632 activities: CCCSIP Report Chapter 9: GMP. CCCSIP Report Chapter 7: 2011 ONSIP
- SSHAC SSC Approach:
  - Evaluate Hardebeck (workshop 3 and data); CCCSIP Report Chapters 9 and 7; LTSP draft reports; TI Team field trips.
  - Consider geometries that extend through seismogenic crust.
  - Consider pattern of marine terrace uplift
- SSHAC SSC Input:
  - Los Osos dips 50 to 80 degrees south-southwest.
  - Fault may be emergent to mostly blind.
  - Fault may be the primary ramp or a secondary back-thrust/axial surface



A4NR-00657

ONSIP and GMP Report Results w/r/t Los Osos fault

- Los Osos fault
  - ONSIP interpret fault dipping steeply SW: N60W, ~76 to 82 SW (AWD; upper ~2 km) and N90E, 55-75 S (Vibe; 0.5 km to 3.6 km depth)
  - GMP Mapping suggests it is blind; could be axial surface; 2011 ONSIP infers blind at western end (interpreted fault-propagation folding; inversion of normal faults).
  - GMP: Strike-slip not detectible at surface; 2011 ONSIP: overall fault geometry interpreted at depth (intersections with Edna and Los Osos) consistent with flower structure, but also consistent with reverse fault
  - GMP and ONSIP: Different character along southern margin of Morro Bay
  - No slip rate information provided other than assistance from estimating dip, slip sense


(a) Uninterpreted
S
N
(b) Interpreted
S
N
EXPLANATION
Pacific Gas and Electric Company
Figure 5-26

SSHAC Implementation, ONSIP, GMP Results for Los Osos fault

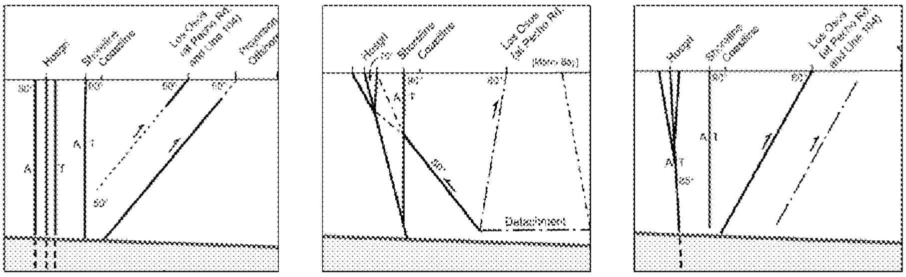
- Top of fault at 0 to -2 km, but stated belief is that it is probably partially blind most of its length (this does not affect hazard). Partial weight to it being an axial surface in SW-vergent model.
- Dip is 50, 60, and 80 (Range is beyond uncertainties reported by ONSIP; partial consideration to not being detectible in data)
- Rake used for slip rate varies between 90 (pure reverse) and 150 (dextral with reverse component)

Parameter Values, Los Osos fault

Model:	1. Outward vergent	2. SW vergent	3. NE Vergent	Range		Weighted mean
	Weight 0.4	Weight 0.3	Weight 0.3			
Los Osos	LC+LM+LV+LE	LC+LM+LV+LE	LC+LM+LV+LE	Summary		
Dip	60	80	50	50	80	63
Dip Direction	SW	SW	SW			
P(S)	1	0.5	1	0.5	1	0.9
Style of faulting	RL/R-O	R	R			
Depth to top (Ztor)	0	0	0	0	0	0.0
Mean Width	14	11	16	11	16	13.7

Section D-D'

NE Vergent **SW Vergent** **Outward Vergent**

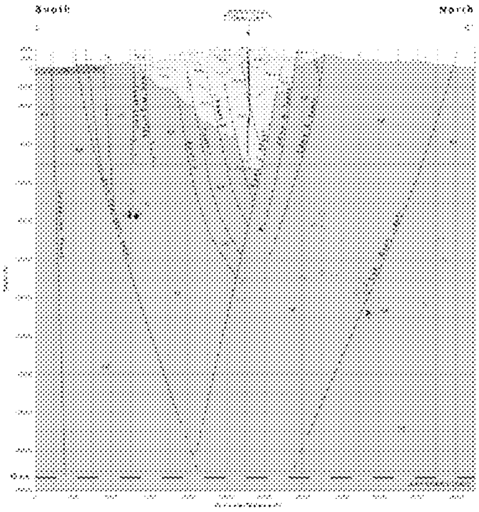


Nearest site-source distance for Los Osos fault is on Section D-D', so that is what is shown here.

* P(S) for Los Osos fault less than one in SW model because the uplift boundary could be explained by a fold hinge instead of a fault. Surface evidence for no faulting is observed at Memorial terrace and bedrock ridges to east.

San Luis Bay Dip

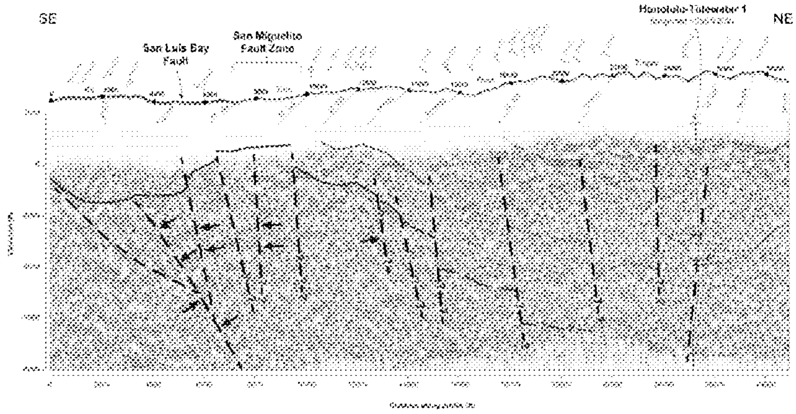
- AB1632 activities: CCCSIP Report
  - Chapter 9: GMP.
  - Chapter 7: 2011 ONSIP.
  - Chapter 12: Response to Dr. Hamilton (RTDH)
- SSHAC SSC Approach:
  - Evaluate Hardebeck (workshop 3 and data); D. Hamilton (workshop 2 and testimony); CCCSIP Report Chapters 9, 7, and 12; TI Team field trips.
  - Consider geometries that extend through seismogenic crust.
  - Consider pattern of marine terrace uplift
- SSHAC SSC Input:
  - San Luis Bay dips 45 to 75 degrees south-southwest.
  - Fault may be emergent to mostly blind; may impinge on Shoreline fault.
  - Fault may be the primary ramp or a secondary back-thrust/axial surface



A4NR-00657

ONSIP and GMP Report Results, San Luis Bay fault

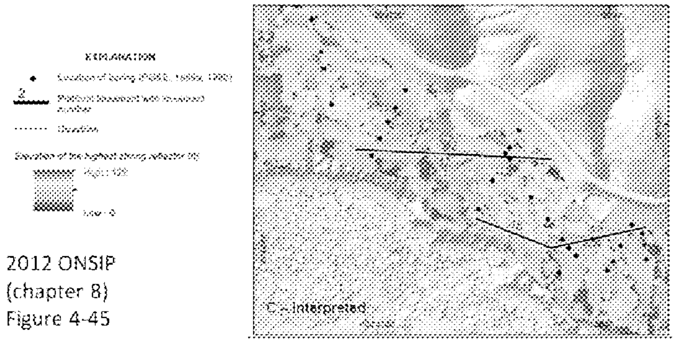
- **2011 ONSIP:** Interpret fault dipping steeply NE: N85W, 72 N (AWD line 112-140; upper 2.4 km); N77W, 65-85N (72 pref) (AWD line 113; upper 2.4 km);



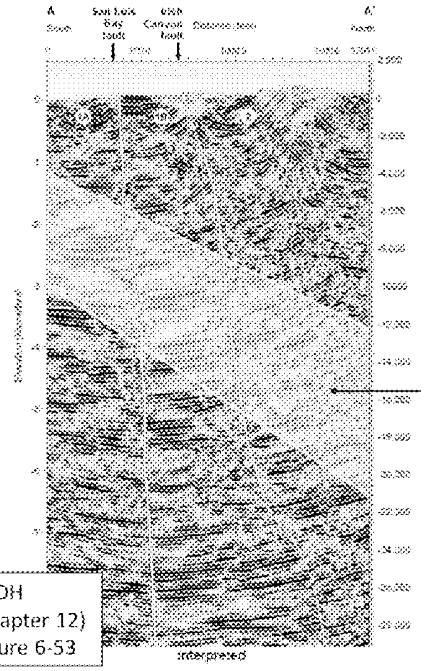
A4NR-00657

ONSIP and RTDH Report Results, San Luis Bay fault

- 2012 ONSIP and RTDH
  - Interpret steeply N-dipping to subvertical San Luis Bay fault between ~1 and 7+ km depth in 3D vibe volume (Response to Hamilton report)
  - No detection of buried scarp at Rattlesnake



2012 ONSIP
(chapter 8)
Figure 4-45



RTDH
(chapter 12)
Figure 6-53

A4NR-00657

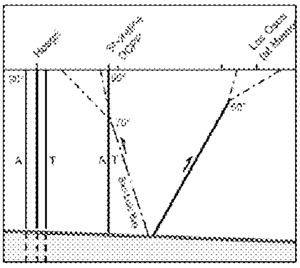
SSHAC Implementation, AB1632 Results for San Luis Bay fault

- Top of fault is 0 to -4 km, but stated belief is that it is probably mostly blind (doesn't affect hazard). Partial weight to it being an axial surface
- Dip is 45, 70, and 75 (Range is beyond uncertainties reported by ONSIP; partial consideration to not being detectible)
- Rake is 90 (reverse); no obliquity considered
- Ruptures with Shoreline permissible

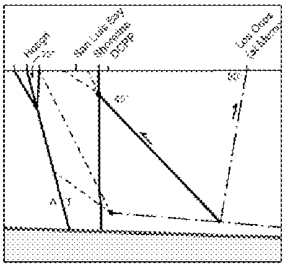
Parameter Values, San Luis Bay fault

Model:	1. Outward vergent Weight 0.4	2. SW vergent Weight 0.3	3. NE Vergent Weight 0.3	Range		Weighted mean
San Luis Bay	BR/BO+BE	BR/BO+BE	BR/BO+BE	Summary		
Dip	75	45	70	45	75	65
Dip Direction	N	N	N			
P(S)	1	1	0.8	0.8	1	0.9
Style of faulting	R	R	R			
Depth to top (Ztor)	4	2	4	2	4	3.4
Mean Width	11	14	12	11	14	12

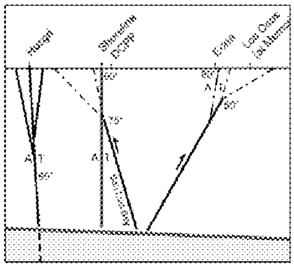
NE Vergent



SW Vergent



Outward Vergent



Note, P(S) is less than one in NE model because SLB fault is characterized as possibly a fold hinge. It is a higher likelihood than for Los Osos fault in the SW vergent model because there are uplift constraints on both sides of the fault.
Ztor is measured at the plant. Fault becomes emergent to the south with Ztor of 0
Widths below plant are 9, 14, 10 km.

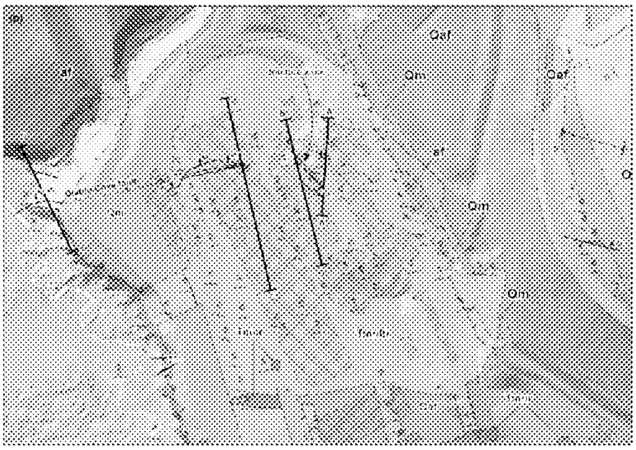
Diablo Cove Fault

- AB1632 activities: CCCSIP Report Chapter 9: GMP. CCCSIP Report Chapter 12: Response to Dr. Hamilton (RTDH)

- SSHAC SSC Approach:
  - Evaluate D. Hamilton (workshop 2 and testimony); CCCSIP Report Chapters 9 and 12.
  - Consider whether the basis for including the Diablo Cove fault as a seismic source is technically defensible
- SSHAC SSC Interpretation:
  - Concur with CCCSIP Report Chapter 12 (RTDH).
  - Diablo Cove fault judged not technically defensible; not included as a seismic source.

AB1632 RTDH Report Results: Diablo Cove fault

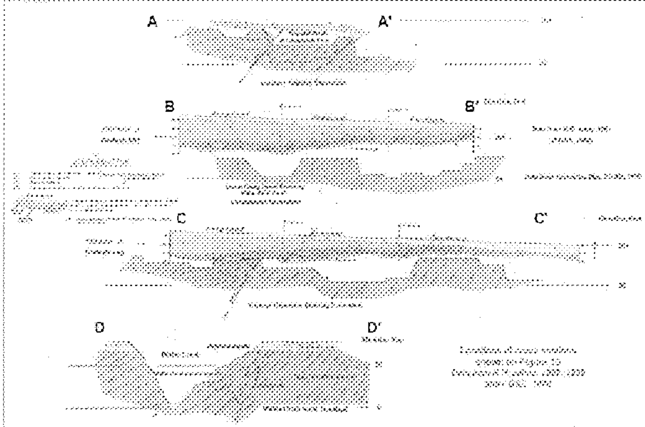
- Concluded not a viable hazard, ground motion or surface rupture
  - Does not offset Q2 terrace deposits or platform
  - Minimal cumulative offset – few feet slip; discontinuous traces
  - No compelling lineament offshore to connect it with Shoreline fault



A4NR-00657

AB1632 RTDH Report Results: Diablo Cove fault

- Concluded not a viable hazard, ground motion or surface rupture
  - Does not offset Q2 terrace deposits or platform
  - Minimal cumulative offset – few feet slip; discontinuous traces
  - No compelling lineament offshore to connect it with Shoreline fault



10 Geologic cross sections across Diablo Cove fault zone logged as exposed on Diablo Creek south headland, in exploratory Trenches A and B, and in DCNPP Unit 1 foundation excavation

AB1632 RTDH Report Results: Diablo Cove fault

(a) Uninterpreted

(b) PG&E Interpretation

A4NR-00657

AB1632 RTDH Report Results: Diablo Cove fault

(a) Uninterpreted

(b) PG&E interpretation

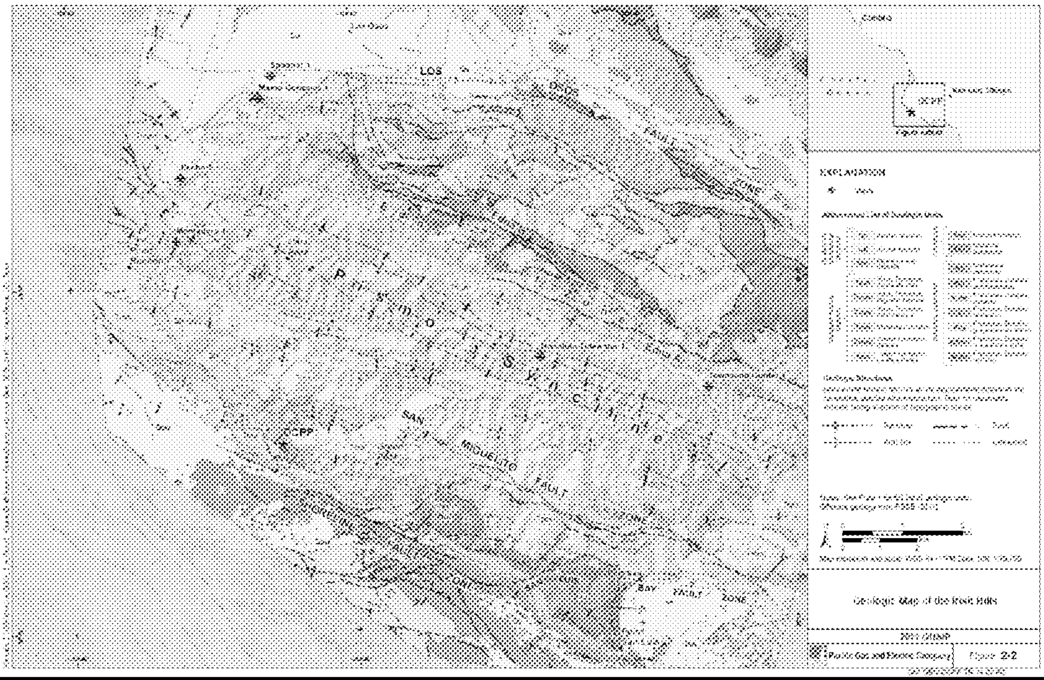
SSHAC Implementation, RTDH Report Results

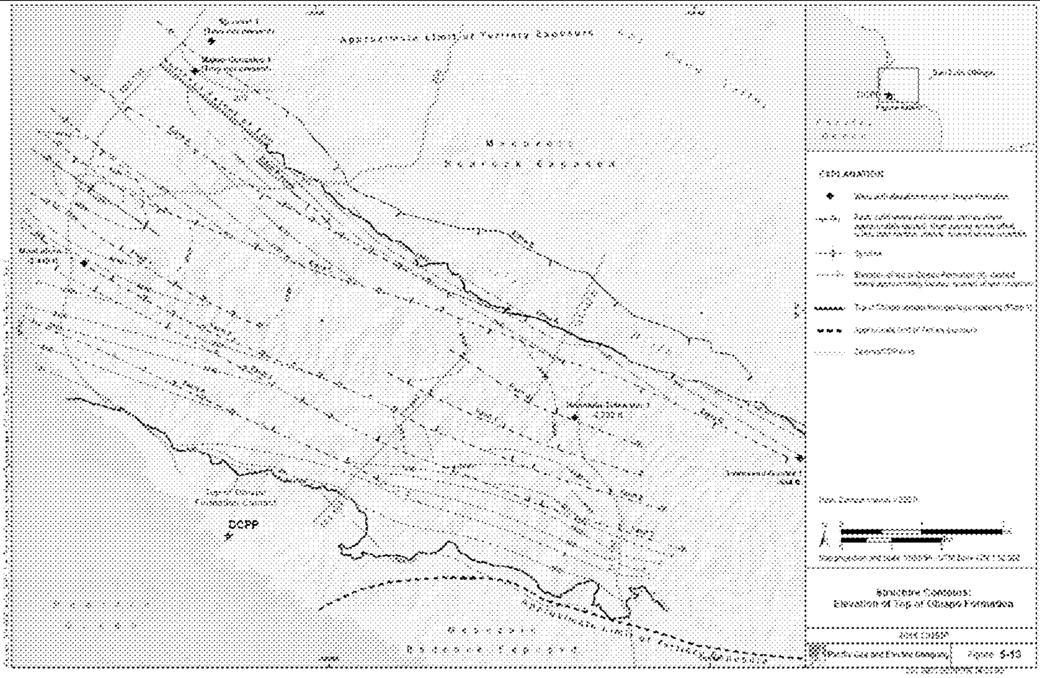
- Diablo Cove fault
  - Concur with AB1632 findings
    - Conclude it is not technically defensible; won't be considered in SSC

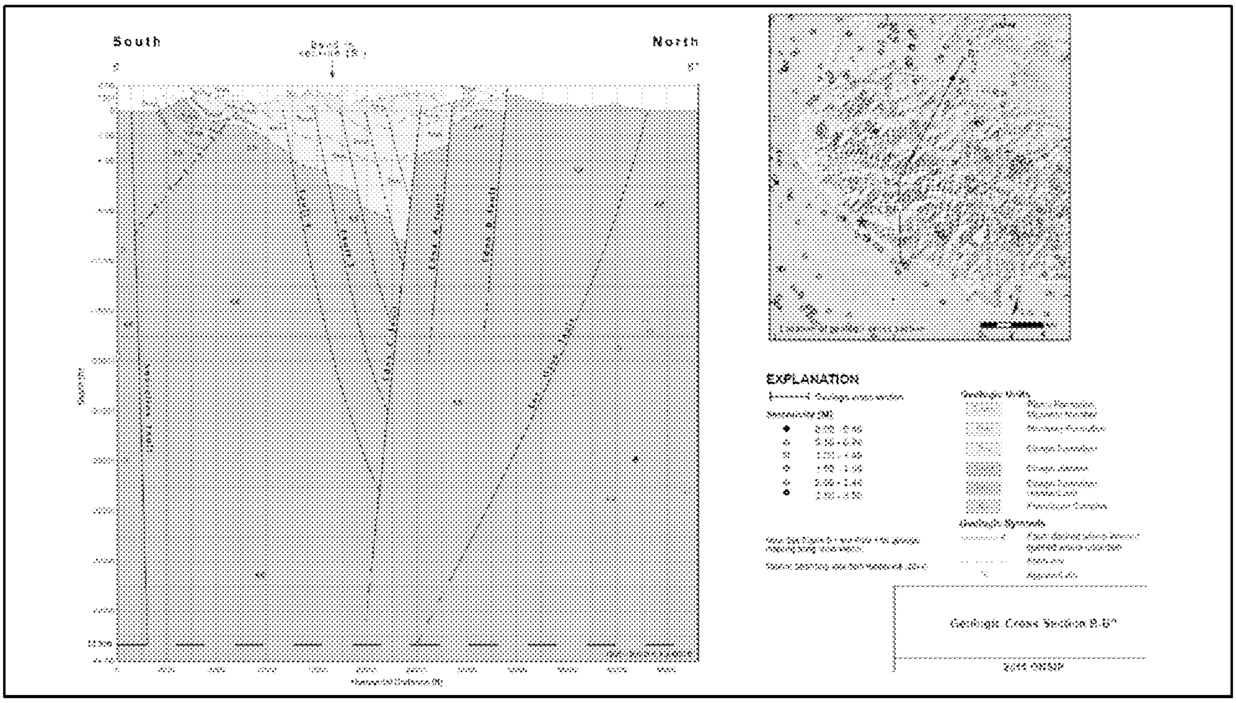
- San Luis Range/IOF Thrust
  - Conclude that there is insufficient evidence to consider it as a fault source *as defined by Hamilton*
  - San Luis Range/IOF thrust concept captured *in the SSHAC SSC* in two ways:
    - San Luis Bay fault source; other SWBZ fault sources capture the main features of interest w/r/t explaining coastal terrace uplift
    - Sub-parallel, or other, deeper structures are captured as part of the Areal source zone

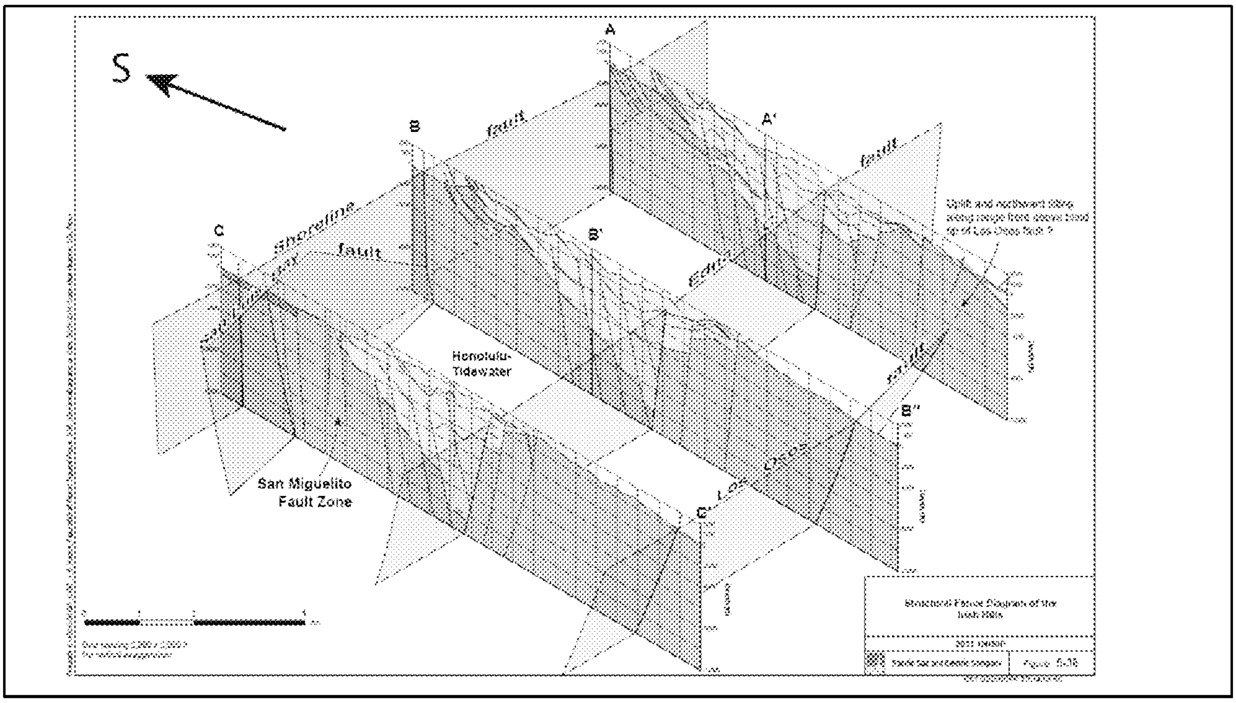
Interpreted Faults within the San Luis-Pismo Block and Estero Bay

- AB1632 activities: CCCSIP Report Chapters 2 (Pt. Buchon); 4 (San Simeon-Estero Bay); 7 (2011 ONSIP); 8 (2012 ONSIP); 9 (GMP); 12 (RTDH)
- SSHAC SSC Approach:
  - Evaluate CCCSIP reports; D. Hamilton (workshop 2 and testimony); Hardebeck (workshops 1-3 and data); Lewandowski and Unruh (workshops 1 and 3).
  - Consider strength of evidence for understanding geometry, extent, and activity of other known or interpreted faults in the area
  - Includes Edna, San Miguelito, Estero Bay seismicity, etc.
- SSHAC SSC Interpretation:
  - None warrant inclusion as distinct fault sources
  - Capture attributes of faulting as an areal source zone


LOS
OSOS
FAULT
ZONE
SAN
MIGUELITO
FAULT
DCPP
BAY
FAULT
ZONE
EXPLANATION
Geologic Map of the Irish Hills
2-2


DCPP
Pacific Gas and Electric Company
Figure 5-13

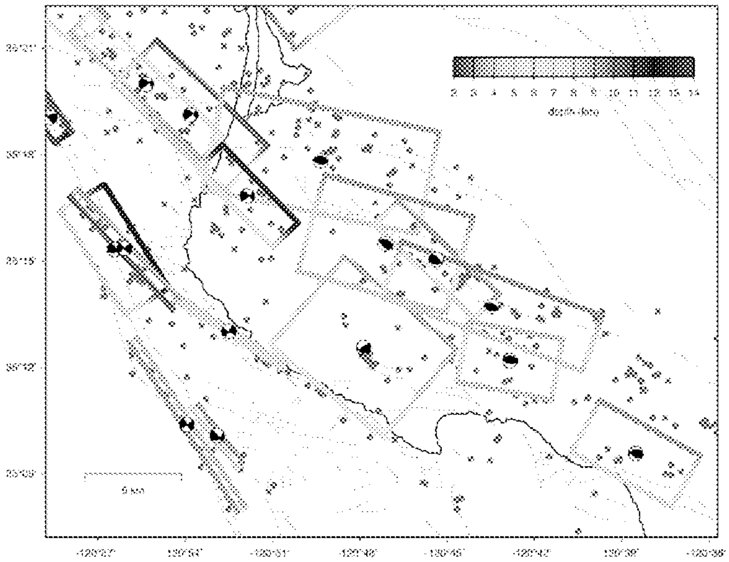

South
North
EXPLANATION
Geologic Units
Geologic Symbols


S
A
A'
B
B'
B''
C
C'
fault
Shoreline
fault
fault
Edna
fault
Los Osos
Honolulu-
Tidewater
San Miguelito
Fault Zone

Faulting within San Luis-Pismo Block:

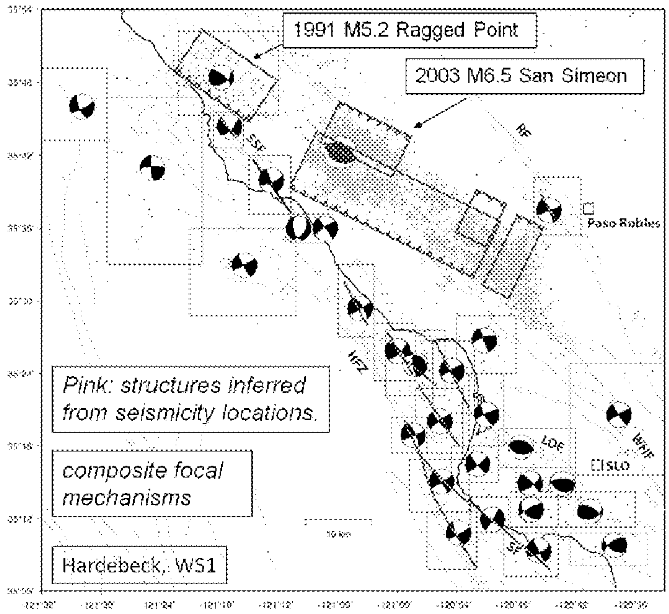
- Alternative interpretations proposed based on OADC-FM

Hardebeck, WS3



Similar fault patterns hypothesized in Estero Bay

- Seismicity
- Seismic Reflection
- Seafloor MBES

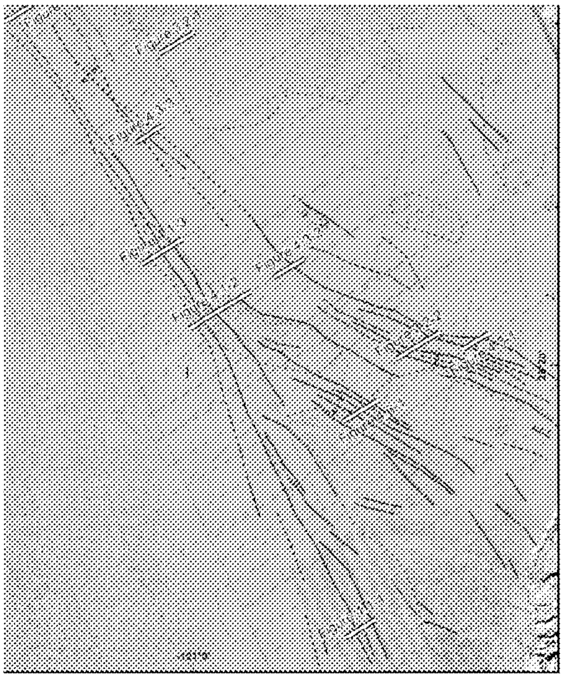


Mechanisms from: Hardebeck, J. L., *Bull. Seism. Soc. Am.*, 100, 1031-1050, 2010.

Chapter 4 (San Simeon Report) mapping

Southern Estero Bay

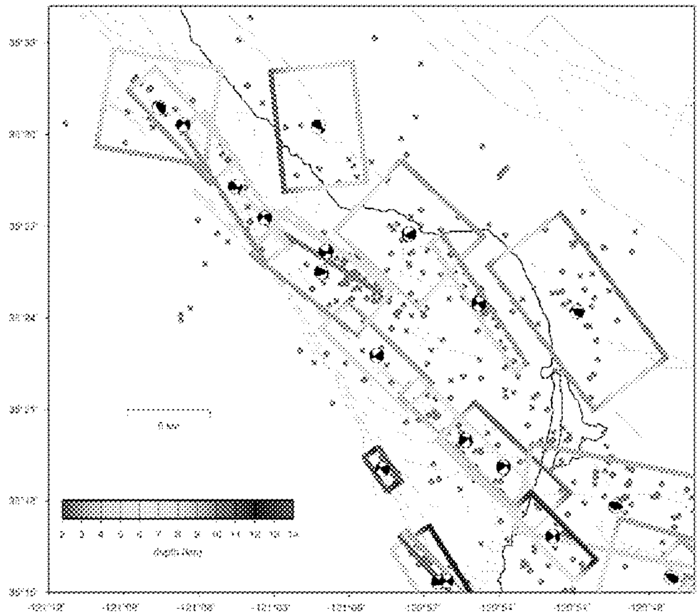
- Red = Hosgri
- Brown = Los Osos
- **Purple = Unassigned**



Faulting within Estero Bay:

- Interpretations proposed based on OADC-FM

Hardebeck, WS3



A4NR-00657

CCCSIP Results w/r/t
Other San Luis-Pismo block and Estero Bay faults

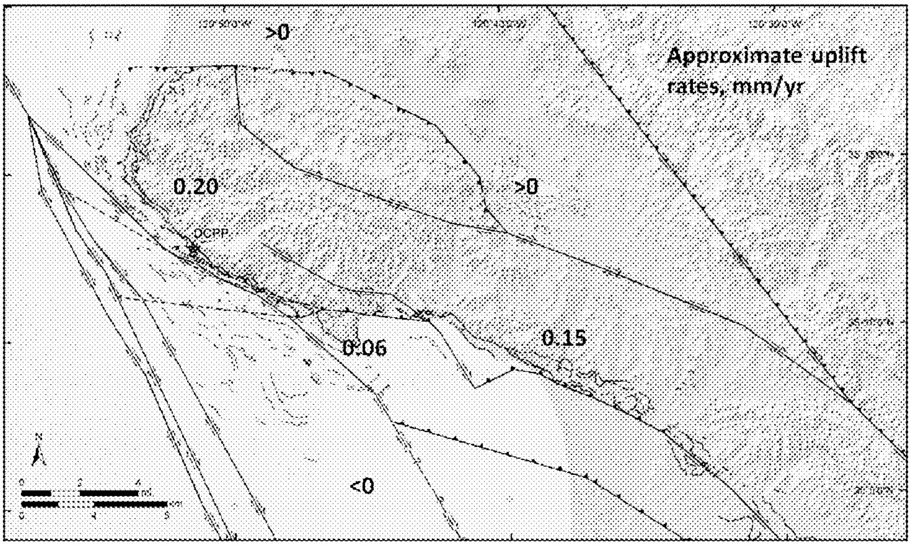
- Edna + Pismo inner graben faults
  - Edna faults strike N40W to N68W; dips 60-87 range; average dips 70-80 ish (AWD to ~2 km; Vibe to ~4 km).
  - **Projections** down-dip suggest Los Osos and Pismo inner graben faults intersect at about 12 km.
  - Faults show normal slip; small anticlines in HW suggest some are reactivated.
  - Strike-slip not detectible at surface, but overall fault geometry interpreted at depth consistent with flower structure (same as Los Osos)
  - No information presented in the reports on slip rate or activity information
- Other faults
  - San Miguelito fault interpreted to be in the hanging wall of San Luis Bay fault; rotated into current position. N66W, 88 to 90 degree dip in upper 1 to 1.5 km (2011 ONSIP).
  - Subvertical fault beneath coastal terraces interpreted to have strike-slip kinematics; along projection to NW with Shoreline (2012 Phase 2 report?)
  - Irish Canyon fault steeply N dipping to subvertical; interpreted to ~7-8 km depth.

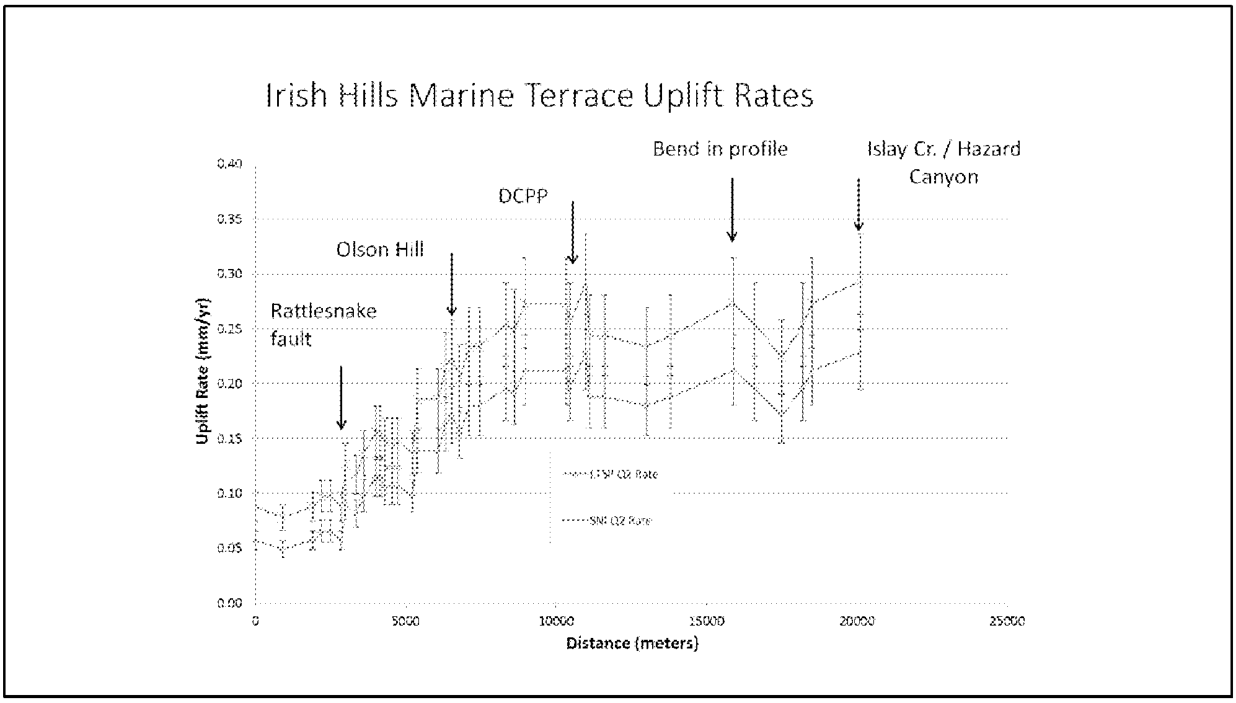
SSHAC Implementation; Other Irish Hills/Pismo basin faults

- Use available information to characterize an areal source zone covering the Pismo-San Luis Block, Estero Bay, and adjacent area.
- Why Areal Source Zone:
  - Appropriate given activity information
    - No evidence that any of these faults deforms marine terraces within limit of resolution; the key late Q strain marker.
    - San Luis Bay, with a dip slip rate of ~0.2 mm/yr, as a point of reference for a well resolved fault signal
    - No detectible offset of Q2 terrace (MIS 5e) for Edna and other faults; consistent with order of magnitude or lower
  - Appropriate given geometry information
    - Multiple structures within Tertiary; closely spaced
    - Less known distribution within pre-Tertiary
    - Continuity between onshore and offshore suspected, but not demonstrated clearly
    - Seismicity is distributed; not aligned everywhere; not a perfect substitution for potential earthquakes

Data to Constrain Uplift Rates

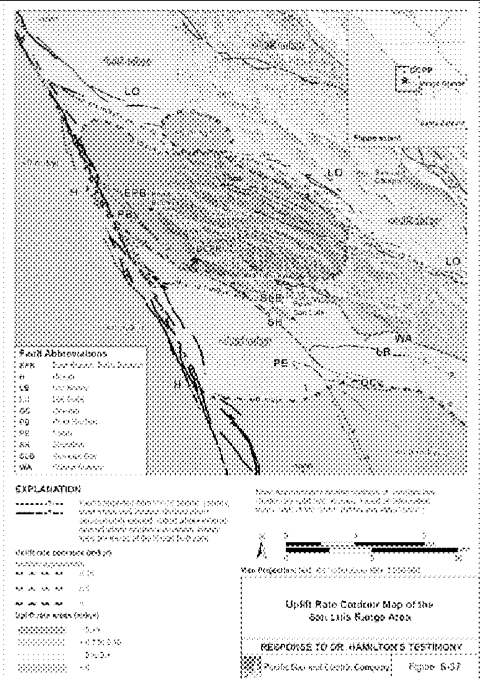
From TI Team, WS3




Irish Hills Marine Terrace Uplift Rates
Bend in profile
Islay Cr. / Hazard Canyon
DCPP
Olson Hill
Rattlesnake fault
Uplift Rate (mm/yr)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0
5000
10000
15000
20000
25000
Distance (meters)

Uplift rate map from Hamilton Report

- Line sources at boundaries
- Areal, background sources within and across boundaries



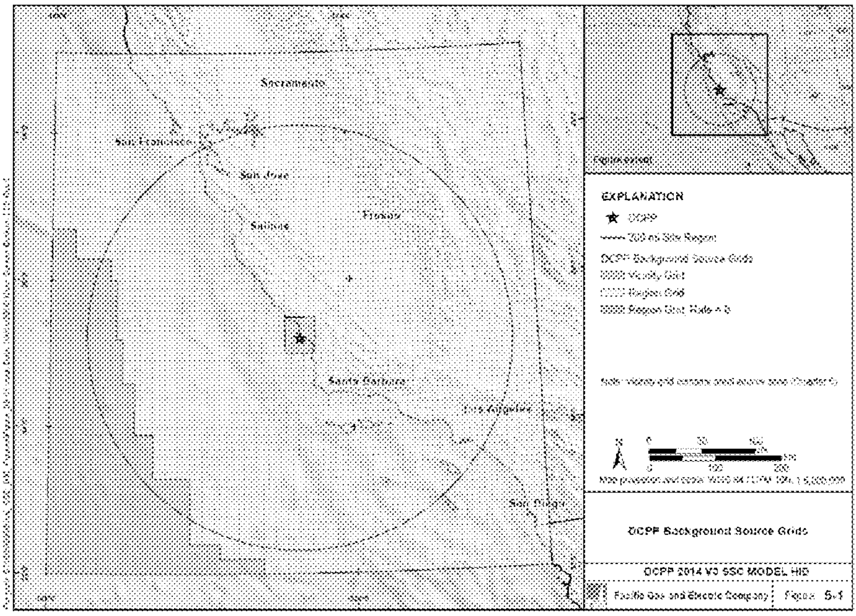
A4NR-00657

SSHAC Implementation;
Other Irish Hills/Pismo basin faults

- Two Sets: More NW, steep, oblique and more WNW, intermediate, reverse. Aleatory variability – model has both sets with some relative frequency. Modeled as subparallel faults
- Geometry:
  - Strike N40W to ~E-W; preferred N45W for set 1 and N65W for set 2
  - Dip divided in to steep (65 to 85 NE and SW) for set 1; intermediate (35 to 60 NE and SW) for set 2
- Kinematics:
  - Guidance from composite focal mechanisms, stress/strain inversion, and conceptual models
  - Correlate steep with dextral to dextral-oblique (set 1); correlate intermediate with reverse (set 2).
- Mmax:
  - Largest earthquake that can occupy area: M 7 +/- 0.3
- Activity:
  - Faults do not deform marine terraces within limits of resolution
  - 12 m in 120 ky gives 0.1 mm/yr – a limit for any one structure
  - Total slip rate on all known faults in area is ~0.6 mm/yr; 10% huristic is 0.06 mm/yr for secondary deformation
  - Check historical, instrumental seismicity for a, b values to use

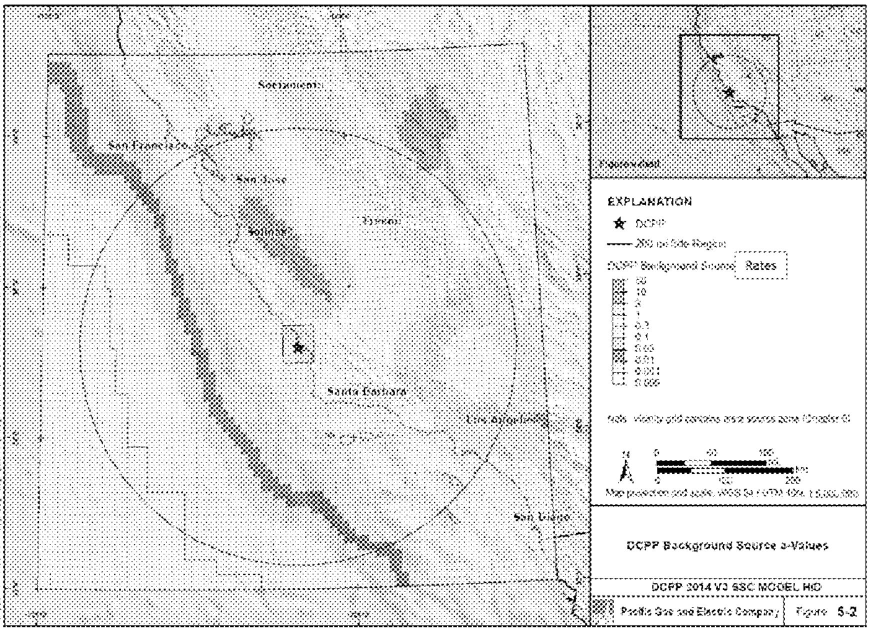
Background sources

- Regional Grid from 2008 NSHMP / UCERF2 smoothed seismicity
- Vicinity Grid 0.5 x 0.5 degree area around DCPP



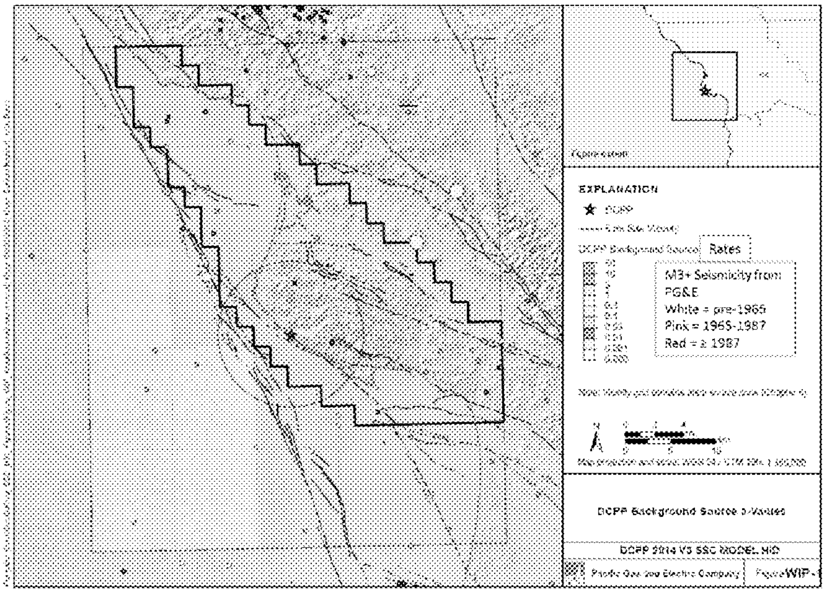
Background sources

- Vicinity Grid rate values scaled to match PG&E catalog N(M≥3)
- (2.0 scale factor)



Vicinity Grid and Areal Source

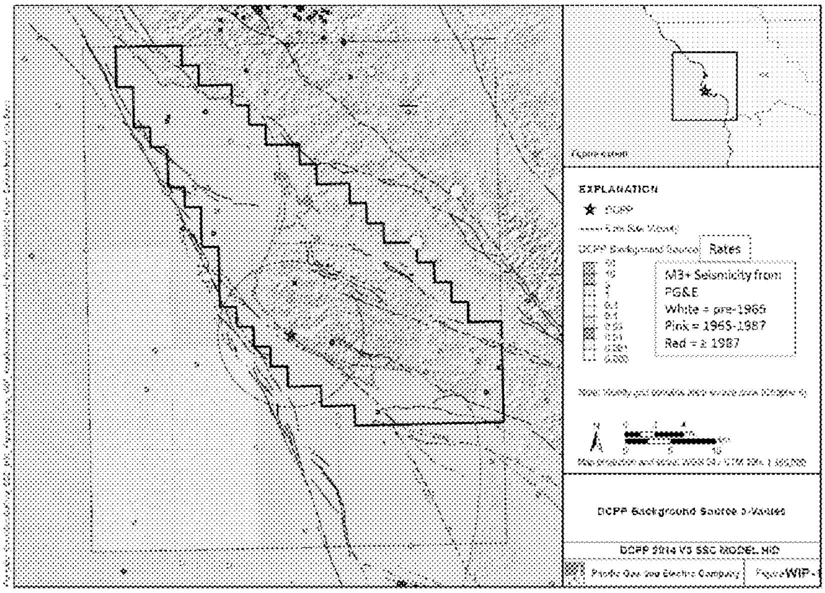
- NSHMP prediction of 7.34 M3+ earthquakes in 26 years
- PG&E Catalog (Reasonberg declustering) shows 13 M3+ earthquakes in 26 years (1988-2013)
- UCERF3 Catalog (Gardner-Knopoff declustering) shows 10 M3+ earthquakes in 26 years (1988-2013)
- Scale NSHMP rates over 0.1 degree grid up by factor of 2



A4NR-00657

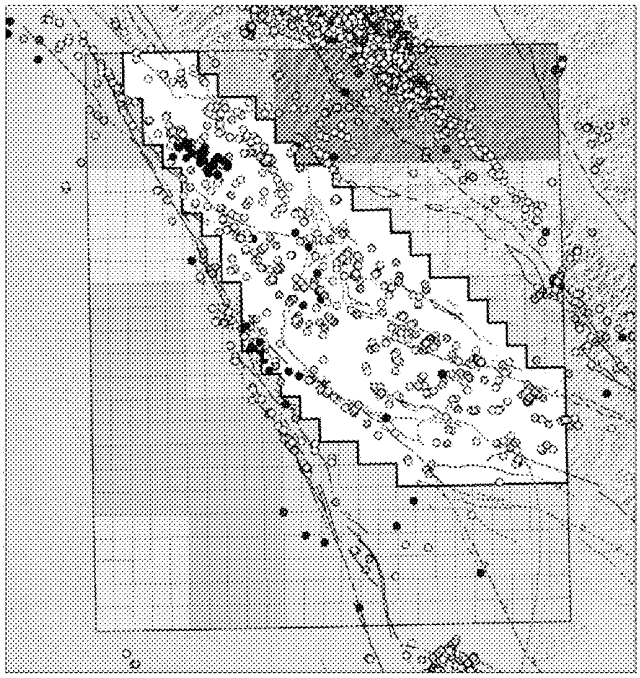
Vicinity Grid and **Areal Source**

- Los Osos, Shoreline, San Luis Bay faults embedded within Areal source
- Areal source contains San Luis-Pismo block, Estero Bay
- Boundaries on a 0.02 degree grid



Areal Source and rate (check seismicity)

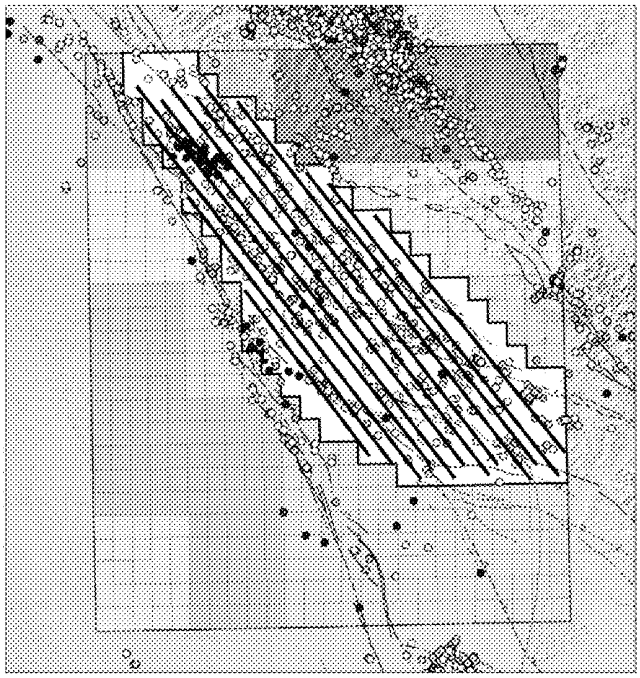
- If Vicinity Grid rates are summed within Areal source:
  - b=0.8
  - a=1.64
  - General fit to Hardebeck catalog
  - Consider M_{max} 7.0 ± 0.3
  - Consistent with 0.17 to 0.4 mm/yr summed slip rate
  - Compare to ~0.6 mm/yr summed rate on modeled fault sources
    - Represents ~50% additional rate



A4NR-00657

Areal Source and geometry; sense of slip

- Earthquakes modeled to occur on closely-spaced, sub-parallel faults (click!)
- Strike, dip information from AB1632 and other data
- Kinematic information from seismicity and geodetic data



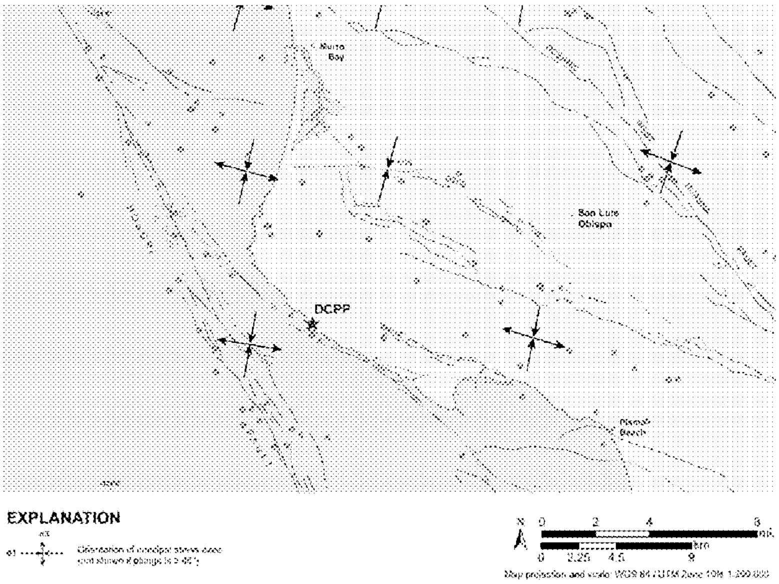
A4NR-00657

Summary of Fault Orientation PE interpretations

Study	Strike	Dip	Style
2011 ONSIP	N65W +/- 25	75 +/- 10	Reverse and Dextral (model analog)
2012 ONSIP	N60W	sub-vertical	Dextral (kinematic interpretation)
Hardebeck WS3	N30W-N65W	70-90	Dextral (kinematic interpretation)
Hardebeck WS3	N60-N80W	50-55+/-15	Reverse with little/no dextral component
Kinematics:			
Lewandowski WS3	N30W for optimal dextal; N75W for optimal reverse (45 degrees to N15E)		

Seismicity Data Analysis II : SATSI Results - FPFIT

0.1° x 0.1° grid, minimum of 8 events per cell



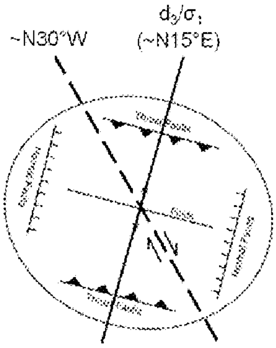
Lewandowski and Unruh, WS3

-S1: trend~-167 (13), plunge~3; S3: trend~-75, plunge~27, phi = 0.24
-S1: trend~-164 (16), plunge~4; S3: trend~-70, plunge~48, phi = 0.16
-S1: trend~-169 (11), plunge~7; S3: trend~-74, plunge~39, phi = 0.23

-2000 bootstrap resamplings
-assume fault plane was correctly identified for 50% of the mechanisms (i.e., fault plane selection is no better than random)
-1-sigma confidence region of the stress model is defined by the 68% of bootstrap solutions closest to the preferred solution

Predicted Style of Faulting?

Lewandowski and Unruh, WS3

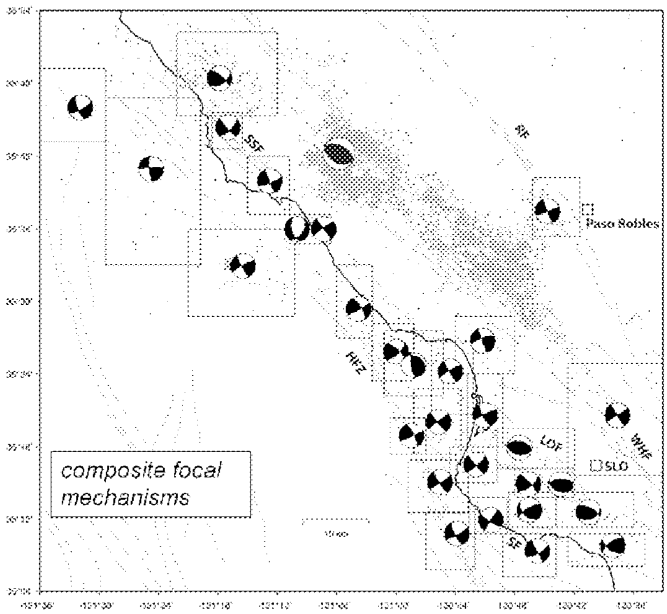


- WNW-ESE trending structures in the Irish Hills oriented at a high angle to d_3/σ_1 are optimally oriented to accommodate shortening and thickening.
- Active structures sub-parallel to the direction of macroscopic dextral shear (~N30°W) are optimally oriented to accommodate horizontal dextral slip.
- Uncertainty in the vertical component of the large-scale deformation contributes to uncertainty in the magnitude of the lateral component of slip on faults.

Composite Focal Mechanisms

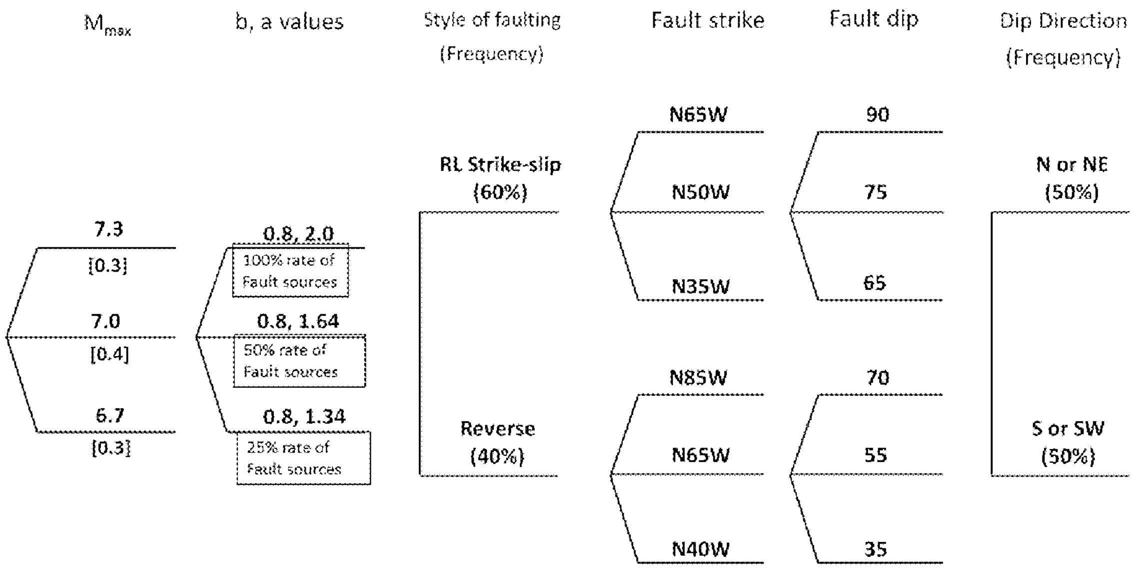
- Comparable to Lewandowski and Unruh (WS3); show horizontal plane strain and thickening
- Support a mix of two source types for areal source

Hardebeck, WS1



Mechanisms from: Hardebeck, J. L., *Bull. Seism. Soc. Am.*, 100, 1031-1050, 2010.

Areal Source zone characterization



Wrap-up notes

- SSHAC Deadline – end of October is drop-dead
  - Approx. Oct. 10 deadline to get input from C. Wills
  - Next
- IPRP/C.Wills Plan
  - Focus on Hosgri slip rate – Gordon/Dawson lead
  - Know Estero Bay study is key; initial question about eastern channel uncertainty
  - Goal – have done right studies to constrain Hosgri slip rate
  - Secondary goals – ibid on Shoreline slip rate, other items (e.g., Gibson meetings)
  - Regarding Hosgri, Shoreline slip rate
    - Intent to give verbal feedback by early October from CGS/IPRP staff.
    - Working backwards, arrange meetings with interpreters prior to early October.
    - Chris gone October 8th.
  - Wills – comment that initial IPPR report (#3) appears to have been fulfilled
    - Cannot see any hazard-significant parameter that PG&E has not investigated
    - Cannot foresee conclusion that SSHAC should not have considered AB1632 along with other data
    - Anticipates IPRP stating that AB1632 has fulfilled recommendations and performed what they set out to do.

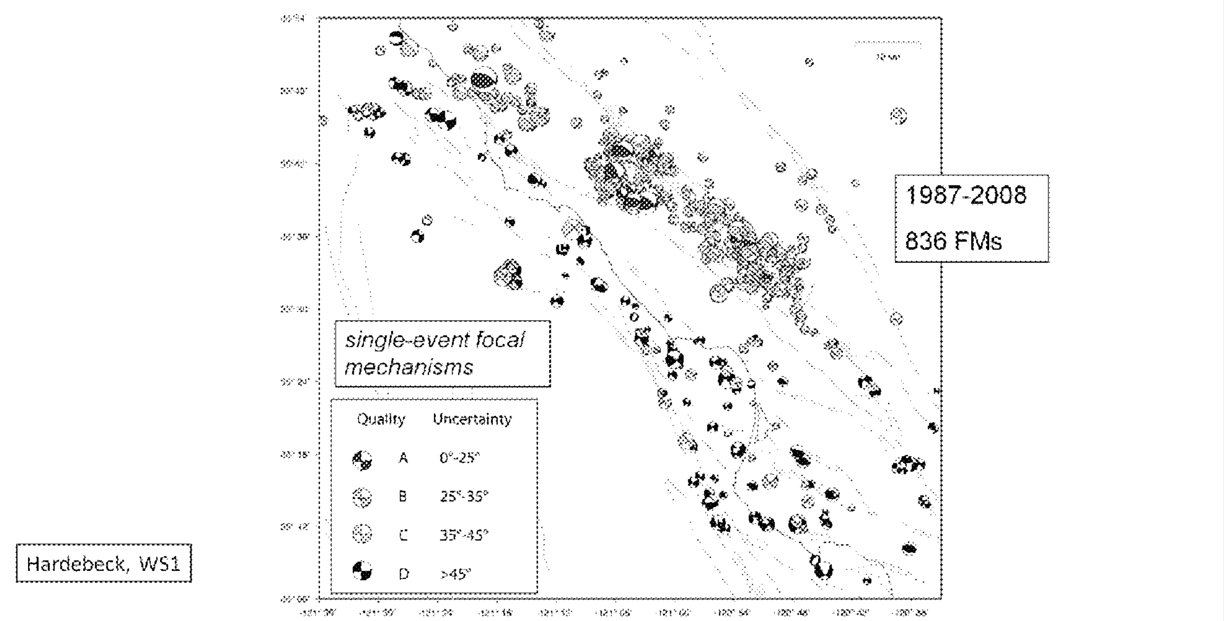
Add'l notes

- IPRP/AB1632 review schedule
  - Chris anticipates schedule faster than stated 6-8 months
    - October – meeting on slip rates
    - November – meeting on tectonic models
    - December – meeting on Site conditions/site amplification
  - Three reports. Does not anticipate a lot of depth.
  - Goal is to have first two reports by end of this year
  - Hope its relevant to the SSHAC process as it's being done
  - Once SSHAC report is done, anticipates CPUC wanting IPRP to look over the SSHAC process and report.

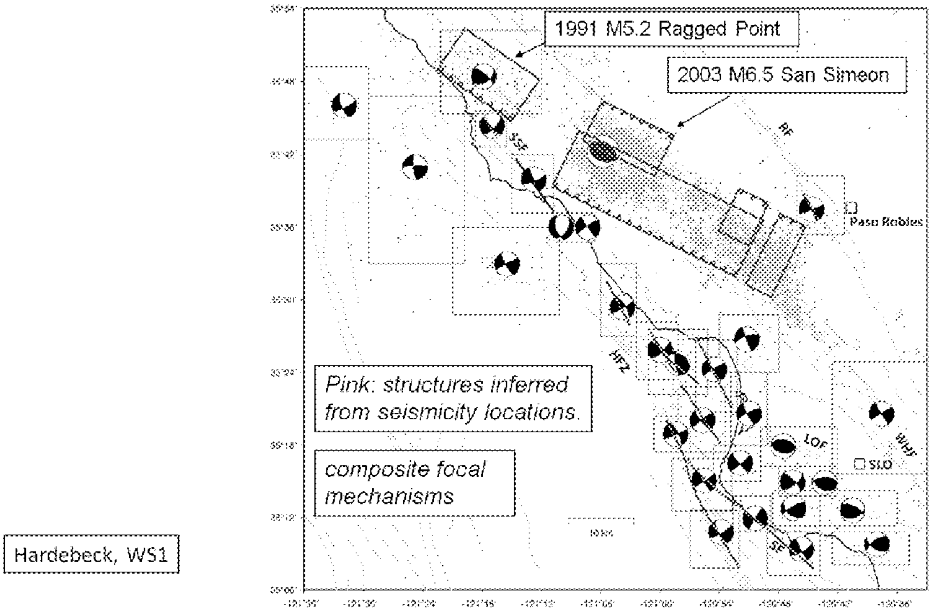
Implied deformation rates

- Vicinity Grid rates fall between geologic rates of known faults and target rates of areal source zone

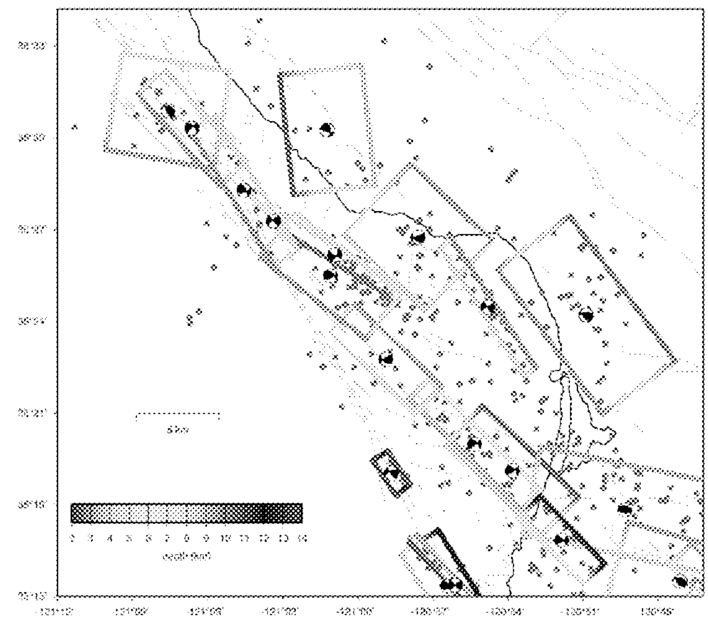
b	0.8	
a	1.64	
M Max	Mo Rate	Sum Slip Rates equiv. (mm/yr)
M ≤ 6.7	2.75E+22	0.15
M ≤ 7.0	4.47E+22	0.25
M ≤ 7.3	7.25E+22	0.40
	10% added for aftershocks	
	3.03E+22	0.17
	4.91E+22	0.27
	7.97E+22	0.44

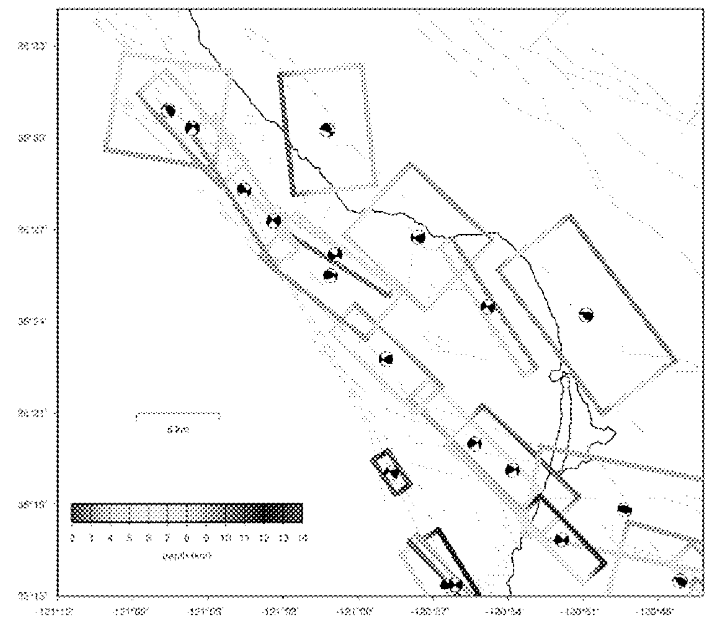


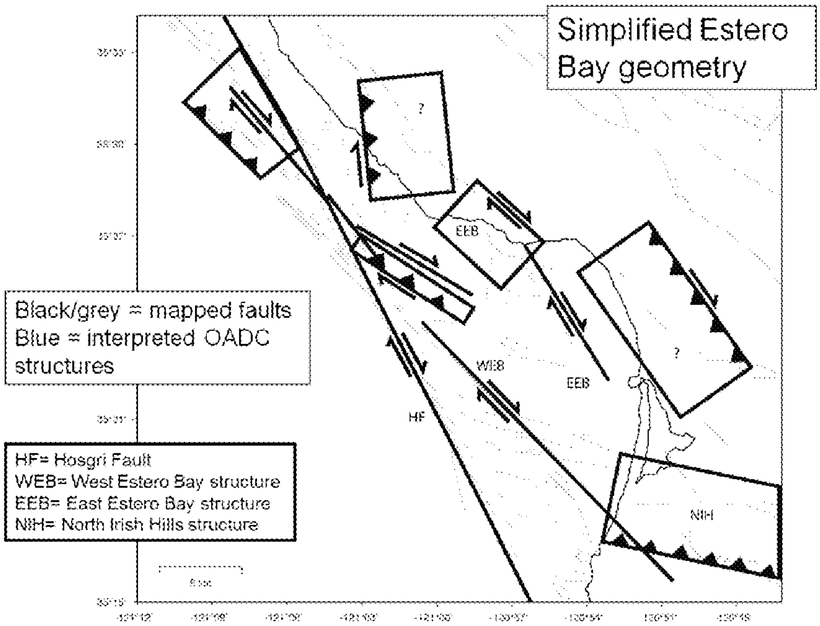
Mechanisms from: Hardebeck, J. L., *Bull. Seism. Soc. Am.*, 100, 1031-1050, 2010.
Available at: http://www.seismosoc.org/publications/BSSA_html/bssa_100-3/2009307-esupp/index.html



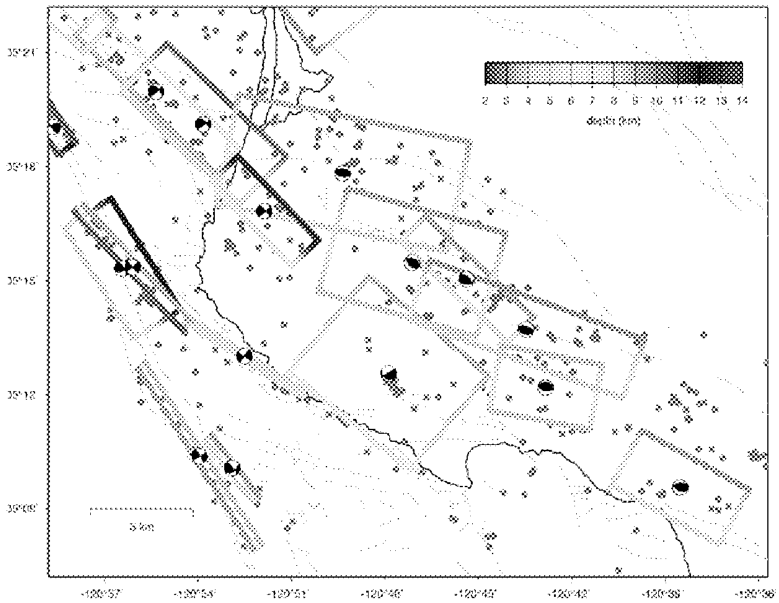
Mechanisms from: Hardebeck, J. L., *Bull. Seism. Soc. Am.*, 100, 1031-1050, 2010.

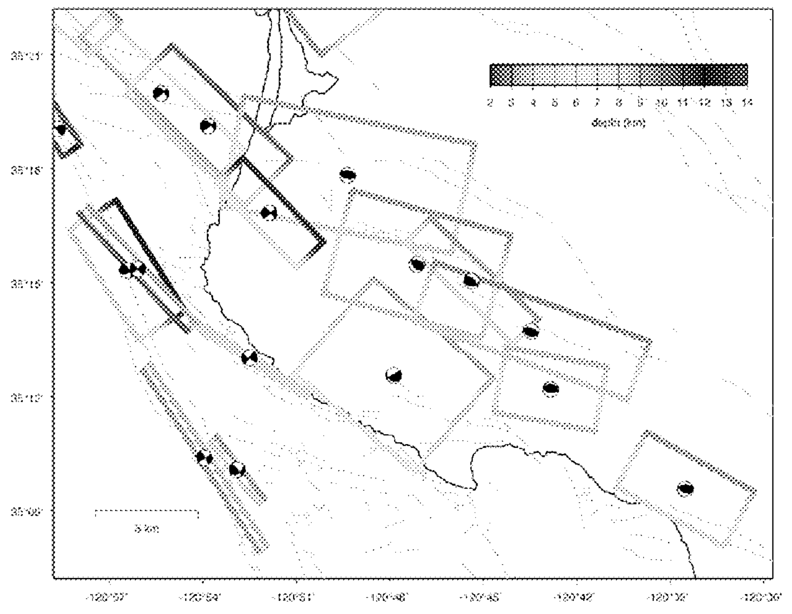






Simplified Estero Bay geometry
Black/grey = mapped faults
Blue = interpreted OADC structures
HF= Hosgri Fault
WEB= West Estero Bay structure
EEB= East Estero Bay structure
NIH= North Irish Hills structure
EEB
WEB
EEB
HF
NIH
?
?


2 3 4 5 6 7 8 9 10 11 12 13 14
depth (km)
5 km
35°21'
35°18'
35°15'
35°12'
35°09'
-120°57'
-120°54'
-120°51'
-120°48'
-120°45'
-120°42'
-120°39'
-120°36'


35°21'
35°18'
35°15'
35°12'
35°09'
2 3 4 5 6 7 8 9 10 11 12 13 14
depth (km)
5 km
-120°57'
-120°54'
-120°51'
-120°48'
-120°45'
-120°42'
-120°39'
-120°36'

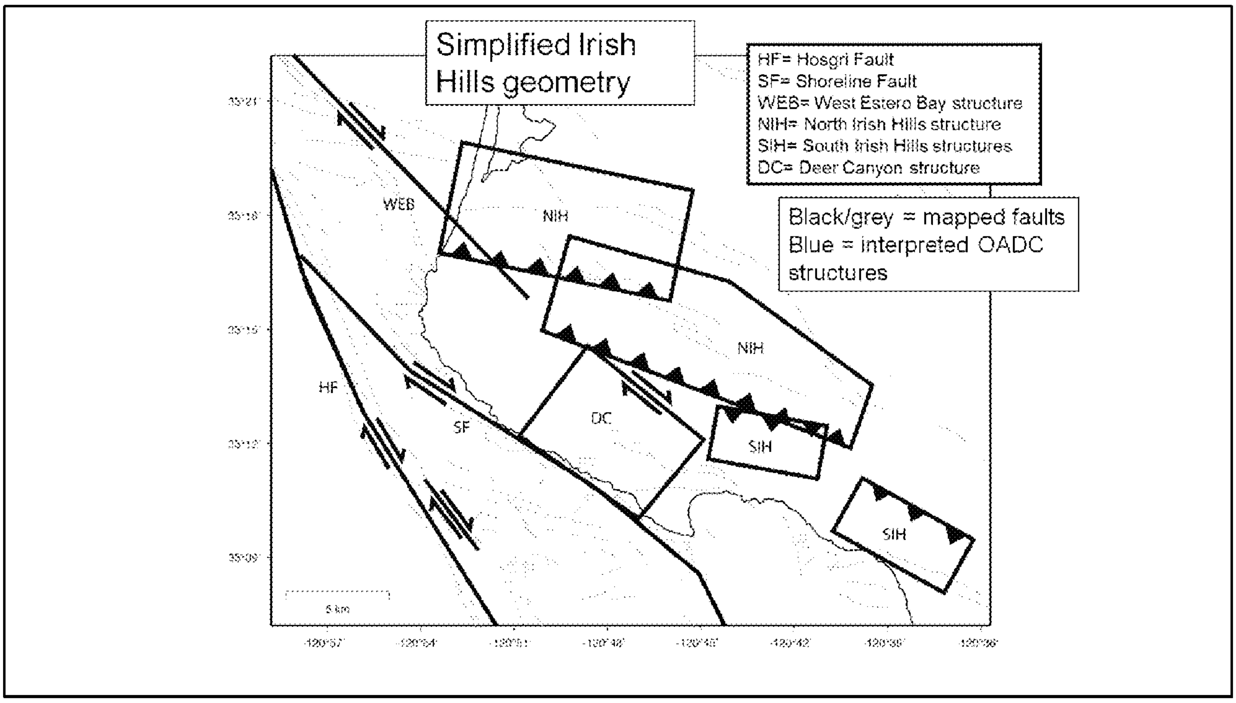

Simplified Irish Hills geometry
HF= Hosgri Fault
SF= Shoreline Fault
WEB= West Estero Bay structure
NIH= North Irish Hills structure
SIH= South Irish Hills structures
DC= Deer Canyon structure
Black/grey = mapped faults
Blue = interpreted OADC structures
WEB
NIH
NIH
HF
SF
DC
SIH
SIH
5 km

Exhibit 40

A4NR-00230

From: Steve Thompson <thompson@lettisci.com>
Sent: Thursday, October 9, 2014 10:03 AM
To: Hanson, Kathryn <Kathryn.Hanson@amec.com>; William Lettis <lettis@lettisci.com>; Glenn Biasi (glenn@seismo.unr.edu); John Caskey (caskey@sfsu.edu); Hans AbramsonWard <abramsonward@lettisci.com>; Serkan Bozkurt <bozkurt@lettisci.com>; Nora Lewandowski <lewandowski@lettisci.com>
Cc: Ferre, Kent S <KSF1@pge.com>; abrahamson@berkeley.edu; Nick Gregor (nick@ngregor.com); Kevin Coppersmith (kcoppersmith@earthlink.net); Thomas Rockwell (trockwell@mail.sdsu.edu); Neal Driscoll (ndriscoll@ucsd.edu); Steven Day (sday@mail.sdsu.edu)
Subject: Status update, DCPP SSC model

SSC TI Team, Kent, Norm, Nick, and PPRP:

For the TI Team: In lieu of a call, let's communicate what is going on by email today and tomorrow.

For everyone, here is an update on our progress as we are nearing completion of the SSC model.

1. Second PPRP Final Briefing: This is scheduled for Friday, October 31st in Walnut Creek. This seems to be the least-bad date for the most people.
   a. We will have a Webinar set up for those who can participate remotely.
   b. We will start at 8:30 am and go until 5:00 pm. We will prioritize key items for the morning and early afternoon in case anyone needs to leave early.
   c. We expect follow-up webinars, phone calls, or other means to go through any questions/issues that are not resolved during the meeting AND to make sure those who cannot attend Oct. 31st have a chance to review the SSC model.
   d. The PPRP will have the HID no later than first thing Monday, Oct. 27th.

2. SSC Contribution to GMC Technical Report: Bill Lettis revised text and figures of the tectonic setting and submitted them to Carola/SWUS team for the GMC report.

3. Incorporation of AB1632 work and IPRP review: We have had two meetings with Chris Wills and his staff (Tim, Gordon) to discuss the AB1632 reports and how the SSHAC TI Team is evaluating and incorporating the information. In a phone call Tuesday, Chris gave us an update on their progress and thoughts. One possible action item is that Tim and/or Gordon may be calling to set up another meeting to review data at LCI's office prior to the Oct. 23th IPRP/AB1632 meeting at the CPUC. This activity is not central to the SSHAC work and schedule, but communicating with the CGS has been helpful to understand their initial thoughts and logic in digesting the AB1632 results and their relevance to the SSC.

4. HID: We are working through the final model HID. THIS MODEL NEEDS TO BE DONE BY OCTOBER 24TH. I'll run through our model "elements" and status:

   a. Fault Geometry Models: Serkan is finishing creating the new build points. I will work with staff here to put them together to create the rupture sources.
      i. Hosgri will be done today
      ii. Other key faults will be done by mid-next week.
   b. Fault Slip Rate Models: Hans, Kathryn, and Nora are nearly completed with the fault slip rate CDFs. We are done with Hosgri and Shoreline faults; Nora is doing final revisions to Los Osos and SLB based on changing weights to different age models (weight on Muhs alternative model being lowered from 30% to 20%).

i. Hosgri is done. Mean slip rate is 1.7 mm/yr
ii. Shoreline is done. Mean slip rate is 0.7 mm/yr
iii. Los Osos and SLB will be done by end of the week.

c. Rupture Model: Hans, Bill and I have finished revisions to the rupture models. We now have:
   i. 9 rupture sources for the Hosgri
   ii. 10 rupture sources each for OV, SW, and NE models
   iii. For the 10 rupture sources, they are re-numbered and organized to shows common themes for rupture source topology. This will be easier for reporting and communicating the rupture source concept, we anticipate.
d. Slip Rate Allocation Model: We are nearly complete with this task.
   i. Hosgri is done.
   ii. Other faults are 95% complete. We are waiting for the final results of the fault slip rate models.
   iii. Last task will then be to calculate the 3- and 5- pt distributions for the rupture sources from the fault slip rate CDF. I plan to use the same method as we used for Workshop 3.
e. Magnitude Distribution Model: This still needs work. Here are updates.
   i. Norm will have results by end of this week that tell us sensitivity of the WAACY model to our rupture cases. This will help us evaluate our initial WAACY logic tree and hopefully allow us to simplify it.
   ii. Mchar and Mmax values need to be re-calculated once the rupture source geometries have been built.
   iii. We need to reach consensus on how to treat magnitude PDFs for the "splay" cases. I'll have a proposal for the group by mid-next week.
f. Time Dependency Model: Glenn needs to perform the final implementation for the Hosgri fault using the weighted mean slip rate of 1.7 mm/yr. Glenn is expected back from NZ next week, and hopefully can jump on this task.
g. SAN ANDREAS AND OTHER ONLAND SOURCES: Glenn has resumed discussion with Nick Gregor regarding how best to use the UCERF3 event sets.
h. Other offshore sources: I will be bundling the five offshore source input files and will get them to Nick and Norm soon; this is not a priority.
i. Areal Source Zone: Nick is building the areal source zone for us now and hopes to have results for our review by end of this week. This is a new element the PPRP has not seen yet, so having sensitivities done prior to the Oct. 31 meeting is important.
j. Background Source Zones: Nick should be implementing this too; input files and logic tree were delivered to Norm and Nick last week.

5. Reporting: There is a lot of work here left to do, but we are making progress on the DRAFT report; especially Bill, Kathryn, and Hans. Deadline is Oct. 31st. We are trying to finish as much as we can by then. Note to PPRP – it is not realistic to expect our draft report will be complete by the due date of Oct. 31st. We are working as hard as we can to complete this and get information to you by then with the rest following ASAP.
   a. Sections 1 to 3 – Intro: Draft complete
   b. Section 4 – Database: Nearly complete?
   c. Section 5 – Seismotectonic setting: Nearly complete
   d. Section 6 – SSC Model overview: Incomplete. The HID is 95% complete, and will be expanded to include technical explanation and become Section 6. I need to get to this as soon as the HID and model are complete and handed over to Norm and Nick.
   e. Section 7 – Fault Models: Kathryn is starting to work on this.
   f. Section 8 – Fault Slip Rate Models: In progress – Hans and Kathryn have been working hard at this.
   g. Section 9 – Rupture Models: Has not been started.
   h. Section 10 – Earthquake Magnitude Models: Has not been started.
   i. Section 11 – Recurrence Models: In progress – Glenn, I believe, has draft text to accompany the figures he has been sharing. Hopefully this draft can be finished as he completes the modeling for the Hosgri.
   j. Section 12 – San Andreas and other regional fault sources: Has not been started.

k. Section 13 – Background and Areal seismic sources: Incomplete. This has been started in crude form.
l. Section 14 – Hazard Calculations and Sensitivity Results: Has not been started.
m. Appendices – Incomplete to not yet started. There is a lot of work to do here, but it is a secondary priority. I can promise the PPRP this will not be done by Oct. 31.

6. Project plan: I've updated the project plan and it is ready for Bill to review, then Kent. It updates the TI Team (adding Kathryn) and updates the schedule.
7. .

Please respond to the group if there is another activity I'm not aware of.

Thanks,
-steve

Lettis Consultants International, Inc. (LCI)
1981 N Broadway, Suite 330
Walnut Creek, CA 94596
Main: (925) 482-0360
Direct: (925) 482-0363, x203

Stephen C. Thompson, PhD
Principal Geologist
thompson@lettisci.com * mobile - (510) 919-7465

Exhibit 41

A4NR-00799

From: Winn, Valerie J </O=PG&E/OU=CORPORATE/CN=RECIPIENTS/CN=VJW3>
Sent: Wednesday, November 5, 2014 9:42 AM
To: Ewing, Lesley@Coastal <Lesley.Ewing@coastal.ca.gov>
Subject: RE: PG&E/Nov 6 IPRP Technical Meeting

Hi Lesley,

Thanks for the voice mail and the email. Yes, the 11/17 meeting is one that Mark would usually have attended. In Mark's absence, you may want to touch base with Chris Wills at CA Geological Survey on whether you should participate or perhaps Chris can provide a report to your agency after the 11/17 meeting. Chris's email is chris.wills@conservation.ca.gov.

You are always welcome to attend, although I expect with Mark out of the office, you have a number of issues you are trying to cover!

Best regards,
Valerie Winn

From: Ewing, Lesley@Coastal [mailto:Lesley.Ewing@coastal.ca.gov]
Sent: Wednesday, November 05, 2014 9:35 AM
To: Winn, Valerie J
Subject: RE: PG&E/Nov 6 IPRP Technical Meeting

Valerie,
Thank you for forwarding this information.
Is the November 17th meeting one that Mark Johnsson would have attended as part of his IPRP responsibilities?
Thanks

Lesley Ewing, Ph.D. PE
Sr. Coastal Engineer
California Coastal Commission

From: Winn, Valerie J [mailto:VJW3@pge.com]
Sent: Tuesday, November 04, 2014 2:15 PM
To: Ewing, Lesley@Coastal
Subject: FW: PG&E/Nov 6 IPRP Technical Meeting

Hi Lesley,

Per Mark Johnsson's out of office email, I am providing the attached info to you on an IPRP technical meeting to be held this Thursday, November 7. A public meeting of the IPRP will also be held on November 17.

Should you have any questions, please call me at the numbers below.

Best regards,

Valerie Winn

From: Winn, Valerie J
Sent: Tuesday, November 04, 2014 2:09 PM

To: Chris.Wills@conservation.ca.gov; Gordon.Seitz@conservation.ca.gov; timothy.dawson@conservation.ca.gov; Bgibson@co.slo.ca.us; Steve Thompson; Anderson@stateseismic.com; mccarthy@stateseismic.com; mark.johnsson@coastal.ca.gov
Cc: Jacobson, Erik B (RegRel); eric.greene@cpuc.ca.gov; Nishenko, Stuart (SPN3@pge.com)
Subject: RE: PG&E/Nov 6 IPRP Technical Meeting

Good afternoon IPRP Members,

Below, please find our proposed draft agenda for the IPRP technical discussion on Thursday. Should you have any questions/concerns, please don't hesitate to call me.

Best regards,

Valerie Winn

Thursday, November 6
8:30 AM

08:30 Welcome/Intros
09:00 Project Overview/Scope
- Project Goals/ Objectives
- Data Collection
  - Surface Mapping (Chap 9, TR.14.01- Thompson)
  - AWD
  - Vibroseis
- Data Processing/ Interpretation
  - Amplitude Data
  - Tomography Data
  - Use of gravity data to constrain inversions

10:00 Chapter 7 (Unruh)

12:00 LUNCH

1:00 Chapters 8 and 10 (O'Connell)

5:00 Adjourn with action items for November 17th meeting

From: Winn, Valerie J
Sent: Thursday, October 30, 2014 4:15 PM
To: Chris.Wills@conservation.ca.gov; Gordon.Seitz@conservation.ca.gov; timothy.dawson@conservation.ca.gov; Bgibson@co.slo.ca.us; Steve Thompson; Anderson@stateseismic.com; mccarthy@stateseismic.com; mark.johnsson@coastal.ca.gov
Cc: Jacobson, Erik B (RegRel); eric.greene@cpuc.ca.gov
Subject: PG&E/Nov 6 IPRP Technical Meeting

Dear IPRP Members:

Our next IPRP technical meeting will be held on Thursday, November 6, beginning at 8:30 AM. The meeting will be held in Walnut Creek at Lettis Consultants Inc. (LCI), 1981 North Broadway, Suite 330. LCI's offices can be easily reached by walking from BART; alternatively, parking is available for no charge. **Your**

feedback on two items, as set forth below, is required at your earliest convenience, but no later than Tuesday, November 4, COB.

1. The primary topic of our meeting will be the land seismic portions of the CCCSIP report, as set forth in Chapters 7 and 8. **If you have specific issues or topics you wish to discuss, please let me know so that we have sufficient time to prepare information on those topics.**

2. A secondary topic at the 11/6 meeting could include discussion of Dr. Hamilton's response, although given the amount of material to discuss on 11/6, we may wish to hold a separate meeting the week ofNovember 13 on this topic. **Please advise as to any time limitations you may have on 11/6 and whether you believe there will be sufficient time to discuss both Chapters** 7 **and 8 and Dr. Hamilton's response on 11/6.**

Thank you for your feedback.

Valerie Winn
Chief, State Agency Relations
Pacific Gas and Electric Company
415.973.3839 (o)
415.730.7179 (m)

Sent from my iPhone

Exhibit 42

A4NR-00780

From: Weaver, Casey@Energy <Casey.Weaver@energy.ca.gov>
Sent: Wednesday, November 5, 2014 11:02 AM
To: Winn, Valerie J <VJW3@pge.com>
Cc: Mills, Danielle@Energy <Danielle.Mills@energy.ca.gov>
Subject: IPRP email list

Hi Valerie

Hey, Danielle and I got dropped from your email list.

I just received notification of tomorrow's meeting from Bruce Gibson and noticed Danielle and I were not on the list.

Please add us back on.

Thanks,

Casey

Casey W. Weaver, CEG
Engineering Geologist
California Energy Commission
(916) 654-4659
Casey.Weaver@energy.ca.gov

Exhibit 43

A4NR-00996

Kickoff Meeting DCPP – December 9th, 5pm to 7.30 pm

Boris Jeremic, Norm Abrahamson, Ellen Rathje (phone), Weiyu Chen, TT, Dan o Connel

Minutes

- Ellen questioned Dan on velocity model. Dan responds that he developed 3 models but there's not a unique answer. Tied Vs data from surface waves to Vp data from tomography when applicable.
- Norm developed a site-specific mean adjustment which is a function of frequency
- 3D damping?
- Jigsaw model. Youssef has issues with. Prefers a smooth model.
- Ellen comments on the limitations of using one motion only to compare model to.
- Youssef has issues with the Rayleigh damping. Proposes to use a Vs-dependent damping
- Dan says that we have some additional small magnitude recordings.
- Need to focus on model calibration.
- San Simeon (2006) Parkfield (2004) nothing else triggered the system at DCPP.

Actions

1. Send appendix A and B of initial memo to Norm (for Youssef)
2. Send the gridded model to Boris and Youssef. Put a data in drop box.
3. Boris will send input wavelets to propagate. Control wave. Do that with earthquakes
4. Send meeting appointment 12 pm to 5pm January 9, February 6th (all day meeting).
5. Norm will give new ground motions by end of the week
6. Telecon 3pm Dec 18th.

Exhibit 44

A4NR-00997

DATE:	December 18th, 2014
TIME:	3pm – 5pm
PLACE:	Online meeting
MINUTES BY:	Thaleia Travasarou
MEETING No.:	2

IN ATTENDANCE	NOT IN ATTENDANCE
Norm Abrahamson	Dan O' Connell
Ellen Rathje	
Youssef Hashash	
Boris Jeremic	
Weiyu Chen (Fugro)	
Connor Hayden (Fugro)	
Thaleia Travasarou (Fugro)	

1. **Items Discussed:**
   3D SHEAR WAVE VELOCITY MODEL
   - Model extent: why does 3D model extend that far offshore (BJ). Full extend of model will not be used in the 3D grid (TT)
   - 3D Vs model was developed solely from geophysics, are there boring data available for ground trothing? (ER). No geotechnical information available (NA)
   - Was a constant poisson ratio used to convert from Vp to Vs? (YH). Yes, v= 0.3 was used (TT)
   - Dan proposed Vs vs Q (i.e., damping) relationship based on literature. Plan is for a Vs-dependent damping to be used in the subsequent 3D FLAC models, based on this function (TT)
   - Will soil nonlinearity be modeled in the analyses? (ER). Current plan is to conduct linear analyses (TT). Nonlinearity could be addressed by randomizing Q (ER).
   - Need to compare Vs with depth vs. available downhole records (ER)

   GRID DISCRETIZATION
   - Frequency range of interest is up to 30Hz (NA)
   - No need to try to propagate higher frequencies than fmax in recordings (BJ)
   - Approach proposed by BJ in a memo to Fugro will be used as a guide to select vertical grid discretization
   - Coarse mesh discretization in horizontal direction may be an issues with propagating high frequencies, need to be assessed (YH)
   - Can compare modeled to recorded ground motions for small magnitude earthquakes (M~1 to 3) if such recordings are available (NA)

   FLAC MODEL SMOOTHNESS
   - Jigsaw model may be adequate because area of interest is in level ground conditions, no prominent topography

   1D VS 3D ANALYSES
   - 3D effect does not seem to be prominent
   - Need to conduct 1d analyses in 3D model (YH)
2. **Action Items:**
   1. Send input motions to Boris (TT)
   2. Explanation of how the best-estimate 3D velocity model will be modified to generate two alternative velocity models (DOC)
   3. Discus the influence of using the best estimate Vs profile from MASW to develop the Vs/Vp conversion (DOC)
   4. Finalize the Vs model, update comparisons with existing surface recordings (Fugro team)
   5. Conduct 1D analyses in 3D (Fugro team)
   6. Devise a method to explore horizontal discretization and optimize grid (Fugro team)

3. **Next Meeting:** January 9th, 2015 1pm – 5pm Fugro Office (1000 Broadway street, Suite 440, Oakland, CA 94607)

Exhibit 45

A4NR-00831

PACIFIC GAS AND ELCTRIC COMPANY
GEOSCIENCES DEPARTMENT
CALCULATION DOCUMENT

Calc Number: GEO.DCPP.14.03
Calc Revision: 0
Calc Date: 8/28/2014
Quality related: Y
ITR Verification method: A

1. **CALCULATION TITLE: DCPP Site Response Factors for Hazard Sensitivity**

2. **SIGNATORIES:**

PREPARED BY: [signature] DATE: 8/28/2014

Norm Abrahamson — Geosciences
Printed Name

VERIFIED BY: [signature] DATE: 8/28/2014

Joseph Sun — Geosciences
Printed Name — Organization

[signature] DATE: 09/02/2014

Kathryn Wooddell — Geosciences
Printed Name — Organization

APPROVED BY: [signature] DATE: 09/02/2014

Richard Klimczak — Geosciences
Printed Name — Organization

REGISTERED PROFESSIONAL ENGINEER
JOSEPH I-HUNG SUN
No. C 060648
Exp. 6/30/2016
CIVIL
STATE OF CALIFORNIA

3. RECORD OF REVISIONS:

Rev. No.	Reason for Revision	Revision Date
0	Initial Calculation, tracked per notification SAPN 50638425-1 This calculation was originally signed, approved and stamped on 8/6/2014, whereupon it was discovered that the wrong form was used for both ITR reports. The calc had not been issued nor sent to the DCPP Records Management System. The ITR reports now use the correct form and have been re-signed with the current date. The calculation coversheet has also been re-signed and re-stamped. No changes have been made to the contents of the calculation nor to the two ITR reports. This calculation remains as revision 0.	8/28/14

4. PURPOSE:

Per Notification SAPN 50638425-1, the purpose of this calculation is to develop updated site amplification factors for DCPP consistent with the new NGA-west2 ground motion models and with the new shear-wave velocity profiles for DCPP given in PGEO-16-PR (Fugro, 2014). Site factors are developed for the power block foundation level and the turbine building foundation level. These site factors are based on existing analytical modeling results and are intended to be used only for the 2014 hazard sensitivity evaluation for the AB1632 study. Existing analytical model results are used here because the site amplification factors depend on the spectral shape of the input rock motion and the final input rock ground motion model is still being developed as part of the SWUS study.

As part of the 50.54(f) hazard update, a final set of site factors will be computed that use the final SWUS ground motion model and updated analytical modeling of the site response considering 3-D effects. The 50.54(f) hazard update is scheduled to be completed in March 2015.

5. ASSUMPTIONS:

5.1 INTERPOLATION OF VS30 AMPLIFICATION

Given an amplification scaling from 760 m/s to 1200 m/s from existing analytical modeling results, it is assumed that the amplification can be interpolated to V_{S30} values between 760 and 1200 using linear interpolation on $\ln(V_{S30})$ and ln(amp) if velocity profile for the interpolated V_{S30} falls between the profiles for the 760 and 1200 m/s cases without a strong impedance contrast in the shallow layers.

$$\ln\left(Amp(760 to V_{S30})\right) = \ln\left(Amp(760 to 1200)\right)\frac{\ln\left(V_{S30}/760\right)}{\ln\left(1200/760\right)} \qquad (5.1)$$

The basis for this assumption is that the scaling in empirical ground motion models is generally modeled using a relation between ln(amp) and $\ln(V_{S30})$.

5.2 EXTRAPOLATION OF VS30 AMPLIFICATION

Given an amplification scaling from V_{S30}=760 m/s to V_{S30}=1200 m/s, it is assumed that the amplification can be applied to V_{S30} values up to1260 m/s.

The basis for this assumption is that the change in the amplification between 1200 m/s and 1260 m/s will be small (about 2 percent using the amplification factors from Kamai et al, 2013) and it is conservative to use the amplification for 1200 m/s.

5.3 Z1 SCALING OF THE AMPLIFICATION

The Z_1 dependence of the long period amplification for shallow soil sites with V_{S30}=560 m/s is assumed to be applicable to shallow soil sites with V_{S30}=750 m/s. The basis for this assumption is that, for shallow soil sites at long periods, the Z1 scaling for 560 m/s and 760 m/s are similar. Figure 5.3-1 shows the amplification from Kamai et. al (2013) for Z_1=25 ft and Z_1=50 ft. As this figure shows, for both the 560 m/s case and the 760 m/s case, there is the same lack of Z_1 scaling for T> 1 sec. Kamai et al (2013) does not consider the case with Z_1>50ft for V_{S30}=760 m/s, but Silva (2008), using the same method, considers Z_1 scaling for V_{S30}=760 m/s and Z_1=50 ft and 120 ft. Figure 5.3-2 shows the amplification from Silva (2008). The difference between the 50 ft and 120 ft amplifications for the two site conditions are similar for long periods (T> 0.5 sec), justifying the use of the Z_1 scaling developed for 560 m/s in Kamai et al to a site with V_{S30}=750 m/s for a shallow soil site and long periods.

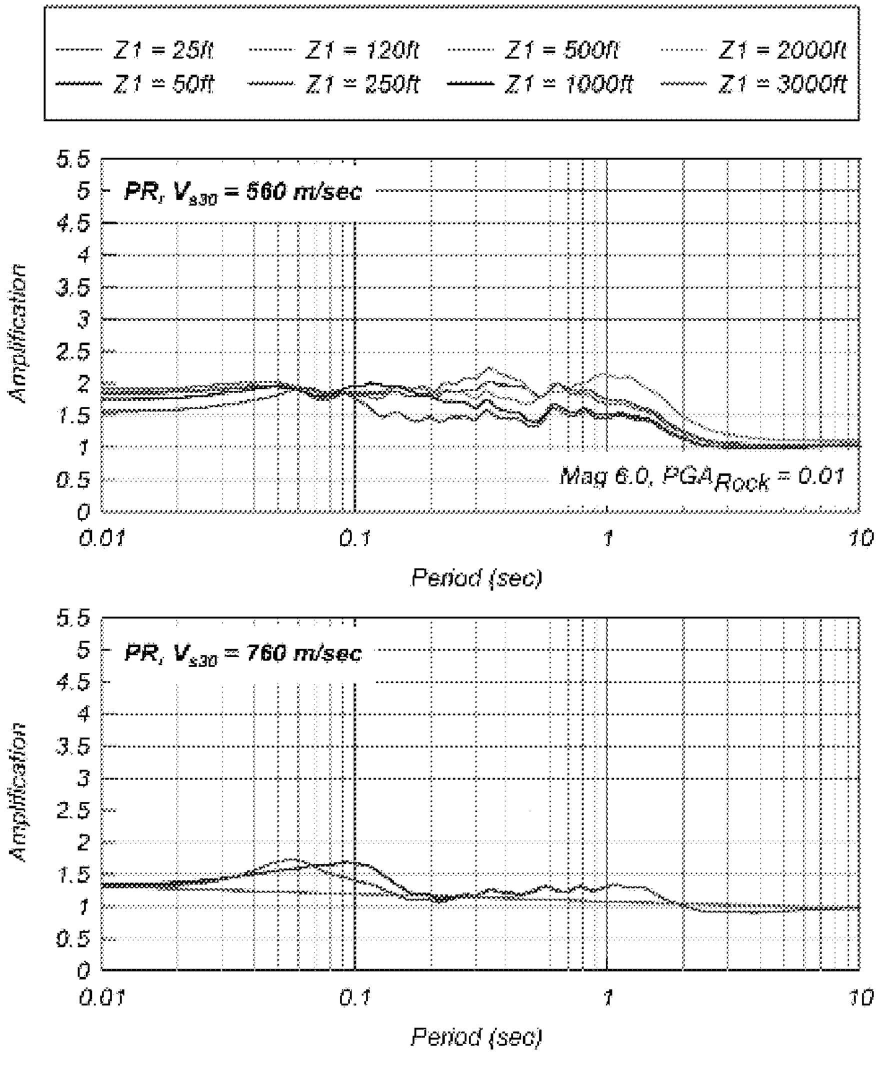


Figure 5.3-1. Z_1 dependence of the amplification factor in the linear range for V_{S30}=560 m/s (top) and V_{S30}=760 m/s (bottom) from Kamai et al (2013) (Figure 3.21).

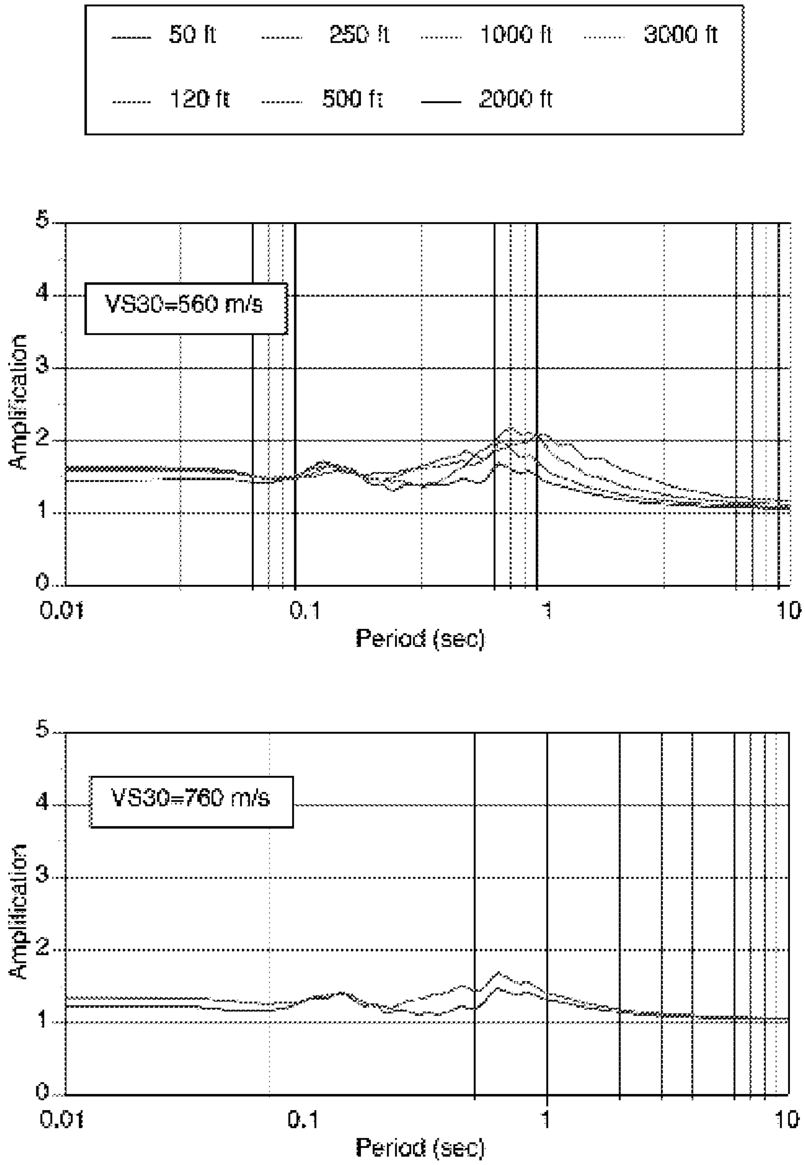


Figure 5.3-2. Z1 dependence of the amplification factor in the linear range for VS30=560 m/s (top) and VS30=760 m/s (bottom) from Silva (2008) (Figure 3.23).

6 INPUTS:

6.1 METADATA AND GROUND MOTION DATA FOR THE 2003 SAN SIMEON AND 2004 PARKFIELD EARTHQUAKES

The metadata and ground motion data are taken from the PEER NGA-W2 flatfile. The flatfile is available at http://peer.berkeley.edu/ngawest2/databases/. A copy of the flatfile is given in Suppporting Documents 1.

Table 6.1-1. Source Parameters for 2003 San Simeon and 2004 Parkfield earthquakes from the NGA-West2 flat file.

	2003 San Simeon	2004 Parkfield
EQID	177	179
Magnitude	6.5	6.0
Rake	97	-175
Dip	52	89
Depth to Top of Rupture (ZTOR)	2 km	2. 5 km
Hypocentral Depth	8.5 km	8.1 km
Rupture Width	10.2 km	8 km

Table 6.1-2. NGA-W2 metadata for the 2003 San Simeon earthquake. Only stations with R_{RUP} between 0 and 100 km are included.

Record Sequence Number	R_{JB} (km)	R_{RUP} (km)	R_X (km)	Source to Site Azimuth (deg)	V_{S30} (m/s)	Z_1 (km)	$Z_{2.5}$ (km)	Lowest Usable Freq (Hz)
4031	5.07	6.22	3	149	410.66	0.279	1.522	0.088
3979	6.97	7.25	-6.97	-90	362.42	0.33	1.707	0.1
4013	16.17	19.01	22.42	90	509.04	0.209	1.27	0.25
4016	31.33	31.39	-22.93	-133	493.5	0.218	1.302	0
4009	31.88	31.94	-31.74	-95	486.19	0.222	1.318	0.15
3994	48.07	48.11	-23.82	-150	365.15	0.327	1.695	0.138
3987	69.08	69.8	64.16	60	280.64	0.467	2.196	0.15
3981	69.51	70.23	75	98	333.61	0.369	1.847	0.038
8167 (DCPP ESTA 27)	37.92	37.97	-37.05	-102.25	*1100	0.034	0.64	0.038

* The V_{S30} of 1100 m/s for DCPP ESTA27 given in the PEER flatfile has been updated based on the velocity profiles described in PGEQ-PR-16.

Table 6.1-3a. NGA-West2 5% damped response spectral values for the 2003 San Simeon earthquake. Only sites with R_{RUP} between 0 and 100 km are included.

Record Sequence Number	T0.010S	T0.020S	T0.030S	T0.050S	T0.075S	T0.100S	T0.150S
4031	4.35E-01	4.49E-01	4.63E-01	5.23E-01	8.01E-01	1.08E+00	1.17E+00
3979	1.61E-01	1.62E-01	1.83E-01	2.61E-01	2.76E-01	3.29E-01	3.69E-01
4013	1.12E-01	1.13E-01	1.14E-01	1.15E-01	1.49E-01	2.38E-01	2.23E-01
4016	1.24E-01	1.27E-01	1.28E-01	1.40E-01	1.81E-01	2.76E-01	4.31E-01
4009	6.58E-02	6.64E-02	6.73E-02	7.48E-02	1.05E-01	1.50E-01	2.11E-01
3994	1.25E-01	1.27E-01	1.29E-01	1.39E-01	1.66E-01	2.56E-01	4.98E-01
3987	1.94E-02	1.95E-02	1.98E-02	2.10E-02	2.80E-02	3.86E-02	3.54E-02
3981	2.59E-02	2.60E-02	2.61E-02	2.64E-02	2.71E-02	2.96E-02	4.42E-02
8167 (DCPP ESTA 27)	3.94E-02	3.96E-02	4.01E-02	4.24E-02	5.65E-02	7.37E-02	9.32E-02

Table 6.1-3b. NGA-West2 5% damped response spectral values for the 2003 San Simeon earthquake. Only sites with Rrup between 0 and 100 km are included.

Record Sequence Number	T0.200S	T0.250S	T0.300S	T0.400S	T0.500S	T0.750S	T1.000S	T1.500S	T2.000S
4031	1.19E+00	8.91E-01	1.18E+00	8.46E-01	7.95E-01	4.27E-01	3.33E-01	2.35E-01	1.60E-01
3979	4.85E-01	5.18E-01	3.91E-01	4.46E-01	2.68E-01	1.87E-01	1.53E-01	7.23E-02	5.09E-02
4013	2.63E-01	2.36E-01	2.13E-01	2.39E-01	1.87E-01	1.86E-01	2.70E-01	1.33E-01	6.50E-02
4016	4.59E-01	3.49E-01	2.43E-01	1.55E-01	1.48E-01	1.11E-01	8.93E-02	9.56E-02	5.77E-02
4009	1.70E-01	1.50E-01	1.10E-01	1.01E-01	1.18E-01	1.16E-01	7.23E-02	6.04E-02	7.97E-02
3994	3.32E-01	2.54E-01	1.97E-01	1.99E-01	1.32E-01	1.44E-01	9.67E-02	7.00E-02	5.65E-02
3987	3.97E-02	5.86E-02	4.96E-02	6.25E-02	4.99E-02	4.06E-02	3.59E-02	2.83E-02	2.20E-02
3981	4.68E-02	4.25E-02	5.00E-02	6.76E-02	7.25E-02	6.49E-02	5.66E-02	3.05E-02	1.52E-02
8167 (DCPP ESTA 27)	1.09E-01	1.11E-01	9.02E-02	9.37E-02	7.19E-02	8.15E-02	6.92E-02	2.92E-02	4.70E-02

Table 6.1-4. NGA-West2 metadata for the 2004 Parkfield earthquake. Only sites with R_{RUP} between 50 and 150 km are included.

Record Sequence Number	R_{JB} (km)	R_{RUP} (km)	R_X (km)	Source to Site Azimuth (deg)	Vs30 (m/s)	Z1 (km)	Z2 (km)	Lowest Usable Freq (Hz)
4092	53.87	54	26.07	151.1	351.43	0.344	1.757	0.038
4076	61.13	61.31	58.22	71.88	493.5	0.218	1.302	0.088
4080	61.72	61.89	49.24	52.79	365.15	0.327	1.695	0.125
4093	68.38	68.48	25.75	157.89	280.64	0.467	2.196	0.063
4087	68.85	69.04	68.99	90	362.42	0.33	1.707	0.075
4082	74.96	75.14	74.76	84.55	486.19	0.222	1.318	0.125
4079	85.6	85.63	-35.72	-24.66	256.41	0.527	2.414	0
4062	109.48	109.51	-107.61	-100.61	243.26	0.566	2.553	0.188
4089	110.33	110.44	68.25	141.82	540.4	0.193	1.212	0.125
4061	112.48	112.51	-111.16	-98.78	246.57	0.556	2.517	0.25
4094	117.38	117.41	-1.00	-179.51	282.14	0.492	2.792	0.05
4077	117.92	117.95	-0.87	-179.58	272.8	0.389	2.894	0.05
4090	119.56	119.62	28.39	166.27	279.56	0.616	1.319	0.063
4095	120.74	120.79	25.99	167.57	315.31	0.623	0.872	0.05
4063	121.51	121.54	-3.57	-178.32	288.67	0.499	2.268	0.063
4091	138.4	138.45	28.02	168.32	311.68	0.601	1.999	0.088
8168 (DCPP ESTA28)	78.14	78.32	77	79.6	1100*	0.034	0.64	0.125

* The V_{S30} of 1100 m/s for DCPP ESTA28 given in the PEER flatfile has been updated based on the velocity profiles described in PGEQ-PR-16.

Table 6.1-5a. NGA-West2 5% damped response spectral values for the 2004 Parkfield earthquake. Only sites with R_{RUP} between 50 and 150 km are included.

Record Sequence Number	T0.010S	T0.020S	T0.030S	T0.050S	T0.075S	T0.100S	T0.150S
4092	5.13E-02	5.28E-02	5.51E-02	9.24E-02	1.16E-01	1.27E-01	1.49E-01
4076	1.25E-02	1.26E-02	1.28E-02	1.37E-02	1.64E-02	2.12E-02	2.60E-02
4080	1.63E-02	1.65E-02	1.65E-02	2.18E-02	3.02E-02	4.86E-02	6.31E-02
4093	2.84E-02	2.88E-02	2.94E-02	3.57E-02	5.10E-02	8.54E-02	6.12E-02
4087	9.59E-03	9.60E-03	9.67E-03	1.01E-02	1.17E-02	1.57E-02	2.12E-02
4082	1.10E-02	1.11E-02	1.13E-02	1.28E-02	1.62E-02	2.85E-02	5.09E-02
4079	7.90E-03	7.90E-03	7.90E-03	8.03E-03	8.24E-03	8.93E-03	1.36E-02
4062	6.51E-03	6.54E-03	6.62E-03	6.81E-03	7.16E-03	7.68E-03	9.44E-03
4089	8.12E-03	8.27E-03	8.61E-03	9.56E-03	1.12E-02	1.55E-02	2.58E-02
4061	4.12E-03	4.13E-03	4.14E-03	4.25E-03	4.50E-03	5.43E-03	5.71E-03
4094	1.28E-02	1.28E-02	1.29E-02	1.29E-02	1.30E-02	1.31E-02	1.50E-02
4077	1.29E-02	1.29E-02	1.29E-02	1.30E-02	1.31E-02	1.32E-02	1.38E-02
4090	1.09E-02	1.09E-02	1.09E-02	1.11E-02	1.16E-02	1.51E-02	1.92E-02
4095	1.27E-02	1.28E-02	1.29E-02	1.30E-02	1.33E-02	1.47E-02	2.03E-02
4063	1.03E-02	1.03E-02	1.03E-02	1.04E-02	1.04E-02	1.06E-02	1.07E-02
4091	1.07E-02	1.07E-02	1.07E-02	1.11E-02	1.12E-02	1.58E-02	1.80E-02
8168 (DCPP ESTA 28)	8.02E-03	8.08E-03	8.42E-03	8.34E-03	9.14E-03	8.95E-03	1.25E-02

Table 6.1-5b. NGA-West2 5% damped response spectral values for the 2004 Parkfield earthquake.

Record Sequence Number	T0.200S	T0.250S	T0.300S	T0.400S	T0.500S	T0.750S	T1.000S	T1.500S	T2.000S
4092	1.44E-01	1.28E-01	1.21E-01	1.12E-01	6.83E-02	4.04E-02	3.67E-02	2.48E-02	1.35E-02
4076	2.44E-02	2.56E-02	3.07E-02	2.91E-02	3.28E-02	2.35E-02	1.28E-02	4.97E-03	2.56E-03
4080	4.18E-02	3.19E-02	2.32E-02	2.26E-02	1.67E-02	1.24E-02	9.94E-03	5.52E-03	3.26E-03
4093	6.44E-02	8.60E-02	6.49E-02	4.66E-02	6.20E-02	4.10E-02	3.84E-02	1.44E-02	9.69E-03
4087	2.37E-02	2.26E-02	2.29E-02	1.94E-02	1.99E-02	2.26E-02	1.04E-02	4.22E-03	3.24E-03
4082	2.62E-02	2.26E-02	2.02E-02	1.97E-02	2.43E-02	1.48E-02	1.18E-02	8.16E-03	4.65E-03
4079	1.76E-02	1.68E-02	1.87E-02	1.68E-02	1.78E-02	2.10E-02	1.76E-02	1.60E-02	6.85E-03
4062	1.23E-02	1.26E-02	1.28E-02	1.37E-02	1.06E-02	7.59E-03	6.09E-03	5.41E-03	2.01E-03
4089	2.13E-02	2.30E-02	2.31E-02	1.53E-02	1.40E-02	9.88E-03	1.05E-02	5.57E-03	3.18E-03
4061	9.05E-03	9.93E-03	1.11E-02	9.68E-03	7.54E-03	6.81E-03	5.29E-03	2.85E-03	2.09E-03
4094	2.44E-02	2.40E-02	2.36E-02	3.23E-02	2.94E-02	2.98E-02	3.56E-02	3.23E-02	3.54E-02
4077	1.70E-02	2.11E-02	2.04E-02	3.17E-02	2.93E-02	3.26E-02	4.78E-02	3.34E-02	2.90E-02
4090	3.30E-02	2.38E-02	2.90E-02	2.76E-02	2.54E-02	2.79E-02	2.43E-02	2.16E-02	1.28E-02
4095	2.35E-02	2.63E-02	2.93E-02	2.77E-02	2.89E-02	4.07E-02	2.65E-02	1.70E-02	1.33E-02
4063	1.16E-02	1.47E-02	1.49E-02	1.97E-02	2.69E-02	2.03E-02	2.12E-02	2.78E-02	2.53E-02
4091	2.28E-02	2.59E-02	2.62E-02	2.78E-02	3.07E-02	3.17E-02	2.63E-02	1.66E-02	1.66E-02
8168 (DCPP ESTA 28)	1.05E-02	1.19E-02	1.26E-02	2.01E-02	2.21E-02	1.34E-02	7.12E-03	4.02E-03	3.06E-03

6.2 SITE CONDITIONS AT DCPP

The site conditions are based on the PGEQ-PR-16 report.

Table 6.2-1. V_{S30} values for DCPP power block and turbine building foundation levels from PGEQ-PR-16 (page 24) given in Supporting Documents 2.

Location	Elevation	V_{S30}
Power block foundation	53 ft	1257 ± 102 m/s
Turbine building foundation	61 ft	983 ± 97 m/s

Table 6.2-2. V_S profiles near the two free-field sites at DCPP from PGEQ-PR-16. The raw data files are given in Supporting Documents 2.

Elevation (ft)	Station A1200 Vs (ft/sec)	Station A100 Vs (ft/sec)	Station B1200 Vs (ft/sec)
87	917.54	1374.71	890.00
82	1006.00	1478.35	975.07
77	1114.04	1606.92	1081.90
72	1248.88	1782.15	1217.50
67	1420.38	2041.52	1392.99
62	1647.07	2407.06	1625.81
57	1959.03	2908.99	1946.44
52	2211.53	3325.54	2211.24
47	2260.87	3426.20	2278.97
42	2313.96	3441.27	2354.74
37	2372.88	3350.90	2435.79
32	2437.00	3208.75	2521.70
27	2500.27	3083.57	2611.73
22	2562.42	3010.24	2705.77
17	2624.20	2957.10	2802.74
12	2687.45	2914.81	2903.22
7	2756.39	2878.22	3008.55
2	2836.35	2842.67	3118.25
-3	2916.86	2806.01	3232.73
-8	3003.28	2774.64	3355.83
-13	3094.90	2746.20	3488.25
-18	3187.97	2719.03	3628.99
-23	3285.13	2692.27	3774.25
-28	3394.43	2664.85	3923.02
-33	3508.97	2637.41	4072.54
-38	3626.70	2611.53	4220.37
-43	3740.62	2588.96	4373.07
-48	3849.40	2572.21	4539.57
-53	3947.82	2563.63	4704.46
-58	4032.95	2565.58	4846.31
-63	4105.51	2578.49	4974.10
-68	4160.56	2602.19	4955.17
-73	4203.36	2634.85	4885.01
-78	4226.74	2675.76	4860.67
-83	4248.16	2725.12	4844.38

-88	4260.13	2781.43	4825.87
-93	4271.15	2842.89	4844.14
-98	4288.02	2906.73	4872.39
-103	4319.92	2969.74	4904.95
-108	4375.86	3029.02	4940.78
-113	4453.59	3082.72	4975.88
-118	4534.36	3132.65	5017.80
-123	4612.40	3181.32	5059.43
-128	4685.62	3229.95	5115.64
-133	4768.77	3279.70	5179.02
-138	4857.32	3332.85	5226.41
-143	4934.11	3385.71	5270.33
-148	5042.96	3441.33	5320.72
-153	5159.07	3499.32	5358.81
-158	5220.09	3561.30	5380.60
-163	5282.95	3627.93	5399.45
-168	5341.99	3697.91	5423.94
-173	5396.56	3769.55	5447.39
-178	5428.82	3840.19	5466.76
-183	5447.22	3911.69	5487.14
-188	5468.12	3985.85	5501.85
-193	5497.58	4060.44	5521.40
-198	5519.64	4133.55	5543.88
-203	5537.35	4202.11	5561.25
-208	5555.56	4266.37	5564.74
-213	5575.39	4324.97	5562.56
-218	5597.63	4373.45	5561.89
-223	5620.05	4410.02	5563.28
-228	5640.57	4437.05	5566.58
-233	5659.07	4459.74	5571.18
-238	5676.86	4480.63	5576.88
-243	5694.56	4501.56	5583.50
-248	5712.11	4525.67	5590.78
-253	5729.69	4554.38	5598.68
-258	5747.66	4588.38	5607.55
-263	5766.46	4626.47	5617.96
-268	5786.56	4667.45	5630.55
-273	5808.51	4710.27	5646.01
-278	5833.04	4753.90	5664.96
-283	5860.67	4797.43	5688.03
-288	5892.05	4840.81	5715.76
-293	5927.82	4882.72	5748.60
-298	5968.26	4922.88	5786.95

Table 6.2-3. V_S profiles for the power block from PGEQ-PR-16. The raw data files are given in Supporting Documents 2.

Elev (ft)	Station B200	Station B300	Station B400	Station B500	Station B600	Station B700	Station B800	Station B900	Station B1000	Station C200	Station C300	Station C400	Station D200	Station D300
87	408.3	441.0	460.4	722.3	458.5	468.8	421.6	356.8	307.7		408.2	510.0	356.7	410.7
82	425.3	471.5	506.5	814.2	505.1	509.8	454.9	389.8	335.8	347.6	450.3	558.1	385.7	439.5
77	456.9	517.9	564.4	935.4	559.5	558.8	499.3	432.0	372.8	387.0	501.9	618.1	424.2	480.6
72	503.3	579.0	636.0	1089.5	620.4	617.1	555.6	485.9	420.6	432.4	564.0	693.5	474.3	534.0
67	566.3	652.7	714.9	1273.4	692.4	689.0	628.6	555.7	482.8	480.7	635.0	778.9	539.1	603.8
62	649.2	742.9	812.9	1400.6	795.8	784.2	725.0	647.9	565.4	538.8	723.8	890.8	625.3	696.7
57	761.8	860.6	942.3	1376.1	926.8	914.9	856.5	774.2	679.0	615.6	844.4	1032.2	742.0	823.6
52	847.5	942.5	1029.9	1347.0	1023.0	1012.2	958.3	876.3	773.2	719.8	934.0	1124.3	833.2	922.0
47	852.9	935.4	1018.7	1322.9	1021.6	1013.8	971.0	898.3	797.9	796.3	931.4	1109.0	847.2	934.7
42	857.0	930.7	1011.0	1301.3	1019.6	1016.8	984.6	921.4	824.2	799.0	931.9	1096.6	861.9	948.4
37	858.8	927.3	1005.4	1279.0	1019.9	1021.4	999.3	945.7	852.2	802.6	933.9	1086.2	877.7	963.4
32	860.0	925.9	1000.9	1261.9	1021.9	1027.2	1015.3	971.3	881.6	807.4	936.0	1077.1	895.9	980.0
27	863.4	925.8	997.9	1248.2	1024.7	1034.2	1033.1	998.4	912.5	813.9	938.0	1069.3	915.9	998.5
22	866.7	926.6	996.8	1236.7	1031.0	1044.4	1053.0	1027.7	945.4	822.3	942.5	1064.3	938.8	1019.5
17	868.2	927.4	996.3	1228.0	1040.5	1057.5	1075.6	1059.2	980.4	832.4	947.7	1060.6	963.1	1043.2
12	867.9	927.0	995.1	1221.6	1052.7	1073.2	1101.1	1093.2	1017.6	844.3	952.5	1056.8	990.1	1069.8
7	869.0	925.2	991.6	1219.4	1064.6	1092.5	1130.0	1130.1	1058.0	856.6	954.9	1051.7	1021.0	1099.9
2	868.4	920.9	985.0	1220.6	1073.1	1114.4	1162.7	1170.6	1101.7	867.9	953.3	1044.7	1054.2	1132.8
-3	863.6	914.8	979.2	1224.1	1074.3	1137.5	1200.2	1216.0	1148.5	878.2	948.9	1038.7	1088.7	1168.8
-8	855.8	908.0	973.9	1227.7	1070.3	1160.0	1242.1	1267.1	1199.5	885.7	942.6	1034.5	1120.5	1206.6
-13	844.6	901.0	968.7	1232.8	1066.3	1184.4	1290.1	1323.1	1254.4	891.8	936.1	1030.9	1151.6	1250.0
-18	832.4	893.6	965.0	1234.9	1067.5	1208.9	1343.7	1382.8	1311.1	897.0	933.2	1027.7	1180.3	1298.9
-23	821.3	885.6	960.1	1233.3	1074.9	1226.8	1395.9	1442.1	1366.5	899.5	932.9	1024.0	1203.1	1347.5
-28	811.6	876.8	953.2	1223.9	1089.6	1248.8	1441.6	1492.7	1416.4	896.0	933.0	1017.7	1211.2	1389.7
-33	803.5	868.0	947.4	1212.2	1093.6	1258.9	1467.8	1527.5	1457.8	884.7	930.1	1010.4	1198.6	1392.6
-38	796.3	858.4	939.1	1194.3	1089.6	1256.1	1453.0	1541.9	1490.9	870.0	920.1	1001.7	1177.1	1361.1
-43	790.2	849.6	931.8	1173.2	1084.8	1251.9	1419.3	1530.6	1522.4	859.9	912.5	991.0	1157.3	1334.6
-48	786.0	841.8	922.8	1147.9	1073.3	1240.3	1410.8	1540.1	1542.5	852.7	906.2	977.2	1136.2	1319.0
-53	784.6	835.7	912.6	1120.5	1055.4	1223.5	1413.5	1551.3	1572.3	848.0	899.4	961.9	1119.6	1305.7
-58	785.6	831.7	902.8	1091.5	1035.5	1199.8	1407.2	1561.2	1607.4	845.7	892.8	946.4	1106.7	1289.6
-63	788.5	829.3	894.0	1061.8	1015.1	1169.7	1383.6	1576.2	1654.5	845.2	886.9	932.0	1091.9	1266.1
-68	793.7	828.8	886.8	1033.7	995.3	1135.6	1334.9	1520.3	1600.5	845.8	882.2	919.4	1076.8	1233.3
-73	801.1	830.5	881.6	1008.7	977.9	1101.8	1282.1	1456.5	1550.1	848.0	879.3	909.2	1063.0	1198.0
-78	810.8	834.9	878.8	988.5	963.7	1073.0	1234.0	1402.1	1503.2	851.9	878.4	902.0	1052.5	1165.7
-83	822.7	841.6	879.0	974.1	953.8	1051.4	1195.4	1355.4	1463.4	857.4	879.7	898.5	1046.0	1139.6
-88	836.5	850.6	882.1	965.9	948.7	1036.9	1167.7	1318.6	1431.9	864.7	883.5	898.8	1042.9	1120.9
-93	851.7	861.2	887.9	963.8	948.1	1029.0	1149.3	1291.9	1407.9	873.4	889.5	902.6	1042.9	1109.3
-98	867.5	873.1	896.1	966.7	951.6	1026.9	1139.1	1274.3	1390.9	883.0	897.6	909.5	1046.3	1104.1
-103	883.6	885.7	906.0	973.8	958.3	1029.7	1136.1	1265.3	1381.0	893.7	907.2	918.7	1053.0	1104.5
-108	899.4	898.9	917.2	983.8	967.2	1036.6	1138.9	1263.9	1378.2	904.8	918.0	929.5	1062.6	1109.5
-113	914.8	912.3	929.3	996.0	978.0	1046.6	1146.1	1268.2	1381.1	916.4	929.9	941.5	1074.1	1117.9
-118	929.9	925.6	941.9	1009.6	990.2	1058.7	1156.6	1276.8	1387.8	928.3	942.1	954.0	1086.6	1129.0
-123	945.1	939.1	954.6	1023.5	1003.2	1072.1	1169.3	1288.1	1396.9	940.0	954.5	966.7	1099.2	1141.9
-128	960.3	952.7	967.3	1037.6	1016.6	1086.2	1183.1	1300.8	1407.5	952.1	967.2	979.4	1112.1	1155.8
-133	975.5	966.6	980.2	1051.8	1030.4	1100.4	1197.1	1313.8	1418.1	964.6	980.3	992.1	1124.9	1169.7
-138	991.2	980.8	993.4	1066.0	1044.1	1114.3	1210.3	1325.7	1427.3	977.4	993.8	1005.1	1137.3	1183.0
-143	1007.2	995.6	1007.1	1079.9	1057.8	1127.6	1222.3	1335.4	1433.8	991.3	1008.1	1018.3	1149.4	1195.1
-148	1023.5	1010.8	1021.3	1094.0	1072.3	1140.4	1232.6	1342.4	1436.7	1006.4	1023.4	1031.8	1160.6	1205.9
-153	1040.2	1026.8	1036.2	1108.2	1086.9	1152.7	1241.5	1346.4	1437.1	1022.2	1039.8	1046.1	1170.9	1215.3
-158	1057.6	1043.3	1051.9	1122.3	1101.3	1164.3	1248.9	1349.0	1439.3	1038.5	1056.8	1061.2	1181.2	1223.3
-163	1075.7	1060.4	1067.9	1136.5	1115.3	1175.1	1255.6	1353.2	1444.3	1055.5	1074.0	1076.7	1190.9	1230.2
-168	1094.2	1078.0	1084.0	1150.8	1128.7	1185.1	1261.9	1356.9	1448.8	1073.6	1091.2	1092.5	1199.3	1236.6
-173	1113.1	1095.7	1100.0	1165.3	1140.8	1194.4	1267.8	1360.0	1453.3	1092.8	1107.7	1108.4	1206.8	1242.8
-178	1131.9	1113.8	1115.8	1179.6	1152.5	1203.4	1273.2	1365.0	1459.3	1112.6	1123.4	1124.2	1214.2	1249.8
-183	1150.9	1132.0	1131.3	1193.6	1163.8	1212.2	1278.7	1372.8	1465.4	1131.7	1138.3	1140.0	1222.2	1256.8
-188	1170.5	1150.2	1146.8	1207.5	1175.0	1220.7	1285.2	1380.4	1471.2	1149.0	1152.5	1155.9	1232.3	1264.2
-193	1190.5	1168.5	1162.5	1221.1	1185.9	1228.5	1293.0	1387.5	1478.4	1164.7	1165.9	1171.4	1242.7	1272.5
-198	1210.7	1186.3	1177.5	1234.1	1196.6	1236.5	1302.2	1395.2	1486.2	1177.1	1178.2	1186.0	1252.5	1282.3
-203	1231.2	1203.9	1192.5	1246.6	1206.5	1245.0	1311.2	1403.4	1495.0	1188.7	1190.6	1200.2	1261.7	1292.1
-208	1251.5	1221.2	1206.9	1258.7	1215.7	1254.6	1319.7	1412.3	1503.9	1198.3	1200.9	1214.3	1270.5	1301.2
-213	1271.0	1238.0	1220.1	1270.5	1225.7	1264.4	1328.5	1422.0	1512.1	1208.5	1210.4	1227.7	1279.3	1310.0
-218	1289.9	1254.6	1232.6	1281.9	1236.8	1274.1	1338.2	1431.9	1519.8	1220.1	1221.7	1240.1	1288.5	1319.4
-223	1308.5	1271.1	1244.8	1292.8	1247.7	1284.2	1348.9	1441.2	1525.9	1228.8	1232.7	1252.0	1298.2	1330.2
-228	1326.0	1286.3	1256.9	1303.3	1258.7	1295.0	1359.3	1450.3	1530.0	1237.8	1244.2	1263.5	1308.0	1341.2

-233	1342.8	1300.0	1269.1	1313.8	1269.8	1305.5	1368.8	1459.5	1534.0	1248.1	1256.4	1275.4	1317.5	1351.6
-238	1357.6	1312.7	1281.0	1324.6	1280.3	1316.0	1378.6	1468.6	1537.6	1258.6	1268.1	1287.3	1327.5	1362.0
-243	1369.0	1324.6	1293.1	1335.4	1291.4	1326.7	1388.6	1476.1	1541.0	1270.0	1280.4	1299.0	1338.0	1372.6
-248	1378.5	1336.6	1306.5	1346.4	1303.8	1337.3	1399.2	1482.4	1545.0	1281.4	1293.6	1311.5	1349.0	1383.5
-253	1388.5	1346.1	1319.6	1357.8	1315.5	1348.0	1410.1	1488.2	1549.4	1292.6	1306.0	1324.2	1360.6	1394.7
-258	1398.7	1354.4	1331.7	1369.6	1327.4	1359.8	1421.0	1494.5	1554.4	1304.0	1317.7	1336.6	1373.1	1406.4
-263	1409.6	1363.4	1342.7	1381.6	1339.7	1372.2	1431.5	1501.6	1560.0	1315.7	1329.1	1349.0	1386.1	1418.1
-268	1420.2	1372.5	1351.9	1393.8	1351.5	1384.7	1441.0	1509.1	1566.5	1327.5	1339.9	1359.3	1399.0	1428.3
-273	1430.3	1382.1	1361.0	1405.9	1363.1	1397.7	1450.3	1517.2	1573.7	1340.1	1350.6	1367.9	1411.1	1437.1
-278	1440.6	1392.2	1370.3	1416.4	1375.0	1409.9	1460.1	1526.0	1581.7	1354.0	1361.7	1376.9	1422.7	1446.4
-283	1450.8	1402.3	1380.3	1426.5	1387.9	1421.2	1470.0	1535.4	1590.4	1369.1	1373.4	1386.8	1432.6	1455.3
-288	1461.1	1412.9	1391.8	1436.9	1400.8	1432.2	1480.2	1545.4	1600.0	1385.3	1386.5	1397.6	1442.0	1464.6
-293	1472.8	1425.3	1404.1	1447.5	1412.6	1442.9	1490.6	1556.1	1610.5	1402.4	1400.7	1409.1	1451.3	1474.4
-298	1483.9	1436.8	1415.7	1458.6	1424.0	1453.7	1501.4	1567.5	1621.8	1418.1	1413.9	1420.4	1461.0	1484.8

Table 6.2-4 V_S profiles for the turbine building from PGEQ-PR-16. The raw data files are given in Supporting Documents 2.

Elev (ft)	Station B200	Station B300	Station B400	Station B500	Station B600	Station B700	Station B800	Station B900	Station B1000	Station C200	Station C300	Station C400	Station D200	Station D300	Station D400
87	408.3	441.0	460.4	722.3	458.5	468.8	421.6	356.8	307.7		408.2	510.0	356.7	410.7	460.5
82	425.3	471.5	506.5	814.2	505.1	509.8	454.9	389.8	335.8	347.6	450.3	558.1	385.7	439.5	503.9
77	456.9	517.9	564.4	935.4	559.5	558.8	499.3	432.0	372.8	387.0	501.9	618.1	424.2	480.6	556.6
72	503.3	579.0	636.0	1089.5	620.4	617.1	555.6	485.9	420.6	432.4	564.0	693.5	474.3	534.0	620.6
67	566.3	652.7	714.9	1273.4	692.4	689.0	628.6	555.7	482.8	480.7	635.0	778.9	539.1	603.8	700.9
62	649.2	742.9	812.9	1400.6	795.8	784.2	725.0	647.9	565.4	538.8	723.8	890.8	625.3	696.7	804.6
57	761.8	860.6	942.3	1376.1	926.8	914.9	856.5	774.2	679.0	615.6	844.4	1032.2	742.0	823.6	944.6
52	847.5	942.5	1029.9	1347.0	1023.0	1012.2	958.3	876.3	773.2	719.8	934.0	1124.3	833.2	922.0	1049.5
47	852.9	935.4	1018.7	1322.9	1021.6	1013.8	971.0	898.3	797.9	796.3	931.4	1109.0	847.2	934.7	1055.4
42	857.0	930.7	1011.0	1301.3	1019.6	1016.8	984.6	921.4	824.2	799.0	931.9	1096.6	861.9	948.4	1062.5
37	858.8	927.3	1005.4	1279.0	1019.9	1021.4	999.3	945.7	852.2	802.6	933.9	1086.2	877.7	963.4	1070.7
32	860.0	925.9	1000.9	1261.9	1021.9	1027.2	1015.3	971.3	881.6	807.4	936.0	1077.1	895.9	980.0	1080.2
27	863.4	925.8	997.9	1248.2	1024.7	1034.2	1033.1	998.4	912.5	813.9	938.0	1069.3	915.9	998.5	1091.1
22	866.7	926.6	996.8	1236.7	1031.0	1044.4	1053.0	1027.7	945.4	822.3	942.5	1064.3	938.8	1019.5	1104.2
17	868.2	927.4	996.3	1228.0	1040.5	1057.5	1075.6	1059.2	980.4	832.4	947.7	1060.6	963.1	1043.2	1120.3
12	867.9	927.0	995.1	1221.6	1052.7	1073.2	1101.1	1093.2	1017.6	844.3	952.5	1056.8	990.1	1069.8	1139.9
7	869.0	925.2	991.6	1219.4	1064.6	1092.5	1130.0	1130.1	1058.0	856.6	954.9	1051.7	1021.0	1099.9	1163.5
2	868.4	920.9	985.0	1220.6	1073.1	1114.4	1162.7	1170.6	1101.7	867.9	953.3	1044.7	1054.2	1132.8	1191.2
-3	863.6	914.8	979.2	1224.1	1074.3	1137.5	1200.2	1216.0	1148.5	878.2	948.9	1038.7	1088.7	1168.8	1224.4
-8	855.8	908.0	973.9	1227.7	1070.3	1160.0	1242.1	1267.1	1199.5	885.7	942.6	1034.5	1120.5	1206.6	1263.4
-13	844.6	901.0	968.7	1232.8	1066.3	1184.4	1290.1	1323.1	1254.4	891.8	936.1	1030.9	1151.6	1250.0	1309.4
-18	832.4	893.6	965.0	1234.9	1067.5	1208.9	1343.7	1382.8	1311.1	897.0	933.2	1027.7	1180.3	1298.9	1362.5
-23	821.3	885.6	960.1	1233.3	1074.9	1226.8	1395.9	1442.1	1366.5	899.5	932.9	1024.0	1203.1	1347.5	1410.9
-28	811.6	876.8	953.2	1223.9	1089.6	1248.8	1441.6	1492.7	1416.4	896.0	933.0	1017.7	1211.2	1389.7	1444.7
-33	803.5	868.0	947.4	1212.2	1093.6	1258.9	1467.8	1527.5	1457.8	884.7	930.1	1010.4	1198.6	1392.6	1458.1
-38	796.3	858.4	939.1	1194.3	1089.6	1256.1	1453.0	1541.9	1490.9	870.0	920.1	1001.7	1177.1	1361.1	1466.5
-43	790.2	849.6	931.8	1173.2	1084.8	1251.9	1419.3	1530.6	1522.4	859.9	912.5	991.0	1157.3	1334.6	1456.9
-48	786.0	841.8	922.8	1147.9	1073.3	1240.3	1410.8	1540.1	1542.5	852.7	906.2	977.2	1136.2	1319.0	1454.0
-53	784.6	835.7	912.6	1120.5	1055.4	1223.5	1413.5	1551.3	1572.3	848.0	899.4	961.9	1119.6	1305.7	1483.8
-58	785.6	831.7	902.8	1091.5	1035.5	1199.8	1407.2	1561.2	1607.4	845.7	892.8	946.4	1106.7	1289.6	1499.9
-63	788.5	829.3	894.0	1061.8	1015.1	1169.7	1383.6	1576.2	1654.5	845.2	886.9	932.0	1091.9	1266.1	1457.9
-68	793.7	828.8	886.8	1033.7	995.3	1135.6	1334.9	1520.3	1600.5	845.8	882.2	919.4	1076.8	1233.3	1385.4
-73	801.1	830.5	881.6	1008.7	977.9	1101.8	1282.1	1456.5	1550.1	848.0	879.3	909.2	1063.0	1198.0	1315.3
-78	810.8	834.9	878.8	988.5	963.7	1073.0	1234.0	1402.1	1503.2	851.9	878.4	902.0	1052.5	1165.7	1253.1
-83	822.7	841.6	879.0	974.1	953.8	1051.4	1195.4	1355.4	1463.4	857.4	879.7	898.5	1046.0	1139.6	1204.5
-88	836.5	850.6	882.1	965.9	948.7	1036.9	1167.7	1318.6	1431.9	864.7	883.5	898.8	1042.9	1120.9	1169.7
-93	851.7	861.2	887.9	963.8	948.1	1029.0	1149.3	1291.9	1407.9	873.4	889.5	902.6	1042.9	1109.3	1146.7
-98	867.5	873.1	896.1	966.7	951.6	1026.9	1139.1	1274.3	1390.9	883.0	897.6	909.5	1046.3	1104.1	1133.2
-103	883.6	885.7	906.0	973.8	958.3	1029.7	1136.1	1265.3	1381.0	893.7	907.2	918.7	1053.0	1104.5	1128.1
-108	899.4	898.9	917.2	983.8	967.2	1036.6	1138.9	1263.9	1378.2	904.8	918.0	929.5	1062.6	1109.5	1129.7
-113	914.8	912.3	929.3	996.0	978.0	1046.6	1146.1	1268.2	1381.1	916.4	929.9	941.5	1074.1	1117.9	1136.4
-118	929.9	925.6	941.9	1009.6	990.2	1058.7	1156.6	1276.8	1387.8	928.3	942.1	954.0	1086.6	1129.0	1146.5
-123	945.1	939.1	954.6	1023.5	1003.2	1072.1	1169.3	1288.1	1396.9	940.0	954.5	966.7	1099.2	1141.9	1159.0
-128	960.3	952.7	967.3	1037.6	1016.6	1086.2	1183.1	1300.8	1407.5	952.1	967.2	979.4	1112.1	1155.8	1172.7
-133	975.5	966.6	980.2	1051.8	1030.4	1100.4	1197.1	1313.8	1418.1	964.6	980.3	992.1	1124.9	1169.7	1186.6
-138	991.2	980.8	993.4	1066.0	1044.1	1114.3	1210.3	1325.7	1427.3	977.4	993.8	1005.1	1137.3	1183.0	1200.1
-143	1007.2	995.6	1007.1	1079.9	1057.8	1127.6	1222.3	1335.4	1433.8	991.3	1008.1	1018.3	1149.4	1195.1	1212.6
-148	1023.5	1010.8	1021.3	1094.0	1072.3	1140.4	1232.6	1342.4	1436.7	1006.4	1023.4	1031.8	1160.6	1205.9	1224.0
-153	1040.2	1026.8	1036.2	1108.2	1086.9	1152.7	1241.5	1346.4	1437.1	1022.2	1039.8	1046.1	1170.9	1215.3	1234.1
-158	1057.6	1043.3	1051.9	1122.3	1101.3	1164.3	1248.9	1349.0	1439.3	1038.5	1056.8	1061.2	1181.2	1223.3	1243.1
-163	1075.7	1060.4	1067.9	1136.5	1115.3	1175.1	1255.6	1353.2	1444.3	1055.5	1074.0	1076.7	1190.9	1230.2	1251.2
-168	1094.2	1078.0	1084.0	1150.8	1128.7	1185.1	1261.9	1356.9	1448.8	1073.6	1091.2	1092.5	1199.3	1236.6	1258.4
-173	1113.1	1095.7	1100.0	1165.3	1140.8	1194.4	1267.8	1360.0	1453.3	1092.8	1107.7	1108.4	1206.8	1242.8	1265.0
-178	1131.9	1113.8	1115.8	1179.6	1152.5	1203.4	1273.2	1365.0	1459.3	1112.6	1123.4	1124.2	1214.2	1249.8	1271.4
-183	1150.9	1132.0	1131.3	1193.6	1163.8	1212.2	1278.7	1372.8	1465.4	1131.7	1138.3	1140.0	1222.2	1256.8	1277.9
-188	1170.5	1150.2	1146.8	1207.5	1175.0	1220.7	1285.2	1380.4	1471.2	1149.0	1152.5	1155.9	1232.3	1264.2	1284.7
-193	1190.5	1168.5	1162.5	1221.1	1185.9	1228.5	1293.0	1387.5	1478.4	1164.7	1165.9	1171.4	1242.7	1272.5	1291.6
-198	1210.7	1186.3	1177.5	1234.1	1196.6	1236.5	1302.2	1395.2	1486.2	1177.1	1178.2	1186.0	1252.5	1282.3	1298.8
-203	1231.2	1203.9	1192.5	1246.6	1206.5	1245.0	1311.2	1403.4	1495.0	1188.7	1190.6	1200.2	1261.7	1292.1	1306.4
-208	1251.5	1221.2	1206.9	1258.7	1215.7	1254.6	1319.7	1412.3	1503.9	1198.3	1200.9	1214.3	1270.5	1301.2	1314.4
-213	1271.0	1238.0	1220.1	1270.5	1225.7	1264.4	1328.5	1422.0	1512.1	1208.5	1210.4	1227.7	1279.3	1310.0	1322.9
-218	1289.9	1254.6	1232.6	1281.9	1236.8	1274.1	1338.2	1431.9	1519.8	1220.1	1221.7	1240.1	1288.5	1319.4	1331.8
-223	1308.5	1271.1	1244.8	1292.8	1247.7	1284.2	1348.9	1441.2	1525.9	1228.8	1232.7	1252.0	1298.2	1330.2	1340.7
-228	1326.0	1286.3	1256.9	1303.3	1258.7	1295.0	1359.3	1450.3	1530.0	1237.8	1244.2	1263.5	1308.0	1341.2	1349.4
-233	1342.8	1300.0	1269.1	1313.8	1269.8	1305.5	1368.8	1459.5	1534.0	1248.1	1256.4	1275.4	1317.5	1351.6	1358.6
-238	1357.6	1312.7	1281.0	1324.6	1280.3	1316.0	1378.6	1468.6	1537.6	1258.6	1268.1	1287.3	1327.5	1362.0	1368.7
-243	1369.0	1324.6	1293.1	1335.4	1291.4	1326.7	1388.6	1476.1	1541.0	1270.0	1280.4	1299.0	1338.0	1372.6	1378.6
-248	1378.5	1336.6	1306.5	1346.4	1303.8	1337.3	1399.2	1482.4	1545.0	1281.4	1293.6	1311.5	1349.0	1383.5	1388.7

-253	1388.5	1346.1	1319.6	1357.8	1315.5	1348.0	1410.1	1488.2	1549.4	1292.6	1306.0	1324.2	1360.6	1394.7	1399.7
-258	1398.7	1354.4	1331.7	1369.6	1327.4	1359.8	1421.0	1494.5	1554.4	1304.0	1317.7	1336.6	1373.1	1406.4	1411.2
-263	1409.6	1363.4	1342.7	1381.6	1339.7	1372.2	1431.5	1501.6	1560.0	1315.7	1329.1	1349.0	1386.1	1418.1	1422.4
-268	1420.2	1372.5	1351.9	1393.8	1351.5	1384.7	1441.0	1509.1	1566.5	1327.5	1339.9	1359.3	1399.0	1428.3	1433.5
-273	1430.3	1382.1	1361.0	1405.9	1363.1	1397.7	1450.3	1517.2	1573.7	1340.1	1350.6	1367.9	1411.1	1437.1	1444.8
-278	1440.6	1392.2	1370.3	1416.4	1375.0	1409.9	1460.1	1526.0	1581.7	1354.0	1361.7	1376.9	1422.7	1446.4	1456.2
-283	1450.8	1402.3	1380.3	1426.5	1387.9	1421.2	1470.0	1535.4	1590.4	1369.1	1373.4	1386.8	1432.6	1455.3	1467.6
-288	1461.1	1412.9	1391.8	1436.9	1400.8	1432.2	1480.2	1545.4	1600.0	1385.3	1386.5	1397.6	1442.0	1464.6	1478.7
-293	1472.8	1425.3	1404.1	1447.5	1412.6	1442.9	1490.6	1556.1	1610.5	1402.4	1400.7	1409.1	1451.3	1474.4	1489.6
-298	1483.9	1436.8	1415.7	1458.6	1424.0	1453.7	1501.4	1567.5	1621.8	1418.1	1413.9	1420.4	1461.0	1484.8	1500.7

6.3 SITE AMPLIFICATION FROM NRC RIL 12-01

The NRC (2012) conducted analytical site response studies and developed amplification factors from a site with V_{S30}=760 m/s to the DCPP power block foundation level with V_{S30}=1200 m/s. The amplification values are listed in Table 6.3-1.

Table 6.3-1. Site amplification factors for adjusting from V_{S30}=760 m/s to 1200 m/s from analytical modeling of the site response (from Table 5-7 in RIL 12-01, NRC 2012)

Freq (Hz)	Amplification Factor
100	0.814
50	0.819
33.3	0.830
20	0.830
13.3	0.820
10	0.794
6.67	0.752
5.0	0.723
4.0	0.733
3.33	0.748
2.5	0.818
2.0	0.864
1.33	0.931
1.0	0.955
0.67	0.977
0.50	0.986

6.4 ANALYTICAL SITE AMPLIFICATION FROM KAMAI et al (2013)

Kamai et al (2013) provides a suite of amplification factors relative to a reference rock profile with V_{S30}=1170 m/s. For a site with V_{S30}=560 m/s, the amplifications are provided for a range of soil depths (Z_1 values), earthquake magnitudes, and PGA rock ground motion levels. The amplification for M=6, PGA_{rock} = 0.05g, is listed in Table 6.4-1. The Kamai et al (2013) appendix C is given in Suppporting Documents 4.

The method used in Kamai et al (2013) is based on the point source stochastic ground motion model. In this approach, the input motion for a given magnitude is scaled to various rock PGA values by adjusting the distance (increasing the distance leads to smaller ground motions). For a given distance, the incidence angles are computed using simplified ray tracing. At very large distances, the incidence range can be non-vertical. To avoid this case, a rock PGA value of 0.05g was selected to be in the linear site response range but avoid possible non-vertical incidence effects for large distances.

Table 6.4-1. Amplification from V_{S30}=560 m/s to V_{S30}=1170 m/s for a range of Z_1 values from Kamai et al (2013), Appendix C. (given at http://peer.berkeley.edu/ngawest2/final-products/).

Mag	Rock PGA (g)	Freq Index	Freq (Hz)	Z_1=50 ft	Z_1=120 ft	Z_1=250 ft
6	0.05	71	0.5012	1.157586	1.237682	1.265014
6	0.05	83	0.6607	1.425748	1.54607	1.584875
6	0.05	101	1.0000	1.517632	1.706405	1.768158
6	0.05	113	1.3183	1.571667	1.839981	1.888728
6	0.05	131	1.9953	1.425764	1.882012	1.883771
6	0.05	141	2.5119	1.585257	2.136558	1.980783

6.5 VARIANCE FOR SITE TERM

The 2011 Shoreline fault report gives the variance of the site-specific site term (mislabeled as ϕ^2_{S2S} σ_{S2S}, but it is really σ^2_{S2S}). New notation now calls this the ϕ^2_{S2S} term.

Table 6.5-1. Variance of the site term from the 2011 Shoreline Fault Report, (Third column from Table 6-7).

Freq (Hz)	ϕ^2_{S2S}
100	0.080
50	0.079
33.3	0.081
20	0.084
13.3	0.087
10	0.089
6.67	0.090
5.0	0.092
4.0	0.092
3.33	0.093
2.5	0.094
2.0	0.096
1.33	0.099
1.0	0.103
0.67	0.106
0.50	0.109

7. METHOD AND EQUATION SUMMARY:

7.1. METHOD:

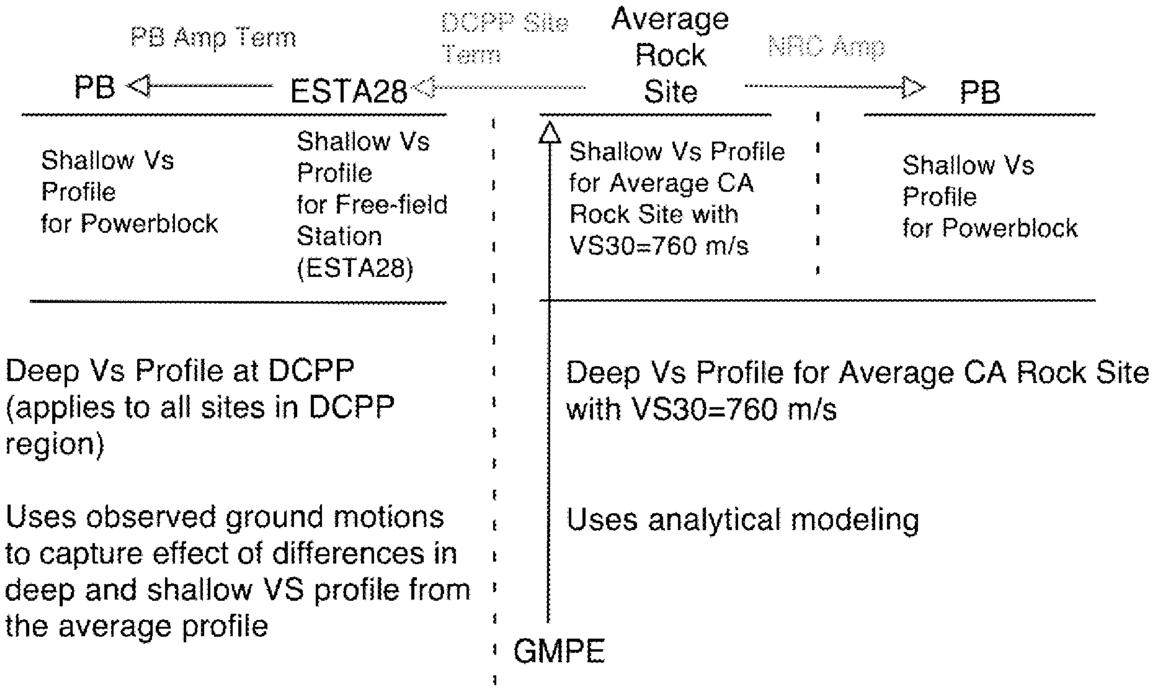
Two amplification factors are computed: (1) a DCPP site-specific site term for the reference free-field station, and (2) an amplification factor to account for the differences in the V_S profiles between the free-field station and the foundation level of the power block and the turbine building.

The concept is that the GMPEs provide an estimate of the ground motion for an average site in California with a given VS30 value. The actual site response at DCPP will depend on the full VS profile at DCPP, which may be different from an average site. The first factor uses recordings at DCPP to compare the DCPP site amplification (at the reference free-field site) with the average site amplification for rock sites in California. Because ground motions recorded at the site are used, this first factor accounts for differences in both the shallow and deep parts of the VS profiles between DCPP and an average rock site in California.

At DCPP, there are also differences in the shallow parts of the VS profiles across the site region. The deep part of the VS profile will affect the entire site region, but the shallow part of the profile will affect a smaller area. The second amplification factor accounts for the difference in the shallow profiles between the reference free-field station and the power block and turbine building foundation levels.

The two factors are combined to give the total adjustment from the average site given by the GMPEs to the power block and turbine building foundation levels.

This approach is shown graphically in Figure 7.1-1. On the right hand side, the traditional approach is shown in which only the differences in the shallow VS profiles are considered using analytical modeling. On the left hand side, the approach of using the recordings at the site to constrain the site-specific effects is shown.



GMPE: The GMPE is used to compute the reference rock ground motion for an average rock site

NRC Amp: Uses analytical modeling to account for differences in the shallow VS profile from average rock site to the shallow profile for the powerblock (PB). In the analytical model, the deep profile at the powerblock is the same as the deep profile for an average rock site.

DCPP Site Term: Uses observed ground motions to accounts for differences in both the deep and shallow profiles at the reference free-field site (ESTA28) and the deep and shallow profiles for an average rock site.

PB Amp Term: Uses analytical modeling to account for differences in the shallow profile at the reference free-field site and the shallow profile at the powerblock. In the analytical model, the deep profile at the powerblock is the same as the deep profile for the free-field site.

Figure 7.1 Approaches to site-specific site amplification

7.1.1 DCPP SITE-SPECIFIC TERMS:

The first term represents the DCPP site-specific effects for the reference free-field station at DCPP (station ESTA28). It is estimated using the approach described in the 2011 Shoreline fault report with the additional step to account for differences in the velocity profiles between the two free-field sites at DCPP. The steps are listed below.

This evaluation differs from the evaluation used in the 2011 Shoreline report in two ways: the 2014 NGA-W2 GMPEs are used in place of the 2008 NGA GMPEs; and the updated 2014 PEER NGA-W2 ground motion data set is used in place of the 2008 NGA data set. The DCPP recordings are now also part of the PEER data set.

Step 1. The 5% damped response spectral values from the 2003 San Simeon and 2004 Parkfield earthquakes given in the NGA-west2 database are compiled (see Input 6.1). As in the 2011 Shoreline report, the selected data are restricted to distance ranges are 0-100 km for San Simeon and 50-150 km for Parkfield to make the event terms applicable to the distances for DCPP from these two events, yet still have enough data to reliably estimate the event term.

Step 2. The residuals of the 5% damped response spectral values for the selected subsets of data are computed with respect to the four NGA GMPEs that are applicable to soil sites (Abrahamson et al, 2014; Boore et al, 2014; Campbell and Bozorgnia, 2014, and Chiou and Youngs, 2014) using eq (7-1). The Idriss (2014) GMPE is not used because it is only applicable to rock sites and most of the data are for soil sites.

Step 3. For each event, the mean residual for each frequency is computed, averaging the residuals for all stations (excluding the DCPP station) and all four GMPEs (eq. 7-2 and 7-3). This mean residual represents the event term optimized for the relevant distance range. The DCPP recordings were not included in the mean event term to avoid the DCPP site effects impacting the event term. This avoids mapping the DCPP site effects into the event term.

Step 4. The residuals are computed for the two DCPP recordings (ESTA27 from San Simeon and ESTA28 from Parkfield) using eq (7-1).

Step 5. There are two free-field sites at DCPP, ESTA27 and ESTA28, which have different site conditions (see Table 6.2-2). The deeper part of the velocity profile at Station ESTA28 is more consistent with deeper parts of the velocity profile for the power block and turbine building than station ESTA27 (see Section 9.3), so station ESTA28 is selected as the reference free-field station; however, only ESTA27 was installed as the time of the San Simeon earthquake. To account for the difference in the velocity profiles for stations ESTA27 and ESTA28, an amplification factor is

applied to the data from ESTA27 based on the V_{S30} scaling in the GMPEs (e.g. the median scaling in the GMPE is used).

The expected difference in the amplification between ESTA27 and ESTA28 is computed using the NGA-W2 GMPEs and the two V_{S30} values. The response spectra are computed for the two V_{S30} values using the four NGA-W2 GMPEs with equal weight (geometric mean weighting) for a magnitude 6 strike-slip earthquake at a distance of 30 km. This distance and magnitude is selected to capture the linear site amplification and be in the center of the data range where the GMPEs are most accurate.

Step 6. The within-event residuals are computed for stations ESTA27 and ESTA28 using eq. (7-4) and (7-5).

Step 7. A smoothed DCPP site term is developed based on the within-event residuals for the two earthquakes. The uncertainty of the DCPP site term is also estimated based on the limited number of recordings available.

7.1.2 SITE-SPECIFIC TERMS FOR DCPP STRUCTURES:

The site amplification from the reference free-field site (ESTA28) to the power block foundation level is estimated using the existing amplification from 760 m/s to 1200 m/s given by the NRC RIL 12-01. This amplification addresses the effect of a change in shallow velocity structure using the assumed profiles shown in Figure 7-2. The velocity profile for free-field station ESTA28 is similar at depth to the NRC profile, but it has a deeper soil (Figure 7-3) which will tend to affect the low frequency amplification. An additional factor is developed to account for this difference in soil depth (Z_1 scaling). The combination of the NRC amplification factor and this additional soil depth factor are used to compute the total amplification factors for the power block and the turbine building foundation levels relative to the reference free-field station ESTA28.

The effect of the differences in the Z_1 for the reference free-field site (ESTA28) and the power block foundation is estimated using the Z_1 scaling from Kamai et al (2013) for shallow sites with V_{S30}=560 m/s. This Z_1 scaling is assumed to apply to V_{S30}=750 m/s ESTA28 (assumption 5.3).

The total amplification factor (in LN units) from ESTA28 to the power block foundation level is given by adding these two terms.

For the turbine building foundation level, the amplification is computed using linear interpolation of the LN(amp) versus LN(V_{S30}) scaling from ESTA28 to the power block (see assumption 5.1).

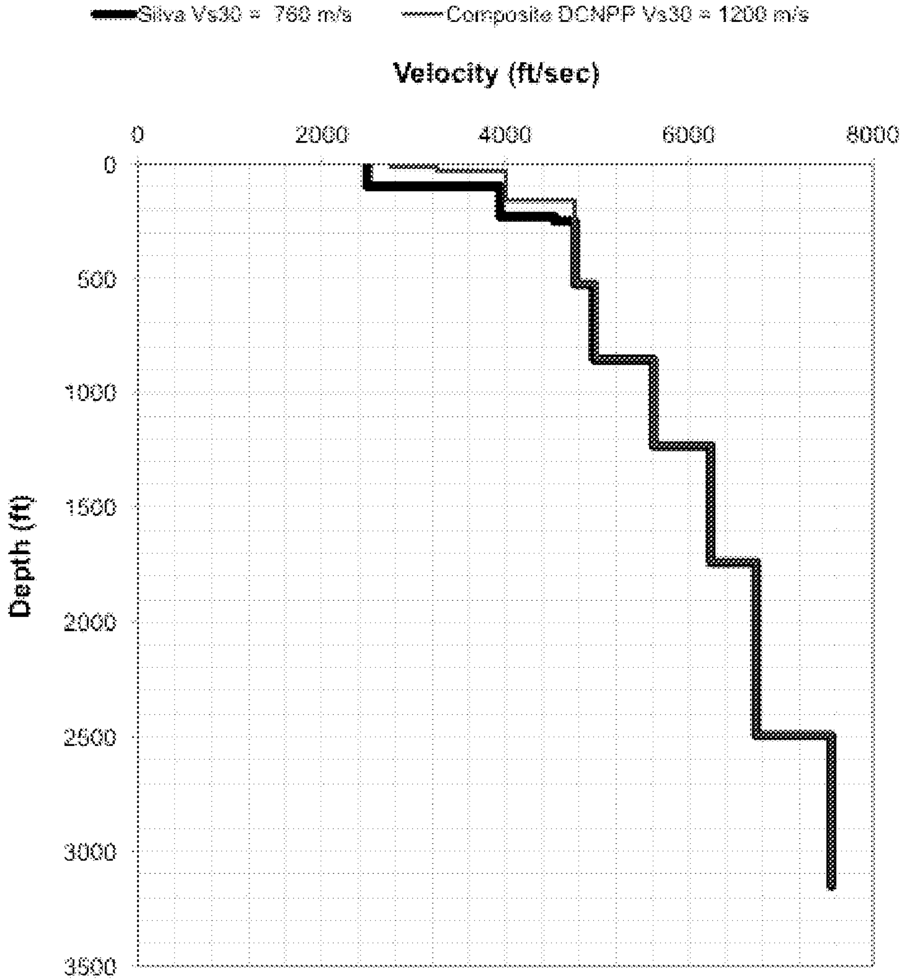


Figure 7-2. Velocity profiles used by the NRC (2012) to estimate the amplification from a difference in the shallow material only. From NRC Figure B-6

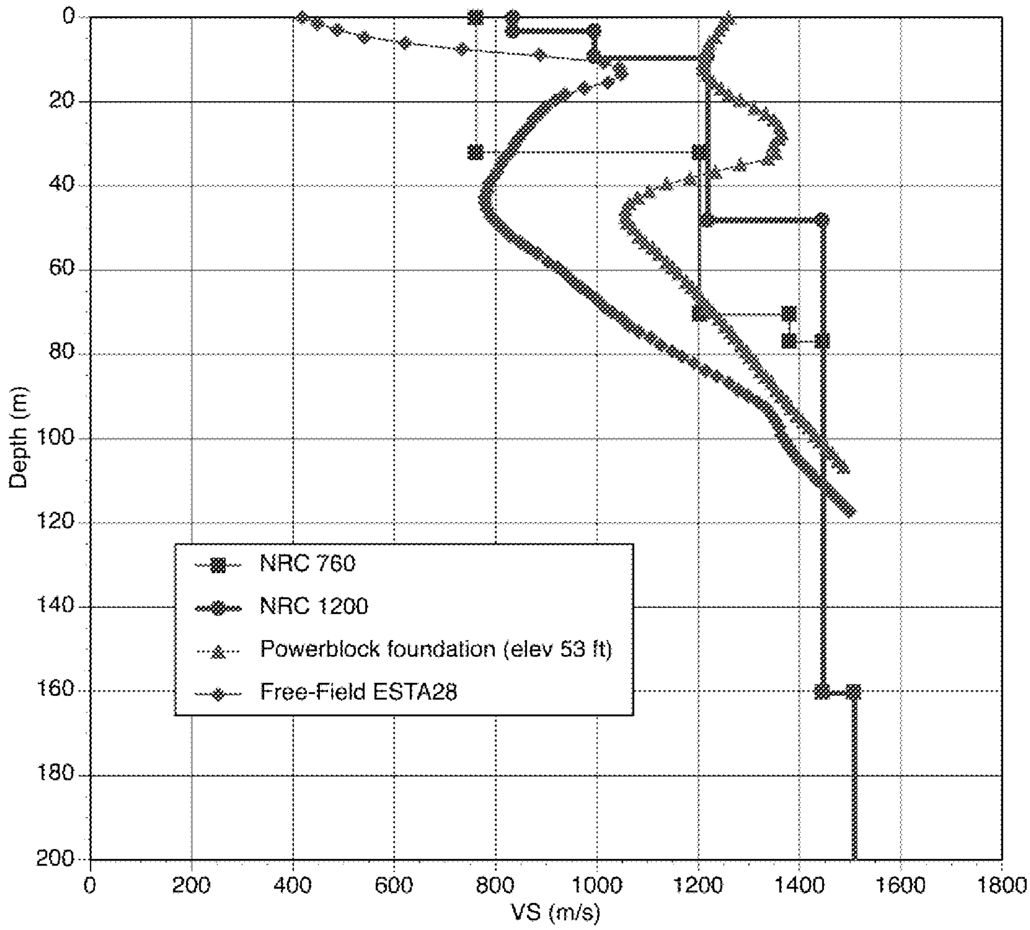


Figure 7-3. Comparison of the velocity profiles used by the NRC to estimate the amplification and the velocity profiles developed in PGEQ-PR-16.

7.2. EQUATIONS:

7.2.1 Calculation of Residuals

The residual is defined as the observed value minus the calculated value. For ground motions, which are modeled as lognormal, the residual is defined as the LN(OBS) - LN(Calc) as shown in eq. (7-1).

$$\begin{aligned}\text{Resid}_{ijk}(EQK_i, M_i, R_{ij}, ..., f) &= \ln\left(PSA(EQK_i, Site_j, f)\right) \\ &\quad - \ln\left(NGA_k(M_i, R_{ij}, ..., f)\right)\end{aligned} \tag{7-1}$$

where i is the index for the earthquake, j is the index for the site, and k is the index for the GMPE.

7.2.2 Event Terms by GMPE

The event terms for the kth GMPE are given by the mean residual over the limited magnitude and distance range, as shown in eq (7-2)

$$EvTerm_k(EQK_i, f) = \frac{1}{N_i}\sum_{i=1}^{N_i}\left[\text{Resid}_{ijk}(EQK_i, M_i, R_{ij}, ..., f)\right] \tag{7-2}$$

where N_i is the number of recordings

7.2.3 Mean Event Terms

The mean event term is the average event term over the GMPEs as shown in eq (7-3)

$$MeanEvTerm(EQK_i, f) = \frac{1}{N_{GMPE}}\sum_{k=1}^{N_{GMPE}} EvTerm_k(EQK_i, f) \tag{7-3}$$

7.2.4 Within-Event Residuals

For station ESTA28, the within-event residual is given by

$$\begin{aligned}\delta W_{ESTA28}(EQK_i, f) &= \text{Resid}_{ESTA28}(EQK_i, f) \\ &\quad - MeanEvTerm(EQK_i, f)\end{aligned} \tag{7-4}$$

For station ESTA27, the within-event residual is also adjusted for the difference in amplification.

$$\begin{aligned}\delta W_{ESTA27}(EQK_i, f) &= \text{Resid}_{ESTA27}(EQK_i, f) \\ &\quad - MeanEvTerm(EQK_i, f) \\ &\quad + \ln\left(amp(ESTA27\ to\ ESTA28)\right)\end{aligned} \tag{7-5}$$

7.2.5 Generic Amplification for V_{S30} Differences

The ln(amplification) for two different V_{S30} values is given by the ratio of the median ground motion from the GMPEs for the two V_{S30} values with the same source parameters:

$$\ln\left(amp(site1\,to\,site2, f)\right) = \ln\left(\frac{NGA_{med}(M, R, VS30_{site2}, f)}{NGA_{med}(M, R, VS30_{site1}, f)}\right) \quad (7\text{-}6)$$

7.2.6 Definition of V_{S30}

The V_{S30} is the total travel time through the top 30 m divided by 30m,as given in eq (7-4)

$$V_{S30} = \frac{1}{30\,m} \sum \frac{H_i}{V_i} \quad (7\text{-}7)$$

where H_i is the thickness of layer i and V_i is the shear-wave velocity in layer i

7.2.7 Linear Interpolation (log - Linear)

Linear interpolation for X and ln(Y) is given by eq (7-8)

$$\ln\left(Y(X)\right) = \frac{\ln(Y_2) - \ln(Y_1)}{(X_2 - X_1)} (X - X_1) + \ln(Y_1) \quad (7\text{-}8)$$

7.2.8 Linear Interpolation (log - log)

Linear interpolation for ln(X) and ln(Y) is given by eq (7-9)

$$\ln\left(Y(X)\right) = \frac{\ln(Y_2) - \ln(Y_1)}{\ln(X_2) - \ln(X_1)} \left(\ln(X) - \ln(X_1)\right) + \ln(Y_1) \quad (7\text{-}9)$$

7.2.9 Convert from meters to ft

The conversion from meters is ft is given by:

$$1m = \frac{100}{2.54 \times 12} ft \quad (7\text{-}10)$$

7.2.10 Standard error of the mean

The standard error of the mean, σ_μ, given a standard deviation, σ , and N observations is given by:

$$\sigma_\mu = \frac{\sigma}{\sqrt{N}} \tag{7-11}$$

7.2.11 5th and 95th Percentiles for the uncertainty of the mean

Based on a normal distribution, the 5th and 95th percentiles are given by:

$$5th Percentile = Mean - 1.64\sigma_\mu$$
$$95th Percentile = Mean + 1.64\sigma_\mu \tag{7-12}$$

8. SOFTWARE:

To evaluate the ground motion based on the NGA-west2 GMPEs, two different programs were used: a FORTRAN program (NGAW2_Resid) developed by N. Abrahamson but using the NGA-W2 subroutine developed by N. Gregor for PEER and a spreadsheet ("NGAW2_GMPE_Spreadsheets_V5.5_060514_Protected.xlsm") developed by PEER. These two programs are verified below in section 8.1.

8.1. QA METHOD

To check the PEER spreadsheet and FORTRAN program, they are compared against each other and also against two other programs (one by R. Youngs and one by N. Gregor). If the results are within 1% of each other, then the programs are considered to accurately compute the median and standard deviation of the 5% damped spectral acceleration as defined by the NGA-W2 GMPEs.

8.2. QA RESULTS

8.2.1 Comparison of the example cases

Two examples are used as test cases to check that the programs are working properly: one for a strike-slip earthquake and one for a dip slip earthquake with the site over the hanging wall. These two cases are listed in Table 8-1. For each case, 16 spectral periods between 0.01 and 2 sec are used.

For case 1, the medians and standard deviations from the four programs are listed in Table 8-2 to 8-6 for ASK14, BSSA14, CB14, CY14, and I14, respectively. The maximum difference between the results from any two of the programs are listed in each table. In all cases, the maximum differences are less than 1%.

For case 2, the medians and standard deviations from the four programs are listed in Table 8-7 to 8-11 for ASK14, BSSA14, CB14, CY14, and I14, respectively. The maximum difference between the results from any two of the programs are listed in each table. In all cases, the maximum differences are less than 1%.

Table 8-1. Test cases

Parameter	Case 1	Case 2
Magnitude	6.8	6.8
Dip	45	90
rake	90	180
down-dip Width (km)	16.87	12
ZTOR (km)	0	0
Hypocentral Depth (km)	8	8
RRup (km)	7.0	0.6
RJB (km)	0	0.6
Rx (km)	9.9	0.6
SiteSrc Angle (deg)	90	90
VS30 (m/s)	760	760
Z1.0 (km) (ASK14 model)	0.048	0.048
Z2.5 (km) (CB14 model)	0.607	0.607
Z1.0 (km) (CY14 model)	0.041	0.041

Table 8.2 ASK14 Median and Sigma for Test case 1.

	Median Spectral Acceleration (g)					Standard Deviation (LN units)			
Period (sec)	Gregor	Youngs	PEER Spreadsheet	Fortran Code	Maximum difference (%)	Gregor	Youngs	PEER Spreadsheet	Maximum difference (%)
0.01	5.40E-01	5.40E-01	5.40E-01	5.40E-01	0.00	0.639	0.639	0.639	0.00
0.02	5.53E-01	5.53E-01	5.53E-01	5.53E-01	0.00	0.639	0.639	0.639	0.00
0.03	5.85E-01	5.85E-01	5.85E-01	5.86E-01	0.17	0.637	0.637	0.637	0.00
0.05	6.56E-01	6.56E-01	6.56E-01	6.56E-01	0.00	0.624	0.624	0.624	0.00
0.075	8.37E-01	8.37E-01	8.37E-01	8.38E-01	0.12	0.623	0.623	0.623	0.00
0.1	1.01E+00	1.01E+00	1.01E+00	1.01E+00	0.00	0.635	0.635	0.635	0.00
0.15	1.28E+00	1.28E+00	1.28E+00	1.28E+00	0.00	0.672	0.672	0.672	0.00
0.2	1.28E+00	1.28E+00	1.28E+00	1.28E+00	0.00	0.676	0.676	0.676	0.00
0.25	1.14E+00	1.14E+00	1.14E+00	1.14E+00	0.00	0.680	0.680	0.680	0.00
0.3	9.89E-01	9.89E-01	9.89E-01	9.90E-01	0.10	0.689	0.689	0.689	0.00
0.4	7.53E-01	7.53E-01	7.53E-01	7.53E-01	0.00	0.697	0.697	0.697	0.00
0.5	6.14E-01	6.14E-01	6.14E-01	6.15E-01	0.16	0.705	0.705	0.705	0.00
0.75	4.06E-01	4.06E-01	4.06E-01	4.06E-01	0.00	0.718	0.718	0.718	0.00
1	2.92E-01	2.92E-01	2.92E-01	2.92E-01	0.00	0.731	0.731	0.731	0.00
1.5	1.70E-01	1.70E-01	1.70E-01	1.70E-01	0.00	0.740	0.740	0.740	0.00
2	1.13E-01	1.13E-01	1.13E-01	1.13E-01	0.00	0.748	0.748	0.748	0.00

Table 8.3 BSSA14 Median and Sigma for Test case 1.

	Median Spectral Acceleration (g)					Standard Deviation (LN units)			
Period (sec)	Gregor	Youngs	PEER Spreadsheet	Fortran Code	Maximum difference (%)	Gregor	Youngs	PEER Spreadsheet	Maximum difference (%)
0.01	4.37E-01	4.37E-01	4.37E-01	4.37E-01	0.00	0.607	0.607	0.607	0.00
0.02	4.44E-01	4.44E-01	4.44E-01	4.44E-01	0.00	0.610	0.610	0.610	0.00
0.03	4.71E-01	4.71E-01	4.71E-01	4.71E-01	0.00	0.630	0.630	0.630	0.00
0.05	5.93E-01	5.93E-01	5.93E-01	5.93E-01	0.00	0.682	0.682	0.682	0.00
0.075	7.72E-01	7.72E-01	7.72E-01	7.72E-01	0.00	0.715	0.715	0.715	0.00
0.1	9.18E-01	9.18E-01	9.18E-01	9.18E-01	0.00	0.709	0.709	0.709	0.00
0.15	1.08E+00	1.08E+00	1.08E+00	1.08E+00	0.00	0.662	0.663	0.663	0.15
0.2	1.06E+00	1.06E+00	1.06E+00	1.06E+00	0.00	0.621	0.621	0.621	0.00
0.25	1.00E+00	1.00E+00	1.00E+00	1.00E+00	0.00	0.609	0.608	0.608	0.16
0.3	9.30E-01	9.30E-01	9.30E-01	9.30E-01	0.00	0.606	0.606	0.606	0.00
0.4	7.80E-01	7.80E-01	7.80E-01	7.80E-01	0.00	0.617	0.617	0.617	0.00
0.5	6.43E-01	6.43E-01	6.43E-01	6.43E-01	0.00	0.639	0.640	0.640	0.16
0.75	4.30E-01	4.30E-01	4.30E-01	4.30E-01	0.00	0.677	0.676	0.676	0.15
1	3.14E-01	3.14E-01	3.14E-01	3.13E-01	0.32	0.693	0.692	0.692	0.14
1.5	1.76E-01	1.76E-01	1.76E-01	1.76E-01	0.00	0.695	0.695	0.695	0.00
2	1.10E-01	1.10E-01	1.10E-01	1.10E-01	0.00	0.700	0.700	0.700	0.00

Table 8.4 CB14 Median and Sigma for Test case 1.

	Median Spectral Acceleration (g)					Standard Deviation (LN units)			
Period (sec)	Gregor	Youngs	PEER Spreadsheet	Fortran Code	Maximum difference (%)	Gregor	Youngs	PEER Spreadsheet	Maximum difference (%)
0.01	7.48E-01	7.48E-01	7.48E-01	7.49E-01	0.13	0.574	0.574	0.574	0.00
0.02	7.93E-01	7.93E-01	7.93E-01	7.94E-01	0.13	0.577	0.577	0.577	0.00
0.03	9.52E-01	9.52E-01	9.52E-01	9.53E-01	0.11	0.586	0.586	0.586	0.00
0.05	1.34E+00	1.34E+00	1.34E+00	1.34E+00	0.00	0.597	0.597	0.597	0.00
0.075	1.58E+00	1.58E+00	1.58E+00	1.58E+00	0.00	0.627	0.627	0.627	0.00
0.1	1.66E+00	1.66E+00	1.66E+00	1.66E+00	0.00	0.642	0.642	0.642	0.00
0.15	1.62E+00	1.62E+00	1.62E+00	1.62E+00	0.00	0.641	0.641	0.641	0.00
0.2	1.57E+00	1.57E+00	1.57E+00	1.57E+00	0.00	0.647	0.647	0.647	0.00
0.25	1.34E+00	1.34E+00	1.34E+00	1.34E+00	0.00	0.630	0.630	0.630	0.00
0.3	1.22E+00	1.22E+00	1.22E+00	1.22E+00	0.00	0.642	0.642	0.642	0.00
0.4	1.06E+00	1.06E+00	1.06E+00	1.06E+00	0.00	0.649	0.649	0.649	0.00
0.5	8.61E-01	8.61E-01	8.61E-01	8.62E-01	0.12	0.665	0.665	0.665	0.00
0.75	6.34E-01	6.34E-01	6.34E-01	6.35E-01	0.16	0.712	0.712	0.712	0.00
1	3.96E-01	3.96E-01	3.96E-01	3.96E-01	0.00	0.720	0.720	0.720	0.00
1.5	2.22E-01	2.22E-01	2.22E-01	2.22E-01	0.00	0.723	0.723	0.723	0.00
2	1.47E-01	1.47E-01	1.47E-01	1.47E-01	0.00	0.711	0.711	0.711	0.00

Table 8.5 CY14 Median and Sigma for Test case 1.

	Median Spectral Acceleration (g)					Standard Deviation (LN units)			
Period (sec)	Gregor	Youngs	PEER Spreadsheet	Fortran Code	Maximum difference (%)	Gregor	Youngs	PEER Spreadsheet	Maximum difference (%)
0.01	5.84E-01	5.84E-01	5.84E-01	5.84E-01	0.00	0.565	0.565	0.565	0.00
0.02	5.94E-01	5.94E-01	5.94E-01	5.94E-01	0.00	0.567	0.567	0.567	0.00
0.03	6.70E-01	6.70E-01	6.70E-01	6.70E-01	0.00	0.580	0.580	0.580	0.00
0.05	9.09E-01	9.09E-01	9.09E-01	9.09E-01	0.00	0.595	0.595	0.595	0.00
0.075	1.21E+00	1.21E+00	1.21E+00	1.21E+00	0.00	0.605	0.605	0.605	0.00
0.1	1.36E+00	1.36E+00	1.36E+00	1.36E+00	0.00	0.614	0.614	0.614	0.00
0.15	1.46E+00	1.46E+00	1.46E+00	1.46E+00	0.00	0.628	0.628	0.628	0.00
0.2	1.39E+00	1.39E+00	1.39E+00	1.39E+00	0.00	0.639	0.639	0.639	0.00
0.25	1.27E+00	1.27E+00	1.27E+00	1.27E+00	0.00	0.648	0.648	0.648	0.00
0.3	1.14E+00	1.14E+00	1.14E+00	1.14E+00	0.00	0.655	0.655	0.655	0.00
0.4	9.31E-01	9.31E-01	9.31E-01	9.31E-01	0.00	0.666	0.666	0.666	0.00
0.5	7.68E-01	7.68E-01	7.68E-01	7.68E-01	0.00	0.674	0.674	0.674	0.00
0.75	4.89E-01	4.89E-01	4.89E-01	4.89E-01	0.00	0.685	0.685	0.685	0.00
1	3.37E-01	3.37E-01	3.37E-01	3.37E-01	0.00	0.690	0.690	0.690	0.00
1.5	1.88E-01	1.87E-01	1.87E-01	1.87E-01	0.53	0.697	0.697	0.697	0.00
2	1.20E-01	1.20E-01	1.20E-01	1.20E-01	0.00	0.696	0.696	0.696	0.00

Table 8.6 I14 Median and Sigma for Test case 1.

	Median Spectral Acceleration (g)					Standard Deviation (LN units)			
Period (sec)	Gregor	Youngs	PEER Spreadsheet	Fortran Code	Maximum difference (%)	Gregor	Youngs	PEER Spreadsheet	Maximum difference (%)
0.01	3.55E-01	3.55E-01	3.55E-01	3.55E-01	0.00	0.667	0.667	0.667	0.00
0.02	3.65E-01	3.65E-01	3.65E-01	3.65E-01	0.00	0.667	0.667	0.667	0.00
0.03	4.01E-01	4.01E-01	4.01E-01	4.01E-01	0.00	0.667	0.667	0.667	0.00
0.05	4.42E-01	4.42E-01	4.42E-01	4.42E-01	0.00	0.667	0.667	0.667	0.00
0.075	5.71E-01	5.71E-01	5.71E-01	5.71E-01	0.00	0.681	0.681	0.681	0.00
0.1	6.63E-01	6.63E-01	6.63E-01	6.63E-01	0.00	0.691	0.691	0.691	0.00
0.15	7.23E-01	7.23E-01	7.23E-01	7.23E-01	0.00	0.706	0.706	0.706	0.00
0.2	7.04E-01	7.04E-01	7.04E-01	7.04E-01	0.00	0.716	0.716	0.716	0.00
0.25	6.39E-01	6.39E-01	6.39E-01	6.39E-01	0.00	0.724	0.723	0.723	0.14
0.3	5.67E-01	5.67E-01	5.67E-01	5.67E-01	0.00	0.730	0.730	0.730	0.00
0.4	4.66E-01	4.66E-01	4.66E-01	4.66E-01	0.00	0.740	0.740	0.740	0.00
0.5	4.00E-01	4.00E-01	4.00E-01	4.00E-01	0.00	0.748	0.748	0.748	0.00
0.75	2.40E-01	2.40E-01	2.40E-01	2.40E-01	0.00	0.762	0.762	0.762	0.00
1	1.76E-01	1.76E-01	1.76E-01	1.76E-01	0.00	0.772	0.772	0.772	0.00
1.5	1.07E-01	1.07E-01	1.07E-01	1.07E-01	0.00	0.786	0.786	0.786	0.00
2	7.45E-02	7.45E-02	7.45E-02	7.45E-02	0.00	0.796	0.796	0.796	0.00

Table 8.7 ASK14 Median and Sigma for Test case 2.

	Median Spectral Acceleration (g)					Standard Deviation (LN units)			
Period (sec)	Gregor	Youngs	PEER Spreadsheet	Fortran Code	Maximum difference (%)	Gregor	Youngs	PEER Spreadsheet	Maximum difference (%)
0.01	4.86E-01	4.86E-01	4.86E-01	4.86E-01	0.00	0.639	0.639	0.639	0.00
0.02	4.98E-01	4.98E-01	4.98E-01	4.98E-01	0.00	0.639	0.639	0.639	0.00
0.03	5.28E-01	5.28E-01	5.28E-01	5.28E-01	0.00	0.637	0.637	0.637	0.00
0.05	5.97E-01	5.97E-01	5.97E-01	5.97E-01	0.00	0.626	0.626	0.626	0.00
0.075	7.68E-01	7.68E-01	7.68E-01	7.68E-01	0.00	0.624	0.624	0.624	0.00
0.1	9.31E-01	9.31E-01	9.31E-01	9.32E-01	0.11	0.636	0.636	0.636	0.00
0.15	1.17E+00	1.17E+00	1.17E+00	1.17E+00	0.00	0.672	0.672	0.672	0.00
0.2	1.16E+00	1.16E+00	1.16E+00	1.16E+00	0.00	0.676	0.676	0.676	0.00
0.25	1.03E+00	1.03E+00	1.03E+00	1.03E+00	0.00	0.680	0.680	0.680	0.00
0.3	8.86E-01	8.86E-01	8.86E-01	8.86E-01	0.00	0.689	0.689	0.689	0.00
0.4	6.79E-01	6.79E-01	6.79E-01	6.79E-01	0.00	0.697	0.697	0.697	0.00
0.5	5.62E-01	5.62E-01	5.62E-01	5.62E-01	0.00	0.705	0.705	0.705	0.00
0.75	3.81E-01	3.81E-01	3.81E-01	3.81E-01	0.00	0.718	0.718	0.718	0.00
1	2.83E-01	2.83E-01	2.83E-01	2.82E-01	0.35	0.731	0.731	0.731	0.00
1.5	1.78E-01	1.78E-01	1.78E-01	1.78E-01	0.00	0.740	0.740	0.740	0.00
2	1.28E-01	1.28E-01	1.28E-01	1.28E-01	0.00	0.748	0.748	0.748	0.00

Table 8.8 BSSA14 Median and Sigma for Test case 2.

	Median Spectral Acceleration (g)					Standard Deviation (LN units)			
Period (sec)	Gregor	Youngs	PEER Spreadsheet	Fortran Code	Maximum difference (%)	Gregor	Youngs	PEER Spreadsheet	Maximum difference (%)
0.01	4.49E-01	4.49E-01	4.49E-01	4.49E-01	0.00	0.607	0.607	0.607	0.00
0.02	4.57E-01	4.56E-01	4.56E-01	4.56E-01	0.22	0.610	0.610	0.610	0.00
0.03	4.93E-01	4.93E-01	4.93E-01	4.93E-01	0.00	0.630	0.630	0.630	0.00
0.05	6.32E-01	6.32E-01	6.32E-01	6.32E-01	0.00	0.682	0.682	0.682	0.00
0.075	8.07E-01	8.07E-01	8.07E-01	8.07E-01	0.00	0.715	0.715	0.715	0.00
0.1	9.31E-01	9.31E-01	9.31E-01	9.31E-01	0.00	0.709	0.709	0.709	0.00
0.15	1.09E+00	1.09E+00	1.09E+00	1.09E+00	0.00	0.662	0.663	0.663	0.15
0.2	1.08E+00	1.08E+00	1.08E+00	1.08E+00	0.00	0.621	0.621	0.621	0.00
0.25	9.91E-01	9.91E-01	9.91E-01	9.91E-01	0.00	0.609	0.608	0.608	0.16
0.3	9.01E-01	9.01E-01	9.01E-01	9.01E-01	0.00	0.606	0.606	0.606	0.00
0.4	7.50E-01	7.50E-01	7.50E-01	7.50E-01	0.00	0.617	0.617	0.617	0.00
0.5	6.26E-01	6.26E-01	6.26E-01	6.26E-01	0.00	0.639	0.640	0.640	0.16
0.75	4.31E-01	4.31E-01	4.31E-01	4.30E-01	0.23	0.677	0.676	0.676	0.15
1	3.15E-01	3.15E-01	3.15E-01	3.14E-01	0.32	0.693	0.692	0.692	0.14
1.5	1.80E-01	1.80E-01	1.80E-01	1.79E-01	0.56	0.695	0.695	0.695	0.00
2	1.16E-01	1.16E-01	1.16E-01	1.15E-01	0.86	0.700	0.700	0.700	0.00

Table 8.9 CB14 Median and Sigma for Test case 2.

	Median Spectral Acceleration (g)					Standard Deviation (LN units)			
Period (sec)	Gregor	Youngs	PEER Spreadsheet	Fortran Code	Maximum difference (%)	Gregor	Youngs	PEER Spreadsheet	Maximum difference (%)
0.01	5.38E-01	5.38E-01	5.38E-01	5.38E-01	0.00	0.576	0.576	0.576	0.00
0.02	5.79E-01	5.79E-01	5.79E-01	5.79E-01	0.00	0.580	0.580	0.580	0.00
0.03	6.95E-01	6.95E-01	6.95E-01	6.95E-01	0.00	0.589	0.589	0.589	0.00
0.05	9.47E-01	9.47E-01	9.47E-01	9.47E-01	0.00	0.603	0.603	0.603	0.00
0.075	1.09E+00	1.09E+00	1.09E+00	1.09E+00	0.00	0.634	0.634	0.634	0.00
0.1	1.09E+00	1.09E+00	1.09E+00	1.09E+00	0.00	0.649	0.649	0.649	0.00
0.15	1.08E+00	1.08E+00	1.08E+00	1.08E+00	0.00	0.645	0.645	0.645	0.00
0.2	9.74E-01	9.74E-01	9.74E-01	9.74E-01	0.00	0.647	0.647	0.647	0.00
0.25	9.02E-01	9.02E-01	9.02E-01	9.02E-01	0.00	0.630	0.630	0.630	0.00
0.3	8.23E-01	8.23E-01	8.23E-01	8.23E-01	0.00	0.642	0.642	0.642	0.00
0.4	7.10E-01	7.10E-01	7.10E-01	7.10E-01	0.00	0.649	0.649	0.649	0.00
0.5	5.90E-01	5.90E-01	5.90E-01	5.90E-01	0.00	0.665	0.665	0.665	0.00
0.75	4.43E-01	4.43E-01	4.43E-01	4.43E-01	0.00	0.712	0.712	0.712	0.00
1	3.37E-01	3.37E-01	3.37E-01	3.37E-01	0.00	0.720	0.720	0.720	0.00
1.5	2.01E-01	2.01E-01	2.01E-01	2.01E-01	0.00	0.723	0.723	0.723	0.00
2	1.37E-01	1.37E-01	1.37E-01	1.37E-01	0.00	0.711	0.711	0.711	0.00

Table 8.10 CY14 Median and Sigma for Test case 2.

	Median Spectral Acceleration (g)					Standard Deviation (LN units)			
Period (sec)	Gregor	Youngs	PEER Spreadsheet	Fortran Code	Maximum difference (%)	Gregor	Youngs	PEER Spreadsheet	Maximum difference (%)
0.01	5.39E-01	5.39E-01	5.39E-01	5.39E-01	0.00	0.565	0.565	0.565	0.00
0.02	5.45E-01	5.45E-01	5.45E-01	5.45E-01	0.00	0.567	0.567	0.567	0.00
0.03	6.07E-01	6.07E-01	6.07E-01	6.07E-01	0.00	0.580	0.580	0.580	0.00
0.05	8.07E-01	8.07E-01	8.07E-01	8.07E-01	0.00	0.595	0.595	0.595	0.00
0.075	1.06E+00	1.06E+00	1.06E+00	1.06E+00	0.00	0.606	0.605	0.605	0.17
0.1	1.20E+00	1.20E+00	1.20E+00	1.20E+00	0.00	0.614	0.614	0.614	0.00
0.15	1.32E+00	1.32E+00	1.32E+00	1.32E+00	0.00	0.628	0.628	0.628	0.00
0.2	1.30E+00	1.30E+00	1.30E+00	1.30E+00	0.00	0.639	0.639	0.639	0.00
0.25	1.22E+00	1.22E+00	1.22E+00	1.22E+00	0.00	0.648	0.648	0.648	0.00
0.3	1.13E+00	1.13E+00	1.13E+00	1.13E+00	0.00	0.655	0.655	0.655	0.00
0.4	9.64E-01	9.64E-01	9.64E-01	9.64E-01	0.00	0.666	0.666	0.666	0.00
0.5	8.32E-01	8.32E-01	8.32E-01	8.32E-01	0.00	0.674	0.674	0.674	0.00
0.75	5.82E-01	5.82E-01	5.82E-01	5.82E-01	0.00	0.685	0.685	0.685	0.00
1	4.19E-01	4.19E-01	4.19E-01	4.19E-01	0.00	0.690	0.690	0.690	0.00
1.5	2.50E-01	2.50E-01	2.50E-01	2.50E-01	0.00	0.697	0.697	0.697	0.00
2	1.72E-01	1.72E-01	1.72E-01	1.72E-01	0.00	0.696	0.696	0.696	0.00

Table 8.11 I14 Median and Sigma for Test case 2.

	Median Spectral Acceleration (g)					Standard Deviation (LN units)			
Period (sec)	Gregor	Youngs	PEER Spreadsheet	Fortran Code	Maximum difference (%)	Gregor	Youngs	PEER Spreadsheet	Maximum difference (%)
0.01	6.58E-01	6.58E-01	6.58E-01	6.58E-01	0.00	0.667	0.667	0.667	0.00
0.02	6.76E-01	6.76E-01	6.76E-01	6.76E-01	0.00	0.667	0.667	0.667	0.00
0.03	7.42E-01	7.42E-01	7.42E-01	7.42E-01	0.00	0.667	0.667	0.667	0.00
0.05	7.57E-01	7.57E-01	7.57E-01	7.57E-01	0.00	0.667	0.667	0.667	0.00
0.075	9.77E-01	9.77E-01	9.77E-01	9.77E-01	0.00	0.681	0.681	0.681	0.00
0.1	1.17E+00	1.17E+00	1.17E+00	1.17E+00	0.00	0.691	0.691	0.691	0.00
0.15	1.25E+00	1.25E+00	1.25E+00	1.25E+00	0.00	0.706	0.706	0.706	0.00
0.2	1.25E+00	1.25E+00	1.25E+00	1.25E+00	0.00	0.716	0.716	0.716	0.00
0.25	1.13E+00	1.13E+00	1.13E+00	1.13E+00	0.00	0.724	0.723	0.723	0.14
0.3	9.82E-01	9.82E-01	9.82E-01	9.82E-01	0.00	0.730	0.730	0.730	0.00
0.4	7.94E-01	7.94E-01	7.94E-01	7.94E-01	0.00	0.740	0.740	0.740	0.00
0.5	6.82E-01	6.82E-01	6.82E-01	6.82E-01	0.00	0.748	0.748	0.748	0.00
0.75	3.85E-01	3.85E-01	3.85E-01	3.85E-01	0.00	0.762	0.762	0.762	0.00
1	2.85E-01	2.85E-01	2.85E-01	2.85E-01	0.00	0.772	0.772	0.772	0.00
1.5	1.71E-01	1.71E-01	1.71E-01	1.71E-01	0.00	0.786	0.786	0.786	0.00
2	1.21E-01	1.21E-01	1.21E-01	1.21E-01	0.00	0.796	0.796	0.796	0.00

9. BODY OF CALCULATION:

9.1 COMPUTE VS30 FOR THE TWO FREE-FIELD STATIONS

Using the V_S profiles from input Table 6.2-2, the V_{S30} is computed using eq (7-5). The travel times computed through each 5 ft thick layer (H/Vs in eq 7-5) are listed in Table 9.1-1. The travel times for each layer in the top 30 m are summed and listed in the bottom of Table 9.1-1. For the last row, only 2/3 of the travel time is included so that the total thickness is 30 m (98.4 ft). Using eq 7-5, the V_{S30} values are computed and are listed in the last row of Table 9.1-1.

For ESTA28, the V_{S30} at station A100 (753 m/s) is used. For ETSA27, the average of the V_{S30} values at stations A1200 and B1200 (570 m/s) is used.

Table 9.1-1. Estimation of V_{S30} for stations A100 (near ESTA28) and stations A1200 & B1200 (near ESTA27)

	Station A100		Station A1200		Station B1200	
Elevation (ft)	A100 VS (ft/sec)	travel time (sec)	A1200 VS (ft/sec)	travel time (sec)	B1200 VS (ft/sec)	travel time (sec)
87.00	1374.71	0.003637	917.54	0.005449	890.00	0.005618
82.00	1478.35	0.003382	1006.00	0.004970	975.07	0.005128
77.00	1606.92	0.003112	1114.04	0.004488	1081.90	0.004621
72.00	1782.15	0.002806	1248.88	0.004004	1217.50	0.004107
67.00	2041.52	0.002449	1420.38	0.003520	1392.99	0.003589
62.00	2407.06	0.002077	1647.07	0.003036	1625.81	0.003075
57.00	2908.99	0.001719	1959.03	0.002552	1946.44	0.002569
52.00	3325.54	0.001504	2211.53	0.002261	2211.24	0.002261
47.00	3426.20	0.001459	2260.87	0.002212	2278.97	0.002194
42.00	3441.27	0.001453	2313.96	0.002161	2354.74	0.002123
37.00	3350.90	0.001492	2372.88	0.002107	2435.79	0.002053
32.00	3208.75	0.001558	2437.00	0.002052	2521.70	0.001983
27.00	3083.57	0.001621	2500.27	0.002000	2611.73	0.001914
22.00	3010.24	0.001661	2562.42	0.001951	2705.77	0.001848
17.00	2957.10	0.001691	2624.20	0.001905	2802.74	0.001784
12.00	2914.81	0.001715	2687.45	0.001860	2903.22	0.001722
7.00	2878.22	0.001737	2756.39	0.001814	3008.55	0.001662
2.00	2842.67	0.001759	2836.35	0.001763	3118.25	0.001603
-3.00	2806.01	0.001782	2916.86	0.001714	3232.73	0.001547
-8.00	2774.64	0.001201*	3003.28	0.001115*	3355.83	0.000998*
	sum travel time:	0.039815 sec	sum travel time:	0.052934 sec	sum travel time:	0.052399 sec
	VS30	753 m/s	VS30	567 m/s		573 m/s

* Includes 2/3 of the travel time through the 5 ft thick cell to give a total depth of 30 m.

9.2 DCPP SITE-SPECIFIC AMPLIFICATION FOR REFERENCE FREE-FIELD

9.2.1 Step 1: compile ground motion data from PEER NGA-W2

The metadata and ground motion data for the 2003 San Simeon earthquake for rupture distances of 0-100 km are given in Tables 6.1-1, 6.1-2 and 6.1-3. The metadata and ground motion data for the 2004 Parkfield earthquake for rupture distances of 50-150 km are given in Tables 6.1-1, 6.1-4 and 6.1-5.

9.2.2 Step 2: Compute residuals

Using the metadata listed in Tables 6.1-1, and 6.1-2 for the 8 recordings of the 2003 San Simeon earthquake, the median ground motion is computed for each of the sites with the four NGA-W2 models using the PEER spreadsheet. The computed median ground motions, and the observed ground motions are given in spreadsheet "all_resid_sanSim_park.xls" given in Suppporting Documents 2. The residuals are computed using eq 7-1 and are listed in the last column in file "all_resid_sanSim_park.xls".

9.2.3 Step 3: Compute mean residuals

The mean residual for the San Simeon ground motions for each GMPE are computed using eq. 7-2 and are listed in Table 9.2-1. The mean of the San Simeon residuals from the four NGA-W2 models is computed using eq. (7-3) and is listed in the last column of Table 9.2-1.

Similarly, The mean residual for the Parkfield ground motions for each GMPE are computed using eq. 7-2 and are listed in Table 9.2-2. The mean of the Parkfield residuals from the four NGA-W2 models is computed using eq. (7-3) and is listed in the last column of Table 9.2-2.

9.2.4 Step 4: Compute residuals for DCPP free-field stations

The residuals for the DCPP free-field stations are computed using eq. 7-1 with the metadata from Tables 6.1-1, 6.1-2, and 6.1-4 with the ground motion data from station ESTA27 in Table 6.1-3 and ground motion data from station ESTA28 in Table 6.1-5. The results are in Table 9.2-3 and 9.2-4.

9.2.5 Step 5: Compute site factor between two free-field sites

To account for the difference in the velocity profiles for stations ESTA27 and ESTA28, an amplification factor from the VS30 for ESTA27 to the VS30 for ESTA28 based on the V_{S30} scaling in the GMPEs (e.g. the median scaling in the GMPE is used).

Using the NGA-W2 spreadsheet with the following parameters:

M=6.0

Rrup = 30 km

Rx = 30 km
Rjb = 30 km
Mech = SS
Dip = 90
HypoDepth = 8 km
Z1 = DEFAULT
Z2.5 = DEFAULT
ZTOR = 0 km
Rupture Width = 12 km

The median spectral values are computed for two VS30 values: 570 m/s and 753 m/s. The spectral values are listed in Table 9.2-5. The amplification factor, in natural log units, is given by the natural log of the ratio of these two median values. This amplification is shown in the last column of Table 9.2-5. The amplification is computed using eq 7-6.

9.2.6 Step 6. Compute the within-event residuals for DCPP stations

The within event residuals for station ESTA27 are computed using eq. (7-5) which is listed below as eq (9.2-1). The $\mathrm{Resid}_{ESTA27}(EQK_i,f)$ term is from Table 9.2-3, the $MeanEvTerm(EQK_i,f)$ term is from Table 9.2-1, and the $\ln(amp(ESTA27\,to\,ESTA28))$ terms is given in Table 9.2-5. The resulting within-event residuals are given in the last column of Table 9.2-6.

$$\begin{aligned}\delta W_{ESTA27}(EQK_i,f) = {} & \mathrm{Resid}_{ESTA27}(EQK_i,f) \\ & - MeanEvTerm(EQK_i,f) \\ & + \ln(amp(ESTA27\,to\,ESTA28))\end{aligned} \tag{9.2-1}$$

The within event residuals for station ESTA27 are computed using eq. (7-4). which is listed below as eq (9.2-2). The $\mathrm{Resid}_{ESTA28}(EQK_i,f)$ term is from Table 9.2-4; and the $MeanEvTerm(EQK_i,f)$ term is from Table 9.2-2,. The resulting within-event residuals are given in the last column of Table 9.2-7.

$$\begin{aligned}\delta W_{ESTA28}(EQK_i,f) = {} & \mathrm{Resid}_{ESTA28}(EQK_i,f) \\ & - MeanEvTerm(EQK_i,f)\end{aligned} \tag{9.2-2}$$

9.2.7 Step 7. Develop Smoothed DCPP Site term
The within-event residuals for the San Simeon and Parkfield earthquakes (From Tables 9.2-6 and 9.2-7) are plotted in Figure 9.2-2. The average of the two residuals is given by the green line. The within-event residuals from the two earthquakes are similar at the

high frequencies, indicating that this is a systematic site term. In contrast, at low frequencies (< 1 Hz), there is a wider range between the residuals for the two events indicating that path effect differences are being seen in addition to the site term. This is consistent with the observation that the low frequency ground motion from the San Simeon earthquake is controlled by late arriving surface waves.

A smoothed site term is developed by visually smoothing the average site term shown in Figure 9.2-2. The smoothing follows the average residual at the high frequencies, but as the mean is not well constrained at low frequencies and it is close to zero, an average site term value of zero is used at frequencies <= 1 Hz, reflecting that the site term is not as well resolved due to apparent path effects.

The uncertainty of the DCPP site term is estimated based on the standard error of the mean using eq. (7-11). In eq. (7-11), the standard deviation, σ, given by the standard deviation of the site terms (ϕ_{S2S} in Table 6.5-1). There are two recordings (one from San Simeon and one from Parkfield) so N=2.

$$\sigma_\mu = \frac{\sigma}{\sqrt{N}} = \frac{\phi_{S2S}}{\sqrt{2}}$$

These values are listed in the second column of Table 9.2.8.

The 5 and 95% confidence range is computed by adding and subtracting 1.64 times the standard error to the median factor as shown in eq. (7-12).

$$5thPercentile = MeanSiteTerm - 1.64\sigma_\mu$$
$$95thPercentile = MeanSiteTerm + 1.64\sigma_\mu$$

These values are listed in the last two columns of Table 9.2.8.

Table 9.2-1 Mean residuals (in LN units) for each GMPE for San Simeon for the 8 sites listed in Table 6.1-2. The mean over all four GMPEs is given in the last column.

San Simeon					
Frequency (Hz)	ASK14	CY14	CB14	BSSA14	Mean Event Term
100.0	-0.1972	-0.2381	-0.2849	-0.2999	-0.2550
50.0	-0.1996	-0.2328	-0.2833	-0.2670	-0.2457
33.3	-0.2024	-0.2719	-0.3263	-0.2526	-0.2633
20.0	-0.2246	-0.3634	-0.4274	-0.2678	-0.3208
13.3	-0.2135	-0.3701	-0.4047	-0.2816	-0.3175
10.0	-0.0827	-0.1976	-0.2239	-0.1781	-0.1706
6.67	-0.1195	-0.1023	-0.1289	-0.1938	-0.1361
5.0	-0.2286	-0.1515	-0.1497	-0.2701	-0.2000
4.0	-0.3142	-0.2392	-0.2643	-0.3623	-0.2950
3.33	-0.3680	-0.3309	-0.3779	-0.4688	-0.3864
2.5	-0.2063	-0.2226	-0.3134	-0.3405	-0.2707
2.0	-0.2034	-0.2561	-0.3389	-0.3431	-0.2854
1.33	0.0254	-0.1095	-0.1996	-0.1487	-0.1081
1.0	0.1801	0.0205	-0.0910	-0.0142	0.0239
0.67	0.2501	0.1325	0.0065	0.1685	0.1394
0.5	0.2855	0.1619	0.0071	0.2698	0.1811

Table 9.2-2 Mean residuals (in LN units) for each GMPE for Parkfield for 16 sites listed in Table 6.1-4. The mean over all four GMPEs is given in the last column.

Parkfield					
Frequency (Hz)	ASK14	CY14	CB14	BSSA14	Mean Event Term
100.0	-0.2664	-0.3244	-0.4063	-0.7307	-0.4320
50.0	-0.2746	-0.3201	-0.3970	-0.6940	-0.4214
33.3	-0.3030	-0.3370	-0.4153	-0.6874	-0.4357
20.0	-0.3425	-0.3842	-0.4513	-0.6759	-0.4635
13.3	-0.4221	-0.4725	-0.5596	-0.7888	-0.5608
10.0	-0.3749	-0.3914	-0.5496	-0.8114	-0.5318
6.67	-0.4467	-0.3552	-0.5705	-0.9585	-0.5827
5.0	-0.4749	-0.3831	-0.5766	-1.0281	-0.6157
4.0	-0.4750	-0.4179	-0.6491	-0.9899	-0.6330
3.33	-0.4288	-0.4258	-0.7002	-0.8902	-0.6113
2.5	-0.3742	-0.3849	-0.5982	-0.7285	-0.5215
2.0	-0.2973	-0.3299	-0.4960	-0.6160	-0.4348
1.33	0.0002	-0.1659	-0.3313	-0.3735	-0.2176
1.0	0.1917	-0.0396	-0.1480	-0.2135	-0.0524
0.67	0.2164	0.0241	-0.0198	-0.0401	0.0452
0.5	0.2083	0.0222	0.0502	0.0073	0.0720

Table 9.2-3 DCPP Residuals for each GMPE from the 2003 San Simeon earthquake Parkfield for free-field station ESTA27 using the metadata listed in Tables 6.1-2 and 6.1-4. The mean residual averaged over the four GMPEs is shown in the last column.

	San Simeon, station ESTA27				
Frequency (Hz)	ASK14	CY14	CB14	BSSA14	Mean residual
100.0	-0.4414	-0.4086	-0.6455	-0.4925	-0.4970
50.0	-0.4576	-0.4180	-0.6614	-0.4830	-0.5050
33.3	-0.4993	-0.5221	-0.7799	-0.5099	-0.5778
20.0	-0.6014	-0.7453	-1.0017	-0.6412	-0.7474
13.3	-0.5629	-0.7031	-0.9064	-0.6238	-0.6991
10.0	-0.4585	-0.5490	-0.7133	-0.5579	-0.5697
6.67	-0.3672	-0.3845	-0.5333	-0.5191	-0.4510
5.0	-0.2193	-0.1930	-0.3191	-0.3705	-0.2755
4.0	-0.1092	-0.0881	-0.2231	-0.2930	-0.1784
3.33	-0.1808	-0.1956	-0.3478	-0.4201	-0.2861
2.5	0.0755	0.0449	-0.1602	-0.1792	-0.0548
2.0	-0.0133	-0.0374	-0.2353	-0.2319	-0.1295
1.33	0.5344	0.4844	0.2873	0.3295	0.4089
1.0	0.7006	0.6597	0.4614	0.5143	0.5840
0.67	0.3228	0.3055	0.0982	0.2244	0.2377
0.5	1.1487	1.1597	0.9274	1.1560	1.0980

Table 9.2-4 DCPP Residuals from the 2004 Parkfield earthquake for free-field station ESTA28 using the meta data listed in Table 6.1-3 and 6.1-5. The mean residual averaged over the four GMPEs is shown in the last column.

	Parkfield, Station ESTA28				
Frequency (Hz)	ASK14	CY14	CB14	BSSA14	Mean residual
100.0	-0.5695	-0.5392	-0.8840	-0.9182	-0.7277
50.0	-0.5792	-0.5456	-0.8911	-0.9075	-0.7309
33.3	-0.5846	-0.6036	-0.9634	-0.9114	-0.7658
20.0	-0.7391	-0.8538	-1.1968	-1.0951	-0.9712
13.3	-0.8643	-0.9653	-1.3055	-1.2570	-1.0980
10.0	-1.0213	-1.0792	-1.4449	-1.4847	-1.2575
6.67	-0.8039	-0.8198	-1.2055	-1.4043	-1.0584
5.0	-1.0052	-0.9938	-1.3463	-1.6291	-1.2436
4.0	-0.8186	-0.8101	-1.1879	-1.3914	-1.0520
3.33	-0.6484	-0.6779	-1.0961	-1.1550	-0.8944
2.5	-0.0227	-0.0464	-0.4211	-0.4282	-0.2296
2.0	0.2284	0.2072	-0.1151	-0.1260	0.0486
1.33	0.1937	0.0914	-0.2244	-0.1809	-0.0301
1.0	-0.0723	-0.1941	-0.4361	-0.4301	-0.2832
0.67	-0.1358	-0.2268	-0.4046	-0.3760	-0.2858
0.5	-0.0366	-0.0692	-0.2000	-0.1719	-0.1194

Table 9.2-5 Amplification factor from ESTA27 (570 m/s) to ESTA28 (753 m/s)

Frequency (Hz)	Median spectral acceleration (g) V_{S30}=753 m/s	Median spectral acceleration (g) V_{S30}=570m/s	Amplification factor from V_{S30}=570 m/s to V_{S30}=753 m/s (natural log units)
100.0	0.0538	0.0608	-0.1217
50.0	0.0547	0.0615	-0.1168
33.3	0.0600	0.0663	-0.1004
20.0	0.0756	0.0818	-0.0779
13.3	0.0971	0.1050	-0.0779
10.0	0.1121	0.1237	-0.0983
6.67	0.1268	0.1455	-0.1379
5.0	0.1240	0.1477	-0.1751
4.0	0.1111	0.1364	-0.2056
3.33	0.0972	0.1220	-0.2268
2.5	0.0765	0.0980	-0.2470
2.0	0.0622	0.0809	-0.2623
1.33	0.0396	0.0521	-0.2758
1.0	0.0271	0.0361	-0.2878
0.67	0.0150	0.0201	-0.2961
0.5	0.0097	0.0129	-0.2930

Table 9.2-6 DCPP event-corrected Residuals for San Simeon

Frequency (Hz)	Total Residual for ESTA27 (LN units) From Table 9.2-3	Mean Event Term for San Simeon (LN units) From Table 9.2-1	Amplification factor from V_{S30}=570 m/s to V_{S30}=753 m/s (LN units) From Table 9.2-5	Event-term corrected residuals adjusted to 753 m/s
100.0	-0.4970	-0.2550	-0.1217	-0.3637
50.0	-0.5050	-0.2457	-0.1168	-0.3761
33.3	-0.5778	-0.2633	-0.1004	-0.4149
20.0	-0.7474	-0.3208	-0.0779	-0.5045
13.3	-0.6991	-0.3175	-0.0779	-0.4595
10.0	-0.5697	-0.1706	-0.0983	-0.4974
6.67	-0.4510	-0.1361	-0.1379	-0.4528
5.0	-0.2755	-0.2000	-0.1751	-0.2506
4.0	-0.1784	-0.2950	-0.2056	-0.0890
3.33	-0.2861	-0.3864	-0.2268	-0.1265
2.5	-0.0548	-0.2707	-0.2470	-0.0311
2.0	-0.1295	-0.2854	-0.2623	-0.1064
1.33	0.4089	-0.1081	-0.2758	0.2412
1.0	0.5840	0.0239	-0.2878	0.2723
0.67	0.2377	0.1394	-0.2961	-0.1978
0.5	1.0980	0.1811	-0.2930	0.6239

Table 9.2-7 DCPP Event-corrected Residuals for Parkfield

Frequency (Hz)	Total Residual for Parkfield ESTA28 From Table 9.2-4	Mean Event Term for Parkfield (LN units) From Table 9.2-2	Event-term corrected residuals (LN units)
100.0	-0.7277	-0.4320	-0.2957
50.0	-0.7309	-0.4214	-0.3095
33.3	-0.7658	-0.4357	-0.3301
20.0	-0.9712	-0.4635	-0.5077
13.3	-1.0980	-0.5608	-0.5372
10.0	-1.2575	-0.5318	-0.7257
6.67	-1.0584	-0.5827	-0.4757
5.0	-1.2436	-0.6157	-0.6279
4.0	-1.0520	-0.6330	-0.4190
3.33	-0.8944	-0.6113	-0.2831
2.5	-0.2296	-0.5215	0.2919
2.0	0.0486	-0.4348	0.4834
1.33	-0.0301	-0.2176	0.1875
1.0	-0.2832	-0.0524	-0.2308
0.67	-0.2858	0.0452	-0.3310
0.5	-0.1194	0.0720	-0.1914

Table 9.2-8. Smoothed DCPP site-specific site amplification terms

	DCPP Site Term for reference free-field station ESTA28 (LN units)			
Freq (Hz)	Standard deviation of DCPP site term	Smoothed Median Site Term	Upper Range	Lower Range
100	0.200	-0.300	0.028	-0.628
50	0.199	-0.320	0.006	-0.646
34	0.201	-0.360	-0.030	-0.690
20	0.205	-0.520	-0.184	-0.856
13.5	0.209	-0.520	-0.178	-0.862
10	0.211	-0.520	-0.174	-0.866
6.7	0.212	-0.500	-0.152	-0.848
5	0.214	-0.380	-0.028	-0.732
4	0.214	-0.240	0.112	-0.592
3.3	0.216	-0.130	0.224	-0.484
2.5	0.217	0.190	0.546	-0.166
2.0	0.219	0.190	0.549	-0.169
1.3	0.222	0.190	0.555	-0.175
1.0	0.227	0.000	0.372	-0.372
0.67	0.230	0.000	0.378	-0.378
0.5	0.233	0.000	0.383	-0.383

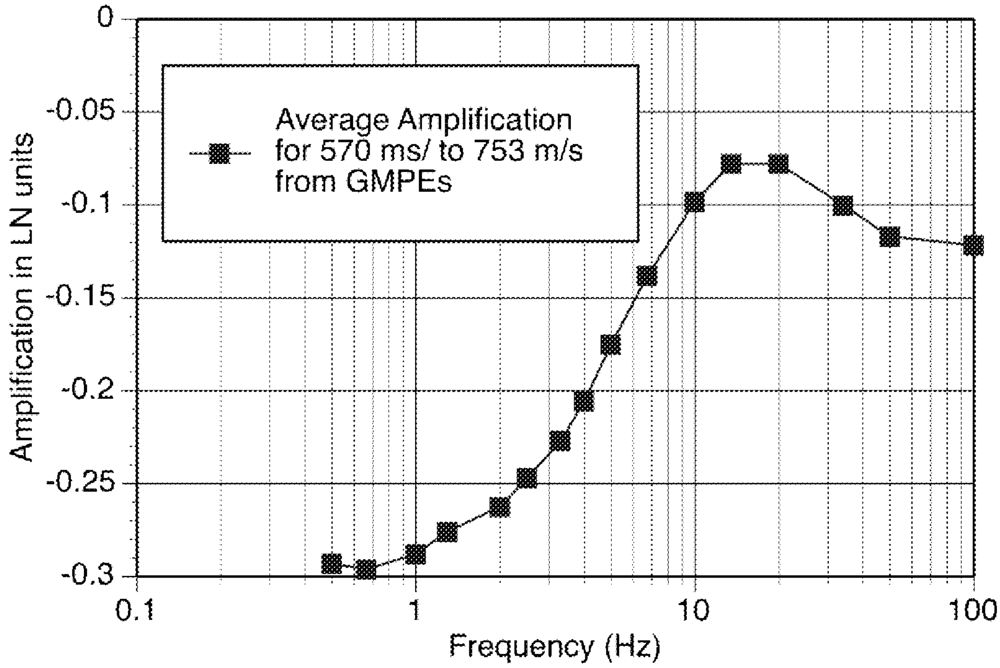


Figure 9.2-1. Factor to correct for the differences in the V_{S30} values at ESTA27 and ESTA28 based on the V_{S30} scaling in the NGA-west2 GMPEs.

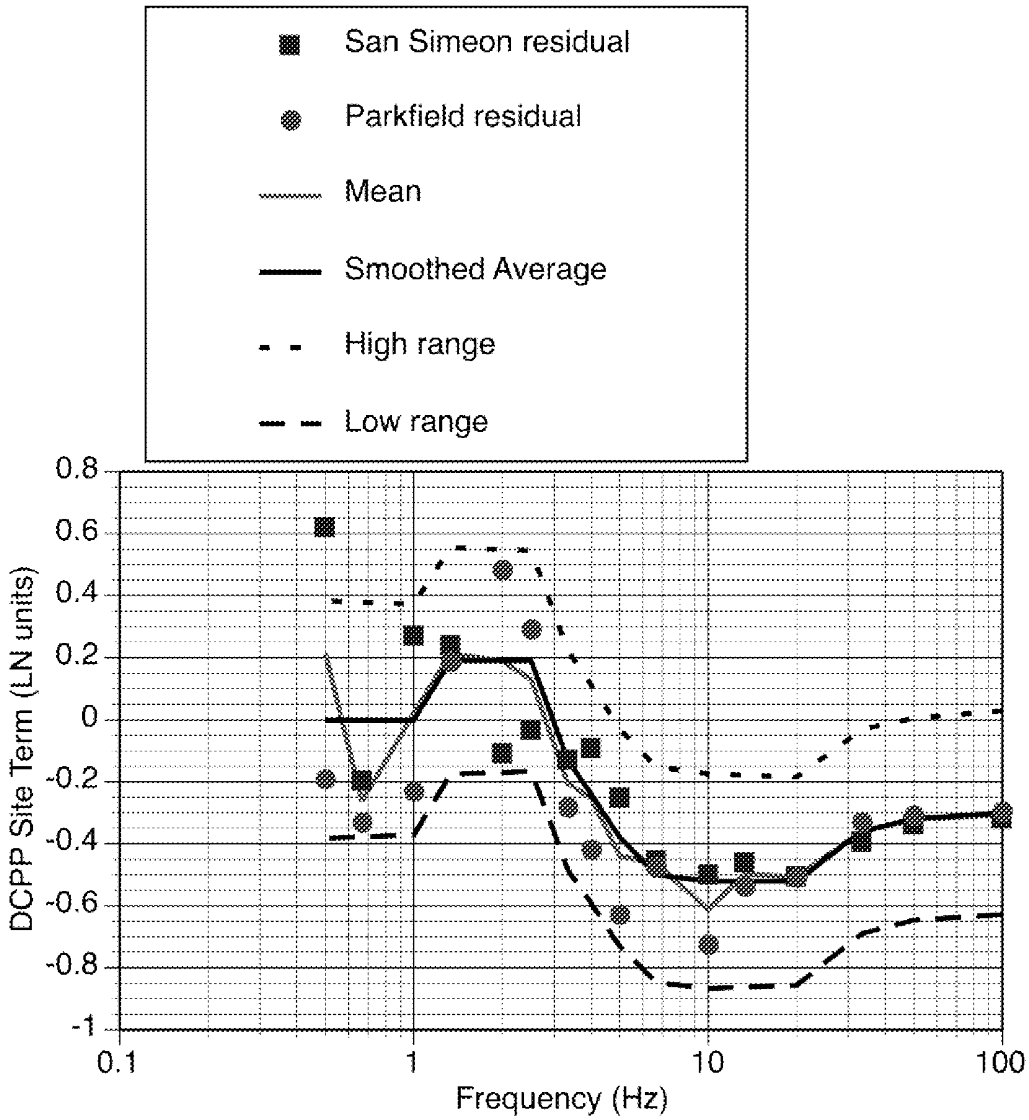


Figure 9.2-2. Smoothed event-specific residuals for DCPP relative to the ESTA28 reference rock site condition with V_{S30}=753 m/s. The epistemic uncertainty (5 and 95 percent confidence levels) are shown by the dashed lines.

9.3 AMPLIFICATION FACTORS FROM REFERENCE FREE-FIELD TO STRUCTURE FOUNDATION LEVELS

9.3.1 VS PROFILE for POWER BLOCK and TURBINE BUILDING

The power block foundation is at elevation 53 ft and the turbine building foundation is at elevation 61 ft (Table 6.2-1). These elevations are rounded to 52 ft and 62 ft to match the depth grids of the velocity profiles given in Tables 6.2-3 and 6.2-4.

The 11 velocity profiles under the power block (listed in Table 6.2-3) were averaged (averaging the velocities at a given elevation). The depth from the power block foundation level is computed by subtracting 52 ft from each elevation in Table 6.2-3. The resulting depth dependence of the average V_S profile under the power block is given in the second column of Table 9.3-1.

The 15 velocity profiles under the turbine building (listed in Table 6.2-4) were averaged (averaging the velocities at a given elevation). The depth from the turbine building foundation level is computed by subtracting 62 ft from each elevation in Table 6.2-4. The resulting depth dependence of the average VS profile under the turbine building is given in the last column of Table 9.3-1.

The average V_S profile for the power block and the turbine building, as a function of depth from the surface, are shown in Figure 9.3-1. This figure also shows the VS profiles closest to free-field station ESTA27 (profile A1200 from Table 6.2-1) and to free-field station ESTA28 (profile A100 from Table 6.2-1).

9.3.2 AMPLIFICATION FOR POWER BLOCK

The amplification from V_{S30}=760 to V_{S30}=1200 m/s developed by the NRC RIL 12-01 was developed for the profiles shown in Figure 9.3-2. This figures shows that the Z_1 value for the 760 profile is 32 m. In contrast, the Z_1 value for station ESTA28 is 68 m (see Figure 9.3-2). Therefore, the amplification developed in RIL 12-01 is for a Z_1 of 32 m, but the application is for a Z_1 of 68 m. To correct for this difference in Z_1 values, a simplified approach is used based on the Z_1 scaling in existing site amplification calculations by Kamai et al (2013).

The Kamai et al (2013) amplifications for Z_1 values of 50 ft, 120 ft, and 250 ft are given in Table 6.3-2.

First, the Kamai et al (2013) amplifications are converted to ln units in Table 9.3-2.

Second, the Kamai et al (2013) amplifications are interpolated to values of 105 ft (32 m) and 223 ft (68) using log-linear interpolation (ln amplification and Z_1) given by eq 7-8. The interpolated values are listed in Table 9.3-2.

Third, the difference in the LN amplifications between 32 m and 68 m are computed. These values are given in the final column of Table 9.3-2. The amplification with respect to 105 ft (32 m) is shown in Figure 9.3-3. This represents the estimated Z1 scaling from ESTA28 to the power block foundation level.

Finally the Z_1 scaling is added to the from V_{S30}=760 to V_{S30}=1200 m/s developed by the NRC RIL 12-01 which are given in Table 6.3-1. The amplification is converted to LN units in the second column of Table 9.3-3. The Z_1 scaling from the last column of Table 9.3-1 is given the third column of Table 9.3-3. The sum of the NRC RIL 12-01 amplification and the Z_1 scaling is given in the fourth column of Table 9.3-3. The original and adjusted amplification is shown in Figure 9.3-4. There is dip in the amplification at 2 Hz. The 2 Hz adjustment is modified to give a smooth amplification as shown in the final column of Table 9.3-3.

9.3.3 AMPLIFICATION FOR TURBINE BUILDING

The V_{S30} for the turbine building foundation is 983 m/s (Table 6.2-1) which is smaller than the V_{S30} of 1200 m/s used in the calculation of the amplifications for the power block. The amplification for the power block, given in Table 9.2-3 is adjusted to a V_{S30} of 983 m/s based on the V_{S30} ratio using assumption 5.1:

$$\ln\left(Amp(760\,\mathrm{to}\,V_{S30})\right)=\ln\left(Amp(760\,\mathrm{to}\,1200)\right)\frac{\ln\left(V_{S30}/760\right)}{\ln\left(1200/760\right)} \qquad (9\text{-}1)$$

For the turbine building, V_{S30}=983 m/s (Input 6.2, Table 6.2-1).

$$\ln\left(\mathrm{Amp}(760\,\mathrm{m/s\,to}\,983\,\mathrm{m/s})\right)=\ln\left(\mathrm{Amp}(760\,\mathrm{m/s\,to}\,1200\mathrm{m/s})\right)\frac{\ln\left(983/760\right)}{\ln\left(1200/760\right)} \qquad (9\text{-}2)$$

$$\ln\left(Amp(760\mathrm{m/s\,to}\,983\mathrm{m/s})\right)=\ln\left(\mathrm{Amp}(760\mathrm{m/s\,to}\,1200\mathrm{m/s})\right)\,\square\,0.563 \qquad (9\text{-}3)$$

Multiplying the values in Table 9.3-3 by the factor 0.56 leads to the values in the last column of Table 9.3-4.

Table 9.3-1 Average velocity profiles for the power block and the turbine building

Depth from Foundation Level (ft)	Average VS for the Power Block (m/s)	Average VS for the Turbine Building (m/s)
0	1260.8	717.4
5	1250.4	840.3
10	1243.3	935.3
15	1233.2	944.5
20	1224.1	949.9
25	1217.2	956.6
30	1212.0	964.6
35	1209.8	973.9
40	1211.9	985.5
45	1219.0	998.5
50	1229.6	1012.8
55	1244.1	1028.2
60	1262.7	1043.6
65	1285.9	1059.3
70	1311.7	1075.4
75	1334.8	1093.1
80	1351.4	1113.2
85	1360.3	1132.5
90	1365.8	1148.4
95	1362.4	1153.4
100	1351.0	1147.8
105	1352.0	1138.8
110	1338.9	1132.2
115	1285.4	1129.0
120	1232.7	1124.4
125	1183.1	1115.5
130	1139.0	1091.3
135	1104.5	1067.7
140	1079.9	1047.9
145	1064.6	1033.3
150	1057.5	1024.3
155	1057.3	1020.3
160	1062.5	1020.9
165	1071.6	1025.3
170	1083.2	1032.8
175	1096.2	1042.8
180	1109.8	1054.4
185	1123.5	1067.0
190	1137.0	1080.1
195	1150.0	1093.4
200	1162.5	1106.6
205	1174.7	1119.4

210	1186.4	1131.7
215	1197.9	1143.7
220	1209.1	1155.6
225	1220.2	1167.7
230	1231.0	1179.6
235	1241.8	1191.1
240	1252.6	1202.7
245	1263.3	1214.5
250	1273.8	1226.3
255	1284.1	1238.1
260	1294.4	1249.7
265	1304.6	1261.3
270	1314.7	1272.4
275	1324.5	1283.5
280	1334.3	1294.8
285	1344.2	1305.9
290	1354.2	1316.8
295	1364.3	1327.7
300	1374.8	1338.3
305	1385.6	1348.7
310	1396.7	1359.4
315	1408.1	1369.9
320	1419.5	1380.6
325	1431.0	1391.4
330	1442.5	1401.8
335	1454.0	1412.0
340	1465.5	1422.5
345	1477.0	1433.3
350	1488.6	1444.5

Table 9.3-2. Interpolation of Z_1 scaling to 32 m and 68 m

	Amplification for V_{S30}=560/s (converted to LN units from Table 6.4-1).			Interpolated using log-linear interpolation (LN units)		Amplification difference between 105 ft and 223 ft (32 m and 68 m) in LN units
Freq (Hz)	50 ft	120 ft	250 ft	105 ft (32 m)	223ft (68 m)	
0.5	0.146	0.213	0.235	0.199	0.231	-0.032
0.67	0.355	0.436	0.461	0.418	0.455	-0.037
1	0.417	0.534	0.570	0.509	0.563	-0.053
1.3	0.452	0.610	0.636	0.576	0.630	-0.054
2	0.355	0.632	0.633	0.573	0.633	-0.060
2.5	0.461	0.759	0.683	0.695	0.699	-0.004

Table 9.3-3. Smoothed Amplification from reference free-field station ESTA28 to the power block foundation level including the Z_1 scaling

Freq (Hz)	NRC amplification for 760 m/s to 1200 m/s (LN units) From Table 6.3-1	Z_1 factor (LN units) From Table 9.3-2	Adjusted Amplification accounting for Z_1 Differences (LN units)	Smoothed model of amplification for reference free-field (ESTA28) to power block foundation (LN units)
100	-0.206	0	-0.206	-0.206
50	-0.200	0	-0.200	-0.200
33.3	-0.186	0	-0.186	-0.186
20	-0.186	0	-0.186	-0.186
13.3	-0.198	0	-0.198	-0.198
10	-0.231	0	-0.231	-0.231
6.67	-0.285	0	-0.285	-0.285
5	-0.324	0	-0.324	-0.324
4	-0.311	0	-0.311	-0.311
3.33	-0.290	0	-0.290	-0.290
2.5	-0.201	-0.004	-0.205	-0.205
2	-0.146	-0.060	-0.206	-0.170
1.33	-0.071	-0.054	-0.125	-0.125
1	-0.046	-0.053	-0.099	-0.099
0.67	-0.023	-0.037	-0.060	-0.060
0.5	-0.014	-0.032	-0.046	-0.046

Table 9.3-4. Smoothed Amplification from reference free-field station ESTA28 to the turbine building foundation level including the Z_1 scaling

Freq (Hz)	Amplification for reference free-field (ESTA28) to Power block foundation level (LN units) From Table 9.3-3	Amplification for reference free-field (ESTA28) to Turbine Building foundation level (LN units) From eqn 9.1-3
100	-0.206	-0.116
50	-0.200	-0.113
33.3	-0.186	-0.105
20	-0.186	-0.105
13.3	-0.198	-0.111
10	-0.231	-0.130
6.67	-0.285	-0.160
5	-0.324	-0.182
4	-0.311	-0.175
3.33	-0.290	-0.163
2.5	-0.205	-0.115
2	-0.170	-0.096
1.33	-0.125	-0.070
1	-0.099	-0.056
0.67	-0.060	-0.034
0.5	-0.046	-0.026

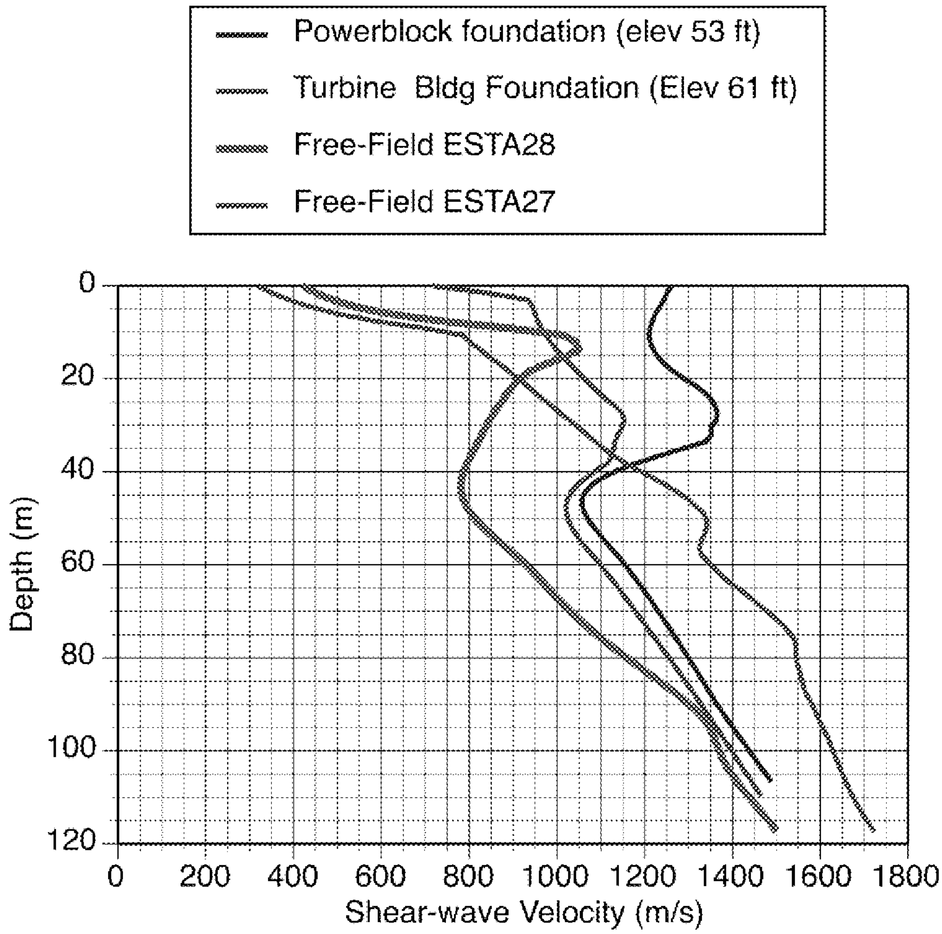


Figure 9.3-1. Comparison of the Mean Shear-Wave Velocity Profiles

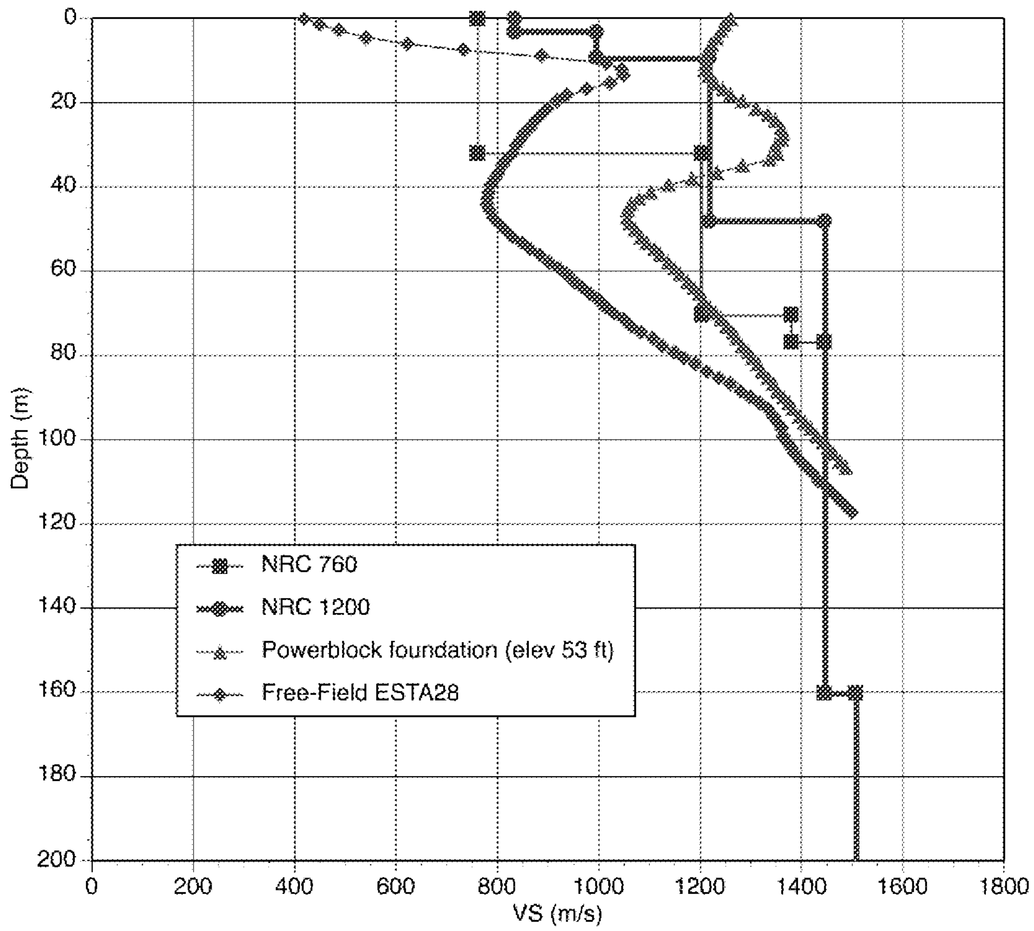


Figure 9.3-2. Velocity profiles used by the NRC in RIL 12-01 and the velocity profiles for the reference free-field site (ESTA28) and the power block.

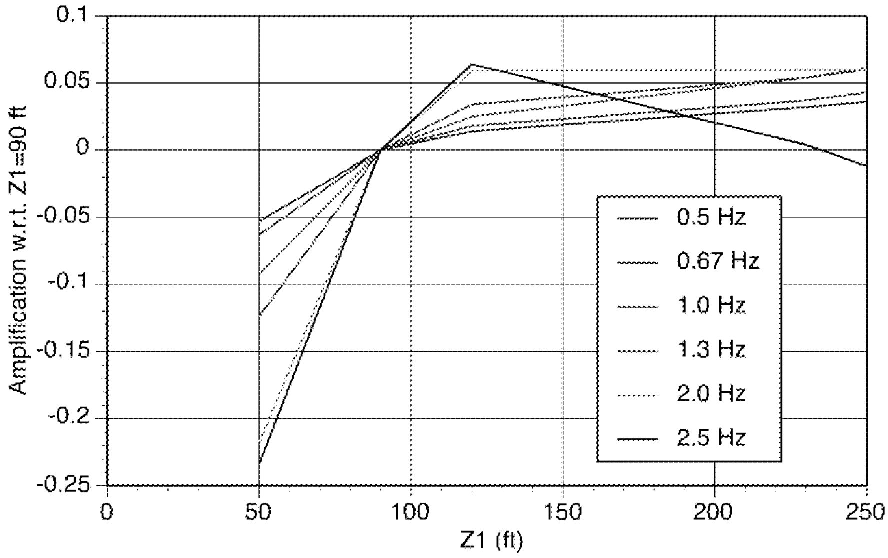


Figure 9.3-3. Amplification due to differences in Z_1 with respect to Z_1=90 ft. (From Table 9.3-3)

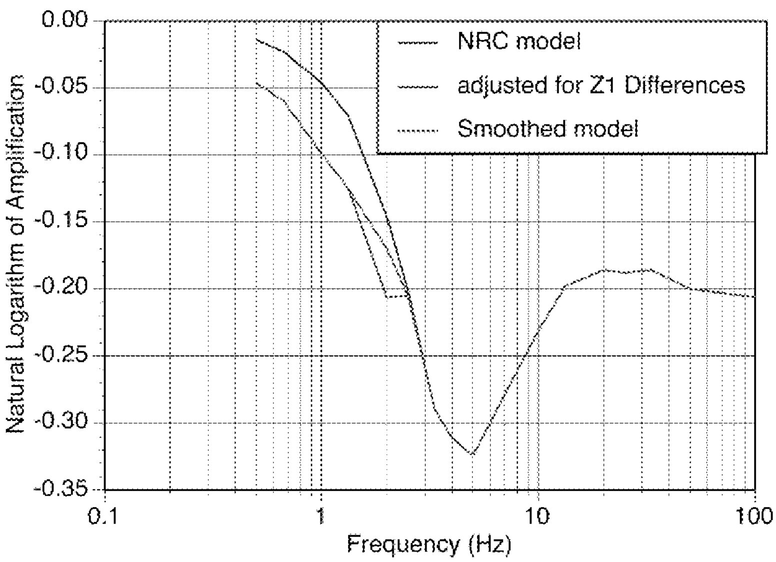


Figure 9.3-4. Amplification from reference free-field (ESTA28) to 1200 m/s (From Table 9.2-3).

9.4 AMPLIFICATION FACTORS FROM GMPE TO STRUCTURE FOUNDATION LEVELS

The total amplification from the GMPE with a reference V_{S30} of 760 m/s to the foundation levels for the foundation and the turbine building are computed by adding the two site terms (Table 9.2-8 and Table 9.3.3). The resulting total amplification terms are listed in Table 9.4-1.

Table 9.4-1 Amplification from GMPE for a reference site condition of V_{S30}=760 m/s to the power block building foundation level

Freq (Hz)	DCPP Site Term (LN units) From Table 9.2-8	Amplification for reference free-field (ESTA28) to Power block foundation level (LN units) From Table 9.3-3	Total Amplification: GMPE for V_{S30}=760 m/s to the power block foundation level
100	-0.300	-0.206	-0.506
50	-0.320	-0.200	-0.520
33.3	-0.360	-0.186	-0.546
20	-0.520	-0.186	-0.706
13.3	-0.520	-0.198	-0.718
10	-0.520	-0.231	-0.751
6.67	-0.500	-0.285	-0.785
5	-0.380	-0.324	-0.704
4	-0.240	-0.311	-0.551
3.33	-0.130	-0.290	-0.420
2.5	0.190	-0.205	-0.015
2	0.190	-0.170	0.020
1.33	0.190	-0.125	0.065
1	0.00	-0.099	-0.049
0.67	0.00	-0.060	-0.010
0.5	0.00	-0.046	0.004

Table 9.4-2 Amplification from GMPE for a reference site condition of V_{S30}=760 m/s to the turbine building foundation level

Freq (Hz)	DCPP Site Term From Table 9.2-8	Amplification for reference free-field (ESTA28) to Turbine Building foundation level (LN units) From Table 9.3-3	Total Amplification: GMPE for V_{S30}=760 m/s to the turbine building foundation level (LN units)
100	-0.300	-0.116	-0.416
50	-0.320	-0.113	-0.433
33.3	-0.360	-0.105	-0.465
20	-0.520	-0.105	-0.625
13.3	-0.520	-0.111	-0.631
10	-0.520	-0.130	-0.650
6.67	-0.500	-0.160	-0.660
5	-0.380	-0.182	-0.562
4	-0.240	-0.175	-0.415
3.33	-0.130	-0.163	-0.293
2.5	0.190	-0.115	0.075
2	0.190	-0.096	0.094
1.33	0.190	-0.070	0.120
1	0.00	-0.056	-0.006
0.67	0.00	-0.034	0.016
0.5	0.00	-0.026	0.024

10. RESULTS AND CONCLUSIONS

The total DCPP amplification factors for the power block foundation level and the turbine building foundation level relative to the median ground motion for a reference rock site with VS30=760 m/s are listed in Table 10.1-1. The standard deviation of the amplification factor is given in the last column of Table 10.1-1. The values in Table 10.1-1 can be used with the NGA-W2 GMPEs to compute the DCPP site-specific ground motions.

Table 10.1-1. Total DCPP site amplification terms relative to the NGA-W2 GMPE for a reference rock site with V_{S30}=760 m/s.

Freq (Hz)	Amplification factor for the power block foundation level (LN units) from Table 9.4-1	Amplification factor for the turbine building foundation level (LN units) from Table 9.4-2	Standard deviation of DCPP site term (LN units) from Table 9.2-8
100	-0.506	-0.416	0.200
50	-0.520	-0.433	0.199
34	-0.546	-0.465	0.201
20	-0.706	-0.625	0.205
13.5	-0.718	-0.631	0.209
10	-0.751	-0.650	0.211
6.7	-0.785	-0.660	0.212
5.0	-0.704	-0.562	0.214
4.0	-0.551	-0.415	0.214
3.3	-0.420	-0.293	0.216
2.5	-0.015	0.075	0.217
2.0	0.020	0.094	0.219
1.3	0.065	0.120	0.222
1.0	-0.049	-0.006	0.227
0.67	-0.010	0.016	0.230
0.5	0.004	0.024	0.233

11. LIMITATIONS

The amplification factors developed in this calculation are based on simplified methods using existing site response results. A full set of updated analytical modeling of the site response has not been conducted because the amplification will depend on the input ground motion and the ground motion characterization being conducted under the SSHAC process is not yet complete. An updated set of amplification factors that includes 3-D site response calculations will be conducted as part of the response to the 2012 50.54(f) letter which is scheduled to be completed in March 2015.

12. IMPACT EVALUATION

The impact of these ground motion factors on the ground motions are DCPP are evaluated in the AB1632 report, chapter 13.

13. REFERENCES

Abrahamson, N. A., W. J. Silva, and R. Kamai (2014). Summary of the ASK14 ground-motion relation for active crustal regions, Earthquake Spectra, in press.

Boore, D. M., J. P. Stewart, E. Seyha, and G. M. Atkinson (2014). NGA-west2 equations for predicting PGA, PGV, and 5% damped PSA for shallow crustal earthquakes, Earthquake Spectra, in press.

Campbell, K. W. and Y. Bozorgnia (2014). NGA-west2 ground moton model for the average horizontal component of PGA, PGV, and 5% damped linear acceleration response spectra, Earthquake Spectra, in press.

Chiou, B, and R. R. Youngs (2014). Update of the Chiou and Youngs NGA model for the average horizontal component of peak ground motion and response spectra, Earthquake Spectra, in press.

Kamai, R., N. Abrahamson, and W. Silva (2013). Nonlinear Horizontal Site Response for the NGA-West2 Project. PEER 2013/12

Nuclear Regulatory Commission (2012). *Confirmatory Analysis of Seismic Hazard at the Diablo Canyon Power Plant From the Shoreline Fault Zone*, Research Information Letter 12-01.

Pacific Gas and Electric Company (PG&E), 2011. *Shoreline Fault Zone Report: Report on the Analysis of the Shoreline Fault Zone, Central Coastal California*, report to the U.S. Nuclear Regulatory Commission, January;. www.pge.com/myhome/edusafety/systemworks/dcpp/shorelinereport/.

14. ATTACHMENTS

Attachment 1: ITR of GEO.DCPP.14.03 R0 by K. Wooddell (4 pages)
Attachment 2: ITR of GEO.DCPP.14.03 R0 by J. Sun (7 pages)

15. SUPPPORTING DOCUMENTSS

There are 8 sets of supporting documents that are located at the following location: \\sfshare01-nas\QA Recorded Docs\DCPP\Calculations\GEO.DCPP.14.03 R0\GEO.DCPP.14.03_supporting_documents
.
The contents of each set of supporting documents are given below.

Supporting Documents Part 1. NGA-west2 flatfile

File Name	Contents
NGA-WEST2_Flatfile_RotD50_d050_public_version.xlsx	PEER flatfile including the ground motion data from the 2003 San Simeon and 2004 Parkfield earthquakes.

Supporting Documents Part 2. PGEQ-PR-16 report and VS profiles

File Name	Contents
PGEQ-PR-16_Foundation_Velocity_Rev 1.pdf	DCPP shallow velocity study
A-A_station_100_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station A100 along profile A-A'
A-A_station_1200_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station A1200 along profile A-A'
B-B_station_1200_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station B1200 along profile B-B'
A-A_station_400_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station A400 along profile A-A'
A-A_station_500_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station A500 along profile A-A'
A-A_station_600_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station A600 along profile A-A'
A-A_station_700_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station A700 along profile A-A'
A-A_station_800_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station A800 along profile A-A'
C-C_station_400_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station C400 along profile C-C'
C-C_station_500_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station C500 along profile C-C'
C-C_station_600_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station C600 along profile C-C'
D-D_station_400_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station C400 along profile D-D'
D-D_station_500_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station C500 along profile D-D'
D-D_station_600_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station C600 along profile D-D'
B-B_station_200_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station B200 along profile B-B'
B-B_station_300_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station B300 along profile B-B'
B-B_station_400_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station B400 along profile B-B'
B-B_station_500_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station B500 along profile B-B'
B-B_station_600_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station B600 along profile B-B'
B-B_station_700_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station B700 along profile B-B'
B-B_station_800_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station B800 along profile B-B'
B-B_station_900_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station B900 along profile B-B'
B-B_station_1000_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station B1000 along profile B-B'

C-C_station_200_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station C200 along profile C-C'
C-C_station_300_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station C300 along profile C-C'
C-C_station_400_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station C400 along profile C-C'
D-D_station_200_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station D200 along profile D-D'
D-D_station_300_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station D300 along profile D-D'
D-D_station_400_Vs_elev_using_z_dep_VpVs_rev1_QA.csv	VS profile for station D400 along profile D-D'

Supporting Documents Part 3. NRC (2012) RIL 12-01, section 5 and appendix B

File Name	Contents
ML121230035_Chap5_appB.pdf	Section 5 and appendix B of RIL 12-01

Supporting Documents Part 4. Analytical site response results from Kamai et al (2013)

File Name	Contents
PEER-2013-12-Kamai_et_al.pdf	Kamai et al (2013) report
short_appC.xlsx	Subset of Appendix C from Kamai et al (2013) for M6 and VS30=560 m/s and VS30=760 m/s

Supporting Documents Part 5. FORTRAN code for computing total residuals using the NGA-W2 GMPEs

File Name	Contents
totalResid.f	Main program
rdat2_bin.f	subroutine to read the NGA-W2 data set
NGAWest2.F	subroutine to implement the NGA-W2 GMPEs
ngaW2_resid	Executable (Macintosh, system 10.6.8)

Supporting Documents Part 6. PEER spreadsheet for implementing the NGA-W2 GMPEs

File Name	Contents
NGAW2_GMPE_Spreadsheets_V5.5_060514_Protected.xlsm	Spreadsheet for computing the median and standard deviations of the NGA-W2 GMPEs Version 5.5 dated Jun 05, 2014

Supporting Documents Part 7. Testing of Other Programs for Evaluating the NGA-W2 GMPEs

File Name	Contents
M68.xlxs	Comparison fo the results from Youngs and Gregero's programs
M68Rm006.d90	Ground motions from Youngs for case 2
M68Rm990.d45	Ground motions from Youngs for case 1
Spectra_Check	Ground motions from Gregor for cases 1 and 2
Youngs_letter.pdf	Transmittal from Youngs with the results from the 2 test cases
Gregor_letter.pdf	Transmittal from Gregor with the results from the 2 test cases

Supporting Documents Part 8. Residuals from San Simeon and Parkfield

File Name	Contents
dcpp_eqk_data1.txt	Data file containing the selected ground motions from the San Simeon and Parkfield earthquakes
run_ask14.txt	Input file for computing residuals for the Abrahamson et al (2014) GMPE
run_BSSA14.txt	Input file for computing residuals for the Borre et al (2014) GMPE
run_CB14.txt	Input file for computing residuals for the Campbell and Bozorgnia (2014) GMPE
run_CY14.txt	Input file for computing residuals for the Chiou and Youngs (2014) GMPE
all_resid_ASK14.txt	Output file with the residuals for the individual stations for the San Simeon and Parkfield earthquakes for the Abrahamson et al (2014) GMPE
all_resid_BSSA14.txt	Output file with the residuals for the individual stations for the San Simeon and Parkfield earthquakes for the Borre et al (2014) GMPE
all_resid_CB14.txt	Output file with the residuals for the individual stations for the San Simeon and Parkfield earthquakes for the Campbell and Bozorgnia (2014) GMPE
all_resid_CY14.txt	Output file with the residuals for the individual stations for the San Simeon and Parkfield earthquakes for the Chiou and Youngs (2014) GMPE
mean_resid_ASK14.txt	Output file with the mean event residuals for the San Simeon and Parkfield earthquakes for the Abrahamson et al (2014) GMPE
mean_resid_BSSA14.txt	Output file with the mean event residuals for the San Simeon and Parkfield earthquakes for the Borre et al (2014) GMPE
mean_resid_CB14.txt	Output file with the mean event residuals for the San Simeon and Parkfield earthquakes for the Campbell and Bozorgnia (2014) GMPE
mean_resid_CY14.txt	Output file with the mean event residuals for the San Simeon and Parkfield earthquakes for the Chiou and Youngs (2014) GMPE
all_resid_SanSim_Park.xls	Combines the individual station residuals from the four GMPEs into one excel file
MeanResid_forSiteTerm_v2.xlsx	Combines the mean event residuals from the four GMPEs into one excel file
resid_DCPP_GM.xlsx	Combines the individual station residuals for the DCPP free-field stations from the four GMPEs into one excel file

CALCULATION VERIFICATION SUMMARY

Item	Parameter	Yes	No	N/A
1	Purpose is clearly stated and the report satisfies the Purpose.	X		
2	Assumptions are reasonable, adequately described, and based upon sound geotechnical principles and practices.	X		
3	Input received via signed communications from authorized signatories and correctly incorporated into the calculation.	X		
4	Methodology is appropriate and properly applied.	X		
5	Software is identified and properly applied. Validation is referenced or included, and is acceptable. Input files are correct.			X
6	Calculation is complete, accurate, and leads logically to Results and Conclusions, or is verified by alternate calculation.	X		
7	Results and Conclusions are accurate, acceptable, and reasonable compared to the Input and Assumptions.	X		
8	The Limitation on the use of the Results has been addressed and is accurate and complete.	X		
9	The Impact Evaluation has been included and is accurate and complete.	X		
10	References are valid for intended use.	X		
11	Attachments are complete, accurate, and support text.			X

5) No software other than Excel was used.
11) Other than the two ITR attachments, there are no additional attachments.

<u>Comments:</u>

This ITR report provides the technical review and verification of the GEO.DCPP.14.03 Revision 0 calculation for the DCPP Site Response Factors for Hazard Sensitivity. As part of this ITR, the purpose, data, assumptions, methodology, results and conclusions from this calculation are verified to be acceptable. The noted software which was used for the analysis is verified in section 8.1 of this calculation.

To perform the necessary chceking of the input, output and results contained in the calculaiton several steps were performed:

- Verification of input source parameters for the 2003 San Simeon and 2004 Parkfield earthquakes.
- Verification of the metadata for the 2003 San Simeon and 2004 Parkfield earthquakes.
- Verification of the 5% damped response spectral values for the 2003 San Simeon and 2004 Parkfield earthquakes.

- Verification of the variance of the site term.
- Verification of the equations.
- Verification of the FORTRAN program used to compute ground motion respnse spectra.
- Verification of the computed median ground motions and mean residuals for the 2003 San Simeon and 2004 Parkfield events with spreadsheet "NGAW2_GMPE_Spreadsheets_V5.5_060514_Protected.xlsm."
- Verification of the computed DCPP ground motions and residuals for the 2003 San Simeon and 2004 Parkfield events using spreadsheet "NGAW2_GMPE_Spreadsheets_V5.5_060514_Protected.xlsm."
- Verification of the amplification factor from ESTA27 (570 m/s) to ESTA28 (753 m/s).
- Verification of the DCPP event-corrected residuals for the 2003 San Simeon and 2004 Parkfield earthquakes.
- Verification of the smoothed DCPP site term.
- Verification of the factors from GMPE to structure foundation levels.
- Verification of the total DCPP site amplification terms and standard deviation in the results and conclusions section.

The NGA-W2 flatfile was downloaded from the PEER website (as referenced in the calculation). For the 2003 San Simeon and 2004 Parkfield earthquakes, the source parameters (Table 6.1-1), the metadata (Tables 6.1-2 and 6.1-4), and the 5% damped response spectral values (Tables 6.1-3a, 6.1-3b, 6.1-5a, and 6.1-5b) were verified to be transferred correctly from the PEER flatfile.

The varience of the site term was verified to be correctly transmittted from Table 6-7 in the 2011 Shoreline Fault Report. It should be noted that a notation change from σ to ϕ has been made since the Shoreline Fault report. Also, the variance is incorrectly labeled as a standard deviation in the Shoreline Fault report. In both the calculation and the Shoreline Fault report, however, the values represent the variance of the site term, and they are correct.

Equations 7-1 through 7-5 pertain to the development of a DCPP site-specific site term for the reference free-field station, and they have been verified to be correct. Equation 7-11 properly stated the definition of the standard error of the mean and equation 7-12 correctly shows how to use the standard error and the mean to compute the 5^{th} and 95^{th} ground motion percentiles.

Verification of the FORTRAN program (NGAW2_Resid) used to compute the ground motion response spectra for computation the ground motion residuals was accomplished through a comparison of the FORTRAN output with the output of the spreadsheet "NGAW2_GMPE_Spreadsheets_V5.5_060514_Protected.xlsm" developed by PEER. To verify the accuracy of this comparison, all values in the "PEER Spreadsheet" column of Table 8.2 and 8.3 have been independently calculated using the PEER spreadsheet and the exact numbers were reproduced. Because the output from these two programs yield ground motion values that are within 1% of each other, the results are considered to be in agreement with each other.

Ground motions and residuals were computed for the earthquakes in the NGA-W2 database with the PEER spreadsheet using four of the NGA-W2 GMPEs. Ground motion values from the PEER spreadsheet are given in "all_resid_SanSim_Park_kew.xls" and "dcpp_resid_SanSim_Park_data1_kew.xls" and they are found to be in agreement with the values in "all_resid_sanSimeon_park.xls." The computed residuals for the San Simeon and Parkfield earthquakes are found to be within 1% of the residuals listed in Tables 9.2-1, 9.2-2, 9.2-3, and 9.2-4. The values in Tables 9.2-1, 9.2-2, 9.2-3, and 9.2-4 are verified to be correct.

Verification of the amplification factor from ESTA27 (570 m/s) to ESTA28 (753 m/s) was accomplished by inputting the parameters listed in Section 9.2.5 of the calculation into the PEER spreadsheet to obtain a ground motion response spectrum for each Vs30 case, 570 m/s and 753 m/s respectively. The amplification factor is then computed using equation 7-6. The ITR results of this calculation are found in "CalculationCheck.xls," and the values in Table 9.2-5 are verified to be correct.

Verification of the DCPP event-corrected residuals for San Simeon included verifying that all columns of Table 9.2-6 were transmitted correctly from the referenced location and the event-term corrected residuals were correctly computed using equation 7-5. Results for the independent ITR computation are found in "CalculationCheck.xls" and all values in Table 9.2-6 have been verified to be correct.

Similarly, verification of the DCPP event-corrected residuals for Parkfield included verifying that all columns of Table 9.2-7 were transmitted correctly from the referenced location and the event-term corrected residuals were correctly computed using equation 7-4. Results for the independent ITR computation are found in "CalculationCheck.xls" and all values in Table 9.2-7 have been verified to be correct.

The DCPP smoothed site term is shown in Figure 9.2-2 of the calculation. The smoothed site term is developed by visually smoothing the average site term and holding the low frequency term (< 1Hz) at a constant value of zero. The visual smoothing is reasonable based on the mean site term. It is also reasonable to constrain the low frequency term to equal zero because these terms are controlled by late arriving surface waves. Considering the close distances of the controlling sources for DCPP, surface waves will not control the DCPP ground motions from the Hosgri, Shoreline, Los Osos, or San Luis Bay controlling sources. Values in Table 9.2-8 are independently verified to be correct and the calculations are found in "CalculationCheck.xls." The standard deviation of the DCPP site term was computed using equation 7-11 and the Upper and Lower Ranges (95th and 5th percentiles) are computed using equation 7-12.

The DCPP site terms and Amplification factors for the reference free-field stations in Tables 9.4-1 and 9.4-2 have been correctly transmitted from the referenced locations. Following the instruction given in Section 9.4 to add the the two site terms to compute the total amplification factor, the two terms were added and the total amplification factors in Tables 9.4-1 and 9.4-2 are verified to be correct. Results for the independent ITR computation are found in "CalculationCheck.xls."

INDEPENDENT VERIFICATION OF CALCULATION

The values in Table 10.1-1 have been verified to be transmitted properly from the referenced locations.

As indicated in the summary table, the necessary aspects of this calculation are verified as being satisfied and acceptable. All attachments are included as referenced in Section 13.

All supporting documents for this ITR report are located at \\sfshare01-nas\QA Recorded Docs\DCPP\Calculations\GEO.DCPP.14.03 R0\GEO.DCPP.14.03_supporting_documents.

Verifier (ITR): ____________________ 09/02/14
(name/signature) (date)

CALCULATION VERIFICATION SUMMARY

Item	Parameter	Yes	No	N/A
1	Purpose is clearly stated and the report satisfies the Purpose.	X		
2	Assumptions are reasonable, adequately described, and based upon sound geotechnical principles and practices.	X		
3	Input received via signed communications from authorized signatories and correctly incorporated into the calculation.	X		
4	Methodology is appropriate and properly applied.	X		
5	Software is identified and properly applied. Validation is referenced or included, and is acceptable. Input files are correct.			X
6	Calculation is complete, accurate, and leads logically to Results and Conclusions, or is verified by alternate calculation.	X		
7	Results and Conclusions are accurate, acceptable, and reasonable compared to the Input and Assumptions.	X		
8	The Limitation on the use of the Results has been addressed and is accurate and complete.	X		
9	The Impact Evaluation has been included and is accurate and complete.	X		
10	References are valid for intended use.	X		
11	Attachments are complete, accurate, and support text.			X

Comments (use additional pages as necessary):
5: No software other than Excel was used.
11: Other than the 2 ITR reports, there are no other attachments. The sources of supporting documents used in this ITR are described below.

PGEQ-PR-16 report and VS profiles. Stored on Geosciences share drive and used accordingly. \\share01-nas\QA Recorded Docs\DCPP\Calculations\GEO.DCPP.14.03 R0\GEO.DCPP.14.03_supporting_documents\SupportingDocuments_part2\alll_A_to_C_profile_station_csv_Vs_elev_using_z_dep_VpVs_rev1_QA

NRC (2012) RIL 12-01, section 5 and appendix B. Downloaded from NRC website and used in independent check. http://a4nr.org/wp-content/uploads/2012/10/090112-NRC-confirms-Shoreline-analysis.pdf.

Analytical site response results from Kamai et al (2013). Downloaded from PEER website and used in independent check. (http://peer.berkeley.edu/ngawest2/final-products/.

This calculation package was reviewed by 2 ITRs. Sections reviewed by Joseph Sun are discussed in this ITR Report (Attachment 2).

Section 5: ASSUMPTIONS

Assumptions are reasonable and all three assumptions have sound technical basis.

Section 6: INPUTS

Table 6.2-2 VS profiles near the two free-field sites at DCPP from PGEQ-PR-16. The raw data files are given in attachment 2.

Verified 1st column: Station A100 Vs A100 against
A-A_100_Station_elev_using_z_dep_VpVs_Rev1_QA.cvs
Verified 2nd column: Station A1200 Vs against
A-A_Station1200_elev_using_z_dep_VpVs_Rev1_QA.cvs
Verified 3rd column: Station B1200 Vs against
B-B_Station1200_elev_using_z-dep_VpVs_Rev1_QA.cvs
<u>Original titles of the Table: "Station A100 Vs A100" and "Station A1200 Vs" were swapped. Correction was made.</u>

Table 6.3-1 Site correction factors for adjusting from Vs30=760 ms/ to 1200 m/s from the NRC site response (Table 5-7 in RIL 12-01).

1. Verified Table 6.3-1 via PDF copy of NRC publication "Research Information Letter 12-01, Confirmatory Analysis of Seismic Hazard at the Diablo Canyon Power Plant from the Shoreline Fault Zone" dated September 2012, Table 5-7 on page 66. (http://a4nr.org/wp-content/uploads/2012/10/090112-NRC-confirms-Shoreline-analysis.pdf)

<u>Table verified via visual inspection.</u>

6.3 SITE AMPLIFICATION FROM NRC RIL 12-01

Table 6.3-1. Site correction factors for adjusting from Vs30=760 ms/ to 1200 m/s from the NRC site response (Table 5-7 in RIL 12-01).

Freq (Hz)	Amplification Factor
100	0.814
50	0.819
33.3	0.830
25	0.829
20	0.830
13.3	0.820
10	0.794
6.67	0.752
5.0	0.723
4.0	0.733
3.33	0.748
2.5	0.818
2.0	0.864
1.33	0.931
1.0	0.955
0.67	0.977
0.50	0.986

Table 6.4-1 Amplification for VS30=560 m/s for a range of Z1 values from Kamai et al (2013) Appendix C.

Independently verified Table 6.4-1 via ASCII file download from PEER website (http://peer.berkeley.edu/ngawest2/final-products/), PEER 2013/12 – Nonlinear Horizontal Site Response for the NGA-West2 Project by Ronnie Kamai, Norman A. Abrahamson, Walter J. Silva Appendix C, sorted for Magnitude =6, Vs=560 m/s, Rock PGA=0.05 and the various frequencies and Z1 depths shown on the Table.

Table verified as shown below.

Magnitude	Vs30	Z1 (ft)	Soil Mode	Freq count	Freq (Hz)	Period (se	PGA_Rock	Sa(T)_Roc	Mean(Am	Std(Amp)
6	560	50	PR	71	0.5012	1.995211	0.05	0.020341	1.157586	0.026974
6	560	50	PR	83	0.6607	1.513546	0.05	0.029326	1.425748	0.032536
6	560	50	PR	101	1	1	0.05	0.048735	1.517632	0.043692
6	560	50	PR	113	1.3183	0.758553	0.05	0.058681	1.571667	0.059196
6	560	50	PR	131	1.9953	0.501178	0.05	0.07265	1.425764	0.105239
6	560	50	PR	141	2.5119	0.398105	0.05	0.088806	1.585257	0.147754
6	560	120	PR	71	0.5012	1.995211	0.05	0.020341	1.237682	0.0375
6	560	120	PR	83	0.6607	1.513546	0.05	0.029326	1.54607	0.04669
6	560	120	PR	101	1	1	0.05	0.048735	1.706405	0.074207
6	560	120	PR	113	1.3183	0.758553	0.05	0.058681	1.839981	0.109233
6	560	120	PR	131	1.9953	0.501178	0.05	0.07265	1.882012	0.205601
6	560	120	PR	141	2.5119	0.398105	0.05	0.088806	2.136558	0.208662
6	560	250	PR	71	0.5012	1.995211	0.05	0.020341	1.265014	0.045848
6	560	250	PR	83	0.6607	1.513546	0.05	0.029326	1.584875	0.058706
6	560	250	PR	101	1	1	0.05	0.048735	1.768158	0.096926
6	560	250	PR	113	1.3183	0.758553	0.05	0.058683	1.888728	0.135037
6	560	250	PR	131	1.9953	0.501178	0.05	0.07265	1.883771	0.20517
6	560	250	PR	141	2.5119	0.398105	0.05	0.088806	1.980783	0.185053

Table 6.4-1. Diff Check

Freq Index	Freq (Hz)	Z1=50 ft	Z1=120 ft	Z1=250 ft	Z1=50 ft	Z1=120 ft	Z1=250 ft
71	0.5012	1.157586	1.237682	1.265014	0	0	0
83	0.6607	1.425748	1.54607	1.584875	0	0	0
101	1	1.517632	1.706405	1.768158	0	0	0
113	1.3183	1.571667	1.839981	1.888728	0	0	0
131	1.9953	1.425764	1.882012	1.883771	0	0	0
141	2.5119	1.585257	2.136558	1.980783	0	0	0

1.157586
1.425748
1.517632
1.571667
1.425764
1.585257
1.237682
1.54607
1.706405
1.839981
1.882012
2.136558
1.265014
1.584875
1.768158
1.888728
1.883771
1.980783

Section 7. METHOD AND EQUATION SUMMARY
Section 7.1: METHOD

Method verified. Katie Woddell is responsible for ITR DCPP site specific reference freefield site term and Joseph Sun is responsible for ITR amplification factor between the freefield station and the foundation level of the powerblock and the turbine building.

Section 7.1.3: SITE-SPECIFI TERMS FOR DCPP STRUCTURES

ITR agree with the proposed method for the powerblock and turbine amplification

Section 7.2.6: Definition of V_{S30}.

Independently check calculated Vs30 as shown below

	A	B	C	D	E	F	G	H	I	J	K	L
1			A-100			A-1200			B-1200		30m=	98.4252 ft
2			Vs_fps	Elevation_ft		Vs_fps	Elevation_ft		Vs_fps	Elevation_ft		
3	0		1374.71	87	0.003637	917.537	87	0.005449	889.997	87	0.005618	
4	-5		1478.35	82	0.003382	1006	82	0.00497	975.068	82	0.005128	
5	-10		1606.92	77	0.003112	1114.04	77	0.004488	1081.9	77	0.004621	
6	-15		1782.15	72	0.002806	1248.88	72	0.004004	1217.5	72	0.004107	
7	-20		2041.52	67	0.002449	1420.38	67	0.00352	1392.99	67	0.003589	
8	-25		2407.06	62	0.002077	1647.07	62	0.003036	1625.81	62	0.003075	
9	-30		2908.99	57	0.001719	1959.03	57	0.002552	1946.44	57	0.002569	
10	-35		3325.54	52	0.001504	2211.53	52	0.002261	2211.24	52	0.002261	
11	-40		3426.2	47	0.001459	2260.87	47	0.002212	2278.97	47	0.002194	
12	-45		3441.27	42	0.001453	2313.96	42	0.002161	2354.74	42	0.002123	
13	-50		3350.9	37	0.001492	2372.88	37	0.002107	2435.79	37	0.002053	
14	-55		3208.75	32	0.001558	2437	32	0.002052	2521.7	32	0.001983	
15	-60		3083.57	27	0.001621	2500.27	27	0.002	2611.73	27	0.001914	
16	-65		3010.24	22	0.001661	2562.42	22	0.001951	2705.77	22	0.001848	
17	-70		2957.1	17	0.001691	2624.2	17	0.001905	2802.74	17	0.001784	
18	-75		2914.81	12	0.001715	2687.45	12	0.00186	2903.22	12	0.001722	
19	-80		2878.22	7	0.001737	2756.39	7	0.001814	3008.55	7	0.001662	
20	-85		2842.67	2	0.001759	2836.35	2	0.001763	3118.25	2	0.001603	
21	-90		2806.01	-3	0.001782	2916.86	-3	0.001714	3232.73	-3	0.001547	
22	-95		2774.64	-8	0.001802	3003.28	-8	0.001665	3355.83	-8	0.00149	
23	-100		2746.2	-13	0.039849	3094.9	-13	0.05296	3488.25	-13	0.052423	
24			2719.03	-18		3187.97	-18		3628.99	-18		
25	ITR Vs 30				752.8427			586.4664			572.2677	
26	Calc Vs30				753			657			573	
27												

<u>ITR verified V_{S30} calculated in Table 9.1-1.</u>

Section 9: BODY OF CALCULATION

Section 9.1: COMPUTE VS30 FOR THE TWO FREE-FIELD STATIONS

Use Attachment 2 from Calc package to independently verify Vs30 calculation as shown below.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1			A-100			A-1200			B-1200		30m=	98.4252 ft	
2			Vs_fps	Elevation_ft		Vs_fps	Elevation_ft		Vs_fps	Elevation_ft			
3	0		1374.71	87	0.003637	917.537	87	0.005449	889.997	87	0.005618		
4	-5		1478.35	82	0.003382	1006	82	0.00497	975.068	82	0.005128		
5	-10		1606.92	77	0.003112	1114.04	77	0.004488	1081.9	77	0.004621		
6	-15		1782.15	72	0.002806	1248.88	72	0.004004	1217.5	72	0.004107		
7	-20		2041.52	67	0.002449	1420.38	67	0.00352	1392.99	67	0.003589		
8	-25		2407.06	62	0.002077	1647.07	62	0.003036	1625.81	62	0.003075		
9	-30		2908.99	57	0.001719	1959.03	57	0.002552	1946.44	57	0.002569		
10	-35		3325.54	52	0.001504	2211.53	52	0.002261	2211.24	52	0.002261		
11	-40		3426.2	47	0.001459	2260.87	47	0.002212	2278.97	47	0.002194		
12	-45		3441.27	42	0.001453	2313.96	42	0.002161	2354.74	42	0.002123		
13	-50		3350.9	37	0.001492	2372.88	37	0.002107	2435.79	37	0.002053		
14	-55		3208.75	32	0.001558	2437	32	0.002052	2521.7	32	0.001983		
15	-60		3083.57	27	0.001621	2500.27	27	0.002	2611.73	27	0.001914		
16	-65		3010.24	22	0.001661	2562.42	22	0.001951	2705.77	22	0.001848		
17	-70		2957.1	17	0.001691	2624.2	17	0.001905	2802.74	17	0.001784		
18	-75		2914.81	12	0.001715	2687.45	12	0.00186	2903.22	12	0.001722		
19	-80		2878.22	7	0.001737	2756.39	7	0.001814	3008.55	7	0.001662		
20	-85		2842.67	2	0.001759	2836.35	2	0.001763	3118.25	2	0.001603		
21	-90		2806.01	-3	0.001782	2916.86	-3	0.001714	3232.73	-3	0.001547		
22	-95		2774.64	-8	0.001802	3003.28	-8	0.001665	3355.83	-8	0.00149		
23	-100		2746.2	-13	0.039849	3094.9	-13	0.05296	3488.25	-13	0.052423		
24			2719.03	-18		3187.97	-18		3628.99	-18			
25	ITR Vs 30				752.8427			586.4664			572.2677		
26	Calc Vs30				753			657			573		
27													

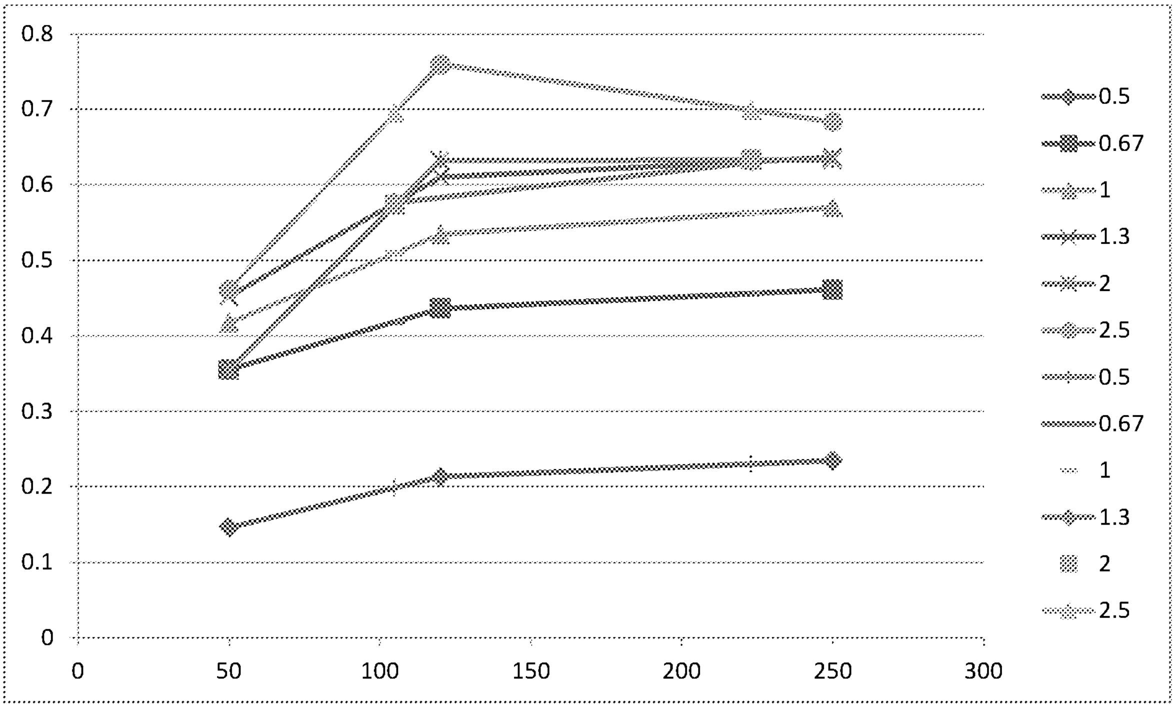
Section 9.3 AMPLIFICATION FACTORS FROM REFERENCE FREE-FIELD TO STRUCTURE FOUNDATION LEVELS

Section 9.3.1 VS PROFILE for POWER BLOCK and TURBINE BUILDING

	A	B	C	D	E	F	G	H
1	Depth from Foundation Level	Average VS for the Power Block	Average VS for the Turbine Building	ITR Average VS for the Power Block (EL 57)	ITR check diff	Average VS for the Turbine Building El. 62	ITR Average VS for the Turbine Building (El. 62)	ITR check diff
2	(ft)	(m/s)	(m/s)	(m/s)		(m/s)	(m/s)	
3	0	1260.8	760.3	1260.764	-0.04	717.4	717.4366	0.04
4	5	1250.4	873	1250.362	-0.04	840.3	840.3308	0.03
5	10	1243.3	959.5	1243.304	0.00	935.3	935.3434	0.04
6	15	1233.2	967.1	1233.182	-0.02	944.5	944.5079	0.01
7	20	1224.1	971.1	1224.082	-0.02	949.9	949.9338	0.03
8	25	1217.2	976.2	1217.163	-0.04	956.6	956.6347	0.03
9	30	1212	982.8	1211.957	-0.04	964.6	964.6111	0.01
10	35	1209.8	991	1209.825	0.02	973.9	973.9378	0.04
11	40	1211.9	1001.3	1211.926	0.03	985.5	985.4519	-0.05
12	45	1219	1013.4	1218.974	-0.03	998.5	998.4555	-0.04
13	50	1229.6	1026.9	1229.584	-0.02	1012.8	1012.801	0.00
14	55	1244.1	1041.9	1244.091	-0.01	1028.2	1028.189	-0.01
15	60	1262.7	1057.4	1262.705	0.01	1043.6	1043.632	0.03
16	65	1285.9	1073.7	1285.872	-0.03	1059.3	1059.333	0.03
17	70	1311.7	1090.5	1311.736	0.04	1075.4	1075.392	-0.01
18	75	1334.8	1109	1334.806	0.01	1093.1	1093.091	-0.01
19	80	1351.4	1129.3	1351.389	-0.01	1113.2	1113.233	0.03
20	85	1360.3	1148.3	1360.33	0.03	1132.5	1132.483	-0.02
21	90	1365.8	1163.1	1365.831	0.03	1148.4	1148.356	-0.04
22	95	1362.4	1167.4	1362.374	-0.03	1153.4	1153.366	-0.03
23	100	1351	1161.1	1350.953	-0.05	1147.8	1147.804	0.00
24	105	1352	1151.1	1351.969	-0.03	1138.8	1138.792	-0.01
25	110	1338.9	1143.4	1338.86	-0.04	1132.2	1132.17	-0.03
26	115	1285.4	1139.2	1285.441	0.04	1129	1128.962	-0.04
27	120	1232.7	1133.6	1232.691	-0.01	1124.4	1124.38	-0.02
28	125	1183.1	1123.5	1183.097	0.00	1115.5	1115.462	-0.04
29	130	1139	1098.2	1139.035	0.04	1091.3	1091.25	-0.05
30	135	1104.5	1073.5	1104.517	0.02	1067.7	1067.672	-0.03
31	140	1079.9	1052.8	1079.933	0.03	1047.9	1047.898	0.00
32	145	1064.6	1037.5	1064.6	0.00	1033.3	1033.269	-0.03
33	150	1057.5	1028	1057.516	0.02	1024.3	1024.274	-0.03
34	155	1057.3	1023.7	1057.282	-0.02	1020.3	1020.348	0.05
35	160	1062.5	1024	1062.493	-0.01	1020.9	1020.863	-0.04
36	165	1071.6	1028.3	1071.615	0.02	1025.3	1025.267	-0.03
37	170	1083.2	1035.9	1083.242	0.04	1032.8	1032.849	0.05
38	175	1096.2	1045.9	1096.247	0.05	1042.8	1042.845	0.04
39	180	1109.8	1057.6	1109.829	0.03	1054.4	1054.417	0.02
40	185	1123.5	1070.2	1123.509	0.01	1067	1066.954	-0.05
41	190	1137	1083.4	1136.98	-0.02	1080.1	1080.103	0.00
42	195	1150	1096.8	1149.988	-0.01	1093.4	1093.424	0.02
43	200	1162.5	1110	1162.547	0.05	1106.6	1106.589	-0.01
44	205	1174.7	1122.8	1174.672	-0.03	1119.4	1119.374	-0.03
45	210	1186.4	1135.1	1186.424	0.02	1131.7	1131.732	0.03
46	215	1197.9	1147	1197.918	0.02	1143.7	1143.666	-0.03
47	220	1209.1	1158.8	1209.14	0.04	1155.6	1155.593	-0.01
48	225	1220.2	1170.8	1220.152	-0.05	1167.7	1167.717	0.02
49	230	1231	1182.7	1231.03	0.03	1179.6	1179.56	-0.04
50	235	1241.8	1194.3	1241.829	0.03	1191.1	1191.091	-0.01
51	240	1252.6	1206	1252.613	0.01	1202.7	1202.75	0.05
52	245	1263.3	1217.8	1263.278	-0.02	1214.5	1214.507	0.01
53	250	1273.8	1229.7	1273.752	-0.05	1226.3	1226.317	0.02
54	255	1284.1	1241.7	1284.101	0.00	1238.1	1238.149	0.05
55	260	1294.4	1253.3	1294.396	0.00	1249.7	1249.734	0.03
56	265	1304.6	1265	1304.617	0.02	1261.3	1261.3	0.00
57	270	1314.7	1276.3	1314.664	-0.04	1272.4	1272.45	0.05
58	275	1324.5	1287.4	1324.544	0.04	1283.5	1283.479	-0.02
59	280	1334.3	1298.8	1334.32	0.02	1294.8	1294.808	0.01
60	285	1344.2	1309.9	1344.154	-0.05	1305.9	1305.93	0.03
61	290	1354.2	1320.7	1354.189	-0.01	1316.8	1316.841	0.04
62	295	1364.3	1331.4	1364.335	0.04	1327.7	1327.656	-0.04
63	300	1374.8	1341.9	1374.772	-0.03	1338.3	1338.262	-0.04
64	305	1385.6	1352.3	1385.599	0.00	1348.7	1348.659	-0.04
65	310	1396.7	1362.9	1396.72	0.02	1359.4	1359.369	-0.03
66	315	1408.1	1373.4	1408.061	-0.04	1369.9	1369.946	0.05
67	320	1419.5	1384	1419.468	-0.03	1380.6	1380.583	-0.02
68	325	1431	1394.8	1430.959	-0.04	1391.4	1391.412	0.01
69	330	1442.5	1405.2	1442.487	-0.01	1401.8	1401.773	-0.03
70	335	1454	1415.5	1453.989	-0.01	1412	1411.977	-0.02
71	340	1465.5	1426	1465.484	-0.02	1422.5	1422.497	0.00
72	345	1477	1436.6	1477.039	0.04	1433.3	1433.271	-0.03
73	350	1488.6	1447.7	1488.572	-0.03	1444.5	1444.55	0.05
74								
75								

Section 9.4: AMPLIFICATION FACTORS FROM REFERENCE FREE-FIELD TO STRUCTURE FOUNDATION LEVELS

Table 9.4-1 Verified interpolation of 105-ft and 223-ft amplification via plotting



Independently checked Tables 9.3-2 and 9.3-3. Identified likely rounding error for amplification difference between 32m and 68 m at 1 Hz. Table list the difference to be -0.053 and I calculated -0.054. The difference carried to Table 9.2-2. Both the adjusted amplification and the smoothed model on Table 9.2-2 at 1Hz are listed as --0.099 where I calculated to be -0.1

	A	B	C	D	E	F	G	H	I	J	K	L
1	**Freq (Hz)**	**Amplification Factor**	Ln	Adjustment		Smoothed model of amplification for reference free-field (ESTA28) to 1200 m/s (LN Unit)	ITR Check	% diff		Table 9.2-	ITR Check	% diff
2	100	0.814	-0.20579		-0.20579	-0.206	-0.0002	-0.1%	-0.11604	-0.115	0.001039	-0.9%
3	50	0.819	-0.19967		-0.19967	-0.2	-0.0003	-0.2%	-0.11266	-0.112	0.000659	-0.6%
4	33.3	0.83	-0.18633		-0.18633	-0.186	0.0003	-0.2%	-0.10477	-0.104	0.000773	-0.7%
5	25	0.829	-0.18754		-0.18754							
6	20	0.83	-0.18633		-0.18633	-0.186	0.0003	-0.2%	-0.10477	-0.104	0.000773	-0.7%
7	13.3	0.82	-0.19845		-0.19845	-0.198	0.0005	-0.2%	-0.11153	-0.111	0.000533	-0.5%
8	10	0.794	-0.23067		-0.23067	-0.231	-0.0003	-0.1%	-0.13012	-0.129	0.001122	-0.9%
9	6.67	0.752	-0.28502		-0.28502	-0.285	0.0000	0.0%	-0.16054	-0.16	0.00054	-0.3%
10	5	0.723	-0.32435		-0.32435	-0.324	0.0003	-0.1%	-0.18251	-0.181	0.001508	-0.8%
11	4	0.733	-0.31061		-0.31061	-0.311	-0.0004	-0.1%	-0.17519	-0.174	0.001185	-0.7%
12	3.33	0.748	-0.29035		-0.29035	-0.29	0.0004	-0.1%	-0.16336	-0.162	0.001356	-0.8%
13	2.5	0.818	-0.20089	-0.004	-0.20489	-0.205	-0.0001	-0.1%	-0.11548	-0.115	0.000476	-0.4%
14	2	0.864	-0.14618	-0.06	-0.20618	-0.206	0.0002	-0.1%	-0.11604	-0.095	0.021039	-18.1%
15	1.33	0.931	-0.0715	-0.054	-0.1255	-0.125	0.0005	-0.4%	-0.07041	-0.07	0.000412	-0.6%
16	1	0.955	-0.04604	-0.054	-0.10004	-0.099	0.0010	-1.1%	-0.05577	-0.055	0.000766	-1.4%
17	0.67	0.977	-0.02327	-0.037	-0.06027	-0.06	0.0003	-0.4%	-0.0338	-0.034	-0.0002	-0.6%
18	0.5	0.986	-0.0141	-0.032	-0.0461	-0.046	0.0001	-0.2%	-0.02591	-0.026	-8.8E-05	-0.3%

This completes the ITR report.

Verifier (ITR): [signature] August 28, 2014

(name/signature) (date)

Exhibit 46

A4NR-00168

Request for Major Project Contingency Release

Completed documents must follow the appropriate approval procedures per the link below:
Major Project Contingency Release / Advanced Authorization Routing Guidelines

Project Name: Diablo Canyon Power Plant – AB-1632 Seismic Study	
Executive Sponsor: Ed Halpin	**Project Number (WBS#): P.04189**
Business Owner: Jeff Summy	**Project Manager: Kent Ferre**
Project Start Date: 12/01/2010	**Project Completion Date**: 12/31/2015
Major Work Categories:	**EPC Authorization Date: 03/28/2013**

EPC Authorized Amount: $51.6M	**EPC Authorized Contingency: $1.6M**
Costs Incurred To Date: $51.3M	**Estimate At Completion (EAC): $64.3M**
Contingency Release Request: $0.5M	**Remaining Contingency (Post-Release): $0.0**
% of Contingency Request in Budget/Operating Plan: 100%	

A) Project Objective Statement

The objective of the Central Coastal California Seismic Imaging Project (aka AB-1632 Seismic Study) is to increase understanding of the seismic hazard at DCPP using 3-D seismic reflection mapping and other advanced techniques.

B) Project Description

This project uses low and high energy 3-D seismic reflection to acquire data, and state-of-the-art techniques to process and interpret these data to image onshore and offshore earthquake faults at depth. The project also includes the procurement and installation of a four-ocean bottom seismometer (OBS) cabled system. The OBS system is used to measure earthquake intensities and sense of slip (e.g., strike slip, reverse) on the ruptured fault, and to constrain onshore and offshore earthquake locations. This project is mandated by the California Public Utilities Commission through Assembly Bill 1632.

C) Reason for Contingency Release

The contingency release is required for additional charges associated with OBS deployment and operability issues. The OBS system, soon after deployment in late 2013, stopped functioning due to underwater cable damage. To mitigate this problem, four temporary OBS units were deployed on November 4, 2014. The cost for the temporary units is covered under warranty. The longer term mitigation is to redesign the OBS system using an enhanced (thicker and more armored) cable to withstand sea floor abrasions. The preliminary costs for the enhanced OBS system will be shared by the manufacturer of the OBS system, Guralp (under warranty) and PG&E from this contingency request.

Through October 2014, costs were within the $1.1M approved contingency release ($51.1M total authorized). However with PG&E internal labor costs accruing in November and December and truing up accruals before year end, authorized amounts will be exceeded by $0.5M. By the end of December costs are forecasted to be $51.6M.

Details of the costs since inception by major scope items are shown below:

The major scope items with end-of-year forecast is shown below:

- *Seismic Survey Design - $0.8M*
- *Offshore High Energy Seismic Survey - $8.4M*
- *Offshore Low Energy Seismic Survey - $14.9M*
- *Onshore Seismic Survey - $19.7M*
- *Ocean Bottom Seismometer - $2.6M*
- *Project Management - $5.2M*
- *Total - $51.6M*

In addition to the increase in costs for the OBS system as described above (covered by this contingency request) costs for the onshore data processing and data interpretation (covered by the already released $1.1M contingency) increased due to the complexity and uniqueness of the data acquired.

Reauthorization will be requested in early January for an amount up to the CPUC authorized amount of $64.3M. This amount will cover the completion of the enhanced OBS system plus potential requests by the CEC appointed Independent Peer Review Panel (IPRP) to conduct additional data collection and/or data processing and interpretation. This potential cost increase is currently unknown. The IPRP is reviewing the final AB1632 Report and will provide comments and recommendations by late January 2015. The reauthorization sought in early January 2015 will include this potential work as a contingency. To the extent possible, charges to this project will be minimized until a reauthorization is approved.

Although not expected the IPRP may recommend in their report, a reattempt at conducting the offshore High Energy Seismic Survey (which was denied by the California Coastal Commission in November 2012). If this work is conducted, the overall completion date will be revised and a separate authorization will be required by the EPC.

D) Lessons Learned / Corrective Action

- *Do not rely on designs by others/establish a design review process for third party designs. Guralp is providing various options for the proposed cable with associated cost-benefits. A formal design review will be conducted using outside experts, PG&E personnel, and Guralp to select the optimum product considering various criteria such as cost, ruggedness, flexibility, ease of deployment, etc.*

E) Budget Impact / Funding Source

The CPUC authorized spending up to $64.25 million to conduct the AB1632 studies. The costs are placed into a balancing account and are recovered through the Electric Resource Recovery Account (ERRA) in annual CPUC proceedings.

Exhibit 47

A4NR-02287

From:	Vardas, Kris </O=PG&E/OU=CORPORATE/CN=RECIPIENTS/CN=KAV6>
Sent:	Thursday, January 22, 2015 9:37 AM
To:	Geldard, Craig <CXGR@PGE.COM>
Cc:	Lum, Megan <MVL2@pge.com>; Risdon, Angela <ACR1@PGE.COM>
Subject:	RE: January 9 EPC Pre-Read, Due 2:00 p.m. Wednesday January 7!

Craig,

Sorry, but I overlooked this item. Here is the status of our involvement:

Environmental Management – Energy Supply continues to support the AB1632 program by assisting DCPP Engineering and the Geosciences Department in permitting for the Ocean Bottom Seismometer (OBS) Project. The existing OBS system is inoperable due to a failed power/data cable. PG&E needs to replace the power/data cable and re-calibrate the four long-term units. Environmental Mgmt worked with the regulatory agencies to identify that repair of the system would require amendments to existing permits and require a minimum six-month process. Environmental Mgmt. obtained necessary approvals to allow deployment of temporary units so that data could be collected until the "fix" was deployed. Temp OBS units were effectively deployed on November 3, 2014. Environmental Mgmt Vetted proposed "fix" with NGOs and the permitting agencies. Targeting submittal of the first application by January 30, 2015 with all permits obtained in time to accommodate a September/October 2015 deployment of the "fix".

Please let me know if you need anything else. I regret the delay in getting this to you.

Thank you

Kris

From: Geldard, Craig
Sent: Tuesday, January 06, 2015 9:20 AM
To: Vardas, Kris
Cc: Lum, Megan; Risdon, Angela
Subject: FW: January 9 EPC Pre-Read, Due 2:00 p.m. Wednesday January 7!

Kris,

Could you send me a write-up for Environmental Management on the DCPP AB-1632 Seismic Study? Environmental Management's previous write-up stated "the permit to conduct high energy studies has been denied by the California Coastal Commission, which impacts the high energy offshore scope of studies. Environmental will continue to support DCPP in planning and permitting efforts as requested." This might still work for the write-up, just let me know.

The increase from the previously authorized amount is "due to an unanticipated failure in the ocean bottom seismometer (OBS) system, as well as higher costs for project management activities and for the regulator's Independent Peer Review Panel (IPRP) reviews, and the addition of onshore seismic survey scope".

I apologize for the quick turn-around. I received the request from Sourcing late yesterday. I'm copying Megan and Angela, so that they're aware of the request. Let me know if you have any questions.

Thanks,
--Craig

Craig Geldard
Manager - Projects
Environmental Management Electric Transmission
Pacific Gas and Electric Company
Phone: (415) 973-6205
Cell: (925) 286-9590

From: O'Shea, John
Sent: Monday, January 05, 2015 4:34 PM
To: Green, Roy; Murley, Stephen; Skerry, John; Connell, Aimee N; Geldard, Craig
Cc: Shim, Gun; Sourcing Leadership; Patton, Nancy; Leung, Schulmynn; Hammond, Michael; Ferrara, Steven; Spingola, Pamela; Cheuk, Wanda
Subject: January 9 EPC Pre-Read, Due 2:00 p.m. Wednesday January 7!

Sourcing EPC Contacts,

The projects that will be reviewed at the Friday, January 9 EPC Meeting are listed below. Within the attached EPC Pre-Read file, please provide write-ups for your assigned projects and **send the file back to me and Nancy Patton by 2:00 p.m. Wednesday, January 7, without exception.** I'm also including the Project Introductions for your review and assistance, and I will send the Business Cases and previous write-ups to you separately. Please be sure to provide information for all fields (Craig Geldard will be answering the Environmental Management question for each project, so Sourcing Contacts can disregard that question).

Please ensure to answer the new EPC questions, which are embedded in the Pre-Read file. For gated projects, the questions are:

- Are there any Supplier disputes (1) regarding this specific project, and (2) regarding the Supplier in general regardless of the specific project being executed? If so, explain:
- Any risk and/or concerns from a supply chain perspective? If so, explain:
- Do we want anything from the LOB (earlier engagement in project, provide us 'x', etc.) ? If so, explain:
- Are there any successes we should highlight?

EPC Pre-Read Slide Number	Project Title	EPC Purpose	Executive Sponsor	Business Owner	Project Manager	Sourcing Contact
2	Embarcadero-Potrero Transmission	Auth.: Gate 3	Williams, Geisha	Yeung, Manho	Billot, Alain	Roy Green
3	Electric Distribution AM/GIS	Reauth.: Gate 3	Williams, Geisha	Dasso, Kevin	Arora, Rajesh	Steve Morley
4	NERC CIP V5 Program	Auth.: Gate 2	Williams, Geisha / Austin, Karen	Sample, Jamey	Hagen, John	John Skerry
5	DCPP AB-1632 Seismic Study	Reauth.: Gate 2	Halpin, Ed	Summy, Jeff	Ferre, Kent	Aimee Connell

Thank you,
John O'Shea
Senior Compliance Analyst, Supply Chain Strategy & Operations
223-2083

Exhibit 48

A4NR-00611

From: Ferre, Kent S <KSF1@pge.com>
Sent: Monday, October 20, 2014 1:20 PM
To: Jones, Blair <BXJk@pge.com>
Cc: abrahamson@berkeley.edu; Nishenko, Stuart <SPN3@pge.com>; Summy, Jeff <J51D@pge.com>
Subject: Response to Santa Barbara New Times/Sam Blakesley

Blair: Below are my proposed responses.

Norm, Stu: Please review for accuracy.

Kent

"This peer review panel was convened to assure that PG&E's research was conducted in a proper and open manner," said Sam Blakeslee, a former geophysicist, as well as the former Republican California assemblyman and senator who authored legislation in 2006 that prompted further analysis of Diablo Canyon. "If the peer review panel is now just a member of the public, what is the point of the peer review panel?"

<u>PG&E Response:</u> In Decision 12-09-008, the Commission was very clear by stating that PG&E shall provide the IPRP the findings and/or results associated with the seismic studies upon finalizing those findings and/or results, and that the IPRP shall review and provide PG&E written comments of those findings and/or results within 30 days of receipt. PG&E complied with the Commission ruling. PG&E looks forward to receiving comments from the IPRP and will address them whenever the written comments are received.

In his own early assessment, Blakeslee said he has concerns about PG&E's conclusions, specifically about the way in which PG&E interpreted ground-motion levels. His concerns fell on many of the same issues the IPRP discussed in its last report, issued about one year before PG&E went public with its final conclusions.

<u>PG&E Response:</u> Since the issuance of IPRP Report #6, *Site shear wave velocity at Diablo Canyon*, PG&E developed a comprehensive 3-D velocity model using thousands of data points obtained during the onshore seismic studies (summarized in CCCSIP Report #10). This extensive data set was used to estimate ground motions in-lieu of the generic shear wave values proposed in the IPRP Report #6, or shear wave values from the on-site borehole data used in the 2011 Shoreline Report. Other site response factors, for estimating ground motions at the site, used state-of-the-art methods, deemed technically sound by the IPRP in Report #6. These site response factors are based on peer reviewed, published scientific papers, and will be additionally peer reviewed and fully documented to satisfy the NRC 50.54(f) commitment.

Exhibit 49

A4NR-00065

From: Page, William <WDP7@pge.com>
Sent: Tuesday, May 20, 2014 3:04 PM
To: Abrahamson, Norman <NAA2@pge.com>
Cc: Klimczak, Richard <RLK1@pge.com>; Nishenko, Stuart <SPN3@pge.com>
Subject: Section for our response to Hamilton

Norm

As you know from the meeting you had last Thursday with Stu and Rich, I am preparing the response to Douglas Hamilton's Testimony for 1632. I need your help in preparing a Report Section that shows that the potential ground motions calculated using his projected San Luis Range fault beneath the DCPP are enveloped by the ground motions used for the plant.

Draft conclusions are

Using both the San Luis Bay fault, and Hamilton's postulated San Luis Range thrust fault as a potential seismic sources, the calculated ground motions are enveloped by the DCPP ground motions, and hence do not present an issue from seismic ground motions.

Let me know what you need to complete this section of the report. I'm

Bill

Exhibit 50

A4NR-00054

From:	Klimczak, Richard <RLK1@pge.com>
Sent:	Thursday, June 12, 2014 1:31 PM
To:	Steve Thompson <thompson@lettisci.com>; Nishenko, Stuart <SPN3@pge.com>; Abrahamson, Norman <NAA2@pge.com>; Page, William <WDP7@pge.com>
Cc:	Post, Jennifer (Law) <JLKm@pge.com>
Subject:	RE: Privileged and Confidential - Hamilton response

Privileged and Confidential

Steve,

As we discussed, I concur with your plan with the addition of a discussion about the uncertainties of the fault planes he draws thru the seismicity data. Also, we noted that his testimony was based on 2009 seismicity data and that his 2012 SSHAC presentation was based on updated 2012 seismicity data.

Thank you for bringing this information to our attention.

Rich

From: Steve Thompson [mailto:thompson@lettisci.com]
Sent: Thursday, June 12, 2014 12:52 PM
To: Klimczak, Richard; Nishenko, Stuart; Abrahamson, Norman; Page, William
Cc: Post, Jennifer (Law)
Subject: Privileged and Confidential - Hamilton response

Privileged and Confidential

Bill, Rich, Stu, and Norm:
This pertains to Hamilton's proponent San Luis Range/Inferred offshore fault (SLRF), his characterization of it as a seismic source, and a proposed response strategy.

HAMILTON'S SLRF SOURCE CHARACTERIZATION

The attached PDF is Table A from Hamilton's testimony document, page 55. I overlooked this page (i.e., I didn't recall it) during our conversations the last few weeks when we were discussing how to treat this part of Hamilton's model in a deterministic calculation. This Table A presents a source characterization for the SLRF adequate for a sensitivity, so it would be incorrect if we say, now or later, that we cannot calculate deterministic ground motions for Hamilton's proponent model because he has not provided a characterization.

Quick summary of his parameters for the SLRF in the attached Table A:

Source-site distance: 1.0 km
Length: 60 km, or 40 km for Irish Hills segment
Dip: 35
Down-dip width: 20 km
Est. Mmax: 7.0

Note that from the dimensions and averaging Leonard and HB02, the 40 km length gives M6.9, and the 60 km length gives M7.1. The stated down-dip width is consistent with a crustal thickness of about 11.5 km.

PROPOSED RESPONSE STRATEGY:

I am working on text for the response report. The approach will include what we've written in the executive summary, namely:

- we collected 2D and 3D seismic data using the best available sources, receivers, and processing (fulfilling the commitment PG&E made at the hearing, correct?).
- we don't see a moderately NE-dipping fault in the 2D or 3D data beneath the Irish Hills.
- However, the data have insufficient depth penetration to evaluate Hamilton's model as stated in his testimony and workshop presentation (we should check this one more time with ONSIP teams)
- his general solution of a moderately north to northeast dipping ramp explaining uplift of the Irish Hills and San Luis Range is being considered as part of the SSHAC process, as was presented at Workshop 3.

To this, I propose we add some language explaining the basis for PG&E's 2011 Shoreline Report SSC (to include the San Luis Bay fault) and why it is preferred to Hamilton's SLRF. Generally, the statements will be:

- Per PG&E (2011), the San Luis Bay fault source has a trend that is consistent with the pattern of differential uplift rate of the Irish Hills. Uniform uplift along the trend of the SLRF would not be consistent with the observed pattern of differential uplift rate observed in the southern Irish Hills.
- Hamilton's model predicts an uplift rate boundary in the offshore coincident with or strongly subparallel and near the Shoreline fault. The interpretation of the MBES data presented by PG&E (2011) suggests strongly that this is not the case. On the other hand, the MBES data do show an uplift rate boundary in the offshore that is subparallel to the San Luis Bay fault source.
- The clear uplift rate boundary separating the uplifting Irish Hills from the subsiding offshore Santa Maria Basin is the Hosgri fault as shown by PG&E (2011) and is not the coastline or the SLRF as implied by Hamilton. Hamilton in his logic appears to be substituting modern-day sea level, and the current divide between onshore and offshore areas, for a late Quaternary boundary between areas of differential uplift rate. It is well known that the average condition over the Quaternary Period has been a sea level much lower than present day; the current coastline is not a proxy for an uplift rate boundary but rather represents the approximate boundary between areas that have been exposed to periodic marine erosion and deposition in the from areas exposed to continuous subaerial erosional and depositional processes over the last million years or so. Instead of modern sea level, a much better indicator to use for separating areas of uplift from areas of subsidence is to evaluate the pattern of Quaternary deposition. Clearly, for the areas adjacent to the SLRF, cumulative deposition is occurring west of the Hosgri fault and not west of the Shoreline fault as Hamilton's model would imply.

To wrap up, I propose to state that the appropriate arena for incorporating Hamilton's SLRF model into hazard is through the SSHAC:

- The efforts of the SSHAC are giving full consideration to the specific elements of Hamilton's SLRF model (e.g., exact length, dip, and location as indicated in his testimony)
- As well as general elements of Hamilton's model (consistency with seismicity, moderate dip, primary uplift rate boundary for the Irish Hills on a northwest to north-dipping fault as opposed to a south or southwest-dipping fault).
- The SSHAC process and PSHA approach allow for alternative models to be evaluated, integrated, and weighed based on their relative merits and consistency with all the available data.
- The SLBF model proposed by Hamilton cannot be considered a unique or preferred solution based on the discussion above, and thus it is inappropriate to consider it in a deterministic hazard assessment.

CLOSURE:

I will continue to work on edits and language for this draft report with Bill Page. In the meantime, I welcome comments and thoughts about this strategy. I think the wrong strategy is to go down a road of performing additional analyses now to try and answer an RAI that has not materialized. It absolutely does seem worthwhile to discuss and create an internal list of additional analyses and their relative merits that we can perform if an RAI on the topic does arise.

Thanks,

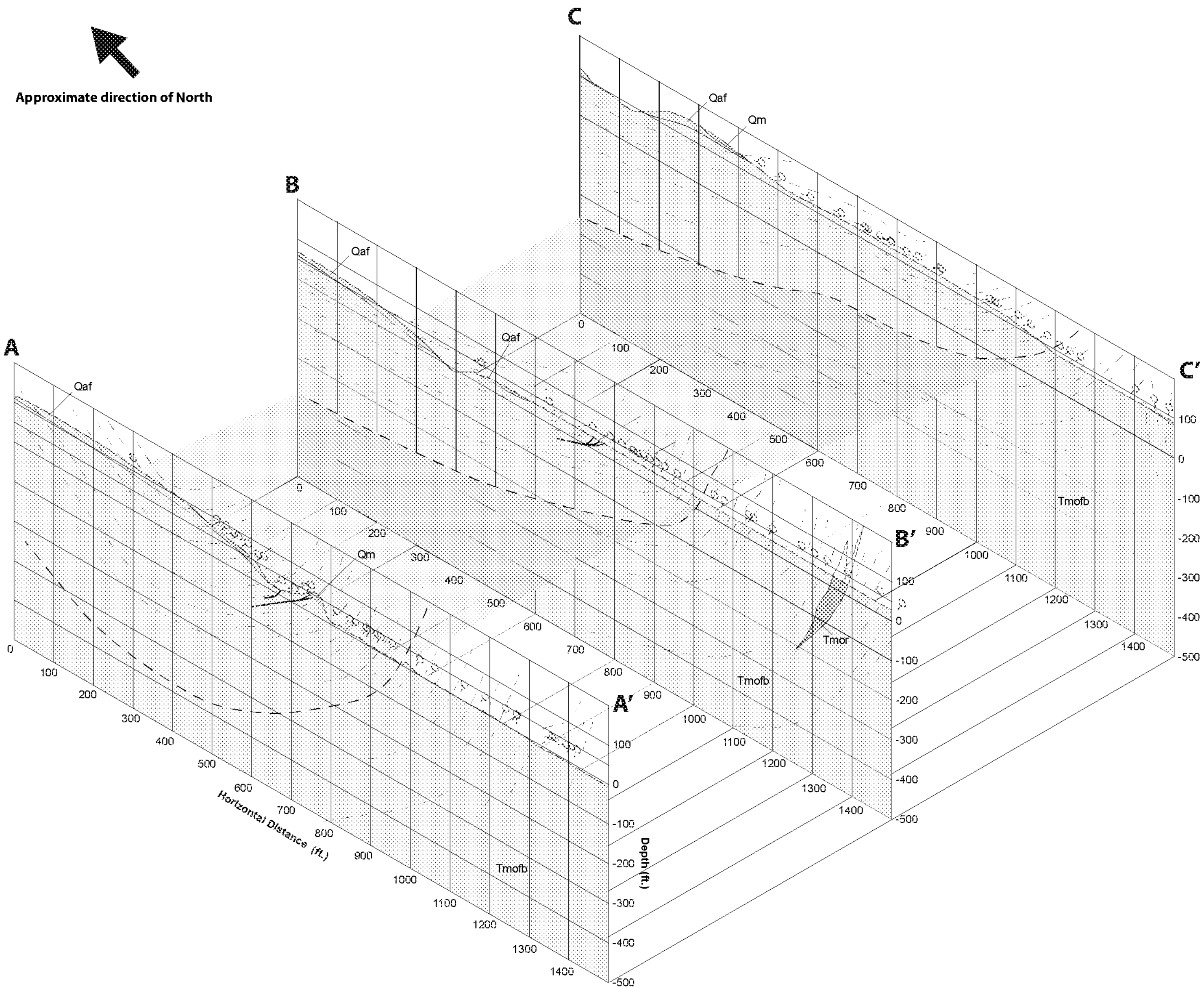
-steve

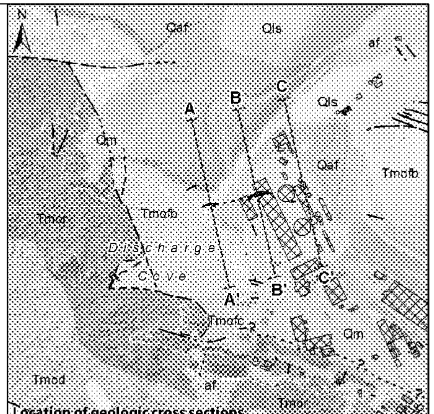
Lettis Consultants International, Inc. (LCI)
1981 N Broadway, Suite 330
Walnut Creek, CA 94596
Main: (925) 482-0360
Direct: (925) 482-0363, x203

Stephen C. Thompson, PhD
Principal Geologist
thompson@lettisci.com * mobile - (510) 919-7465

Exhibit 51

A4NR-00743





Location of geologic cross sections

EXPLANATION

Fault: solid where well located, dashed where approximately located, dotted where concealed, queried where uncertain

Form line

Arbitrary reference plane to show along-strike structural continuity

Apparent dip

Geologic Units

af	Artificial fill
Qls	Landslide deposits
Qaf	Alluvial fan deposits
Qm	Marine terrace deposits
Tmod	Obispo Formation, intrusive diabase
Tmofb	Obispo Formation, tuffaceous siltstone and sandstone
Tmofc	Obispo Formation, tuffaceous siltstone and shale
Tmor	Obispo Formation, resistant tuff

Cross Sections A-A′, B-B′ and C-C′ Illustrating the Diablo Cove Fault at the DCPP

EVALUATION OF HAMILTON TESTIMONY

Pacific Gas and Electric Company | Figure **X-X**

File Path: S:\1005\034\QA_GIS\7_1_5_OtherGISData_QA\Discharge_Cove\Figure_DCF_Cross-Sections_A_to_C.ai; Date: 05/27/2014; User: Alex Remar

A4NR-00743

Exhibit 52

A4NR-00551

From:	Steve Thompson <thompson@lettisci.com>
Sent:	Wednesday, June 18, 2014 2:30 PM
To:	Page, William <WDP7@pge.com>
Cc:	Klimczak, Richard <RLK1@pge.com>; Nishenko, Stuart <SPN3@pge.com>; Post, Jennifer (Law) <JLKm@pge.com>
Subject:	Privileged and Confidential 2D seismic data constraint

---

Privileged and Confidential

Hi Bill,

I had Matt evaluate where Hamilton's San Luis Range thrust would intersect the ONSIP 2D line 112-140 – the line from San Luis Hill to Tidewater well that crosses the San Luis Bay fault.

The attached figure shows the result, and it is not promising. The upper map shows the seismic line in red, and two reference dip lines (purple and brown) oriented perpendicular to the Shoreline fault. The lower cross section has two black stars plotted in the lower left corner. These stars show where a 35 degree dipping fault that strikes parallel to the Shoreline fault and impinges on it at 1 km depth would intersect the seismic line. Only the more southerly of the two points plots on depth extent shown by the ONSIP team, but you can imagine a line connecting the two stars that would traverse the lower-left corner of the profile. The deep corners of 2D seismic profiles are commonly inferred to be of the poorest interpretability based on low fold. Thus, I don't think there is a basis to say we "don't interpret" Hamilton's San Luis Range fault on this 2D seismic line. The more accurate statement is that the data are not of high enough quality at the depths proposed by Hamilton to warrant an evaluation.

Thanks,

-steve

Lettis Consultants International, Inc. (LCI)
1981 N Broadway, Suite 330
Walnut Creek, CA 94596
Main: (925) 482-0360
Direct: (925) 482-0363, x203

Stephen C. Thompson, PhD
Principal Geologist
thompson@lettisci.com * mobile - (510) 919-7465

From: Page, William [mailto:WDP7@pge.com]
Sent: Wednesday, June 18, 2014 11:13 AM
To: Steve Thompson
Cc: Klimczak, Richard; Nishenko, Stuart
Subject: Privileged and Confidential Response

Privileged and Confidential

Steve

Based in discussion with Stu, Norm and Rich yesterday, I'm working on beefing up the seismicity section (with Marcia) and adding the LCI interpretation of the geophysics that helps constrain an east dipping fault near the DCPP. The section on deterministic is deleted. Will have a draft of this late today or first thing tomorrow. Will be adding several figures.

How goes your parts?

Let’s talk this afternoon.

Bill

Exhibit 53

A4NR-00289

From: Ferre, Kent S </O=PG&E/OU=CORPORATE/CN=RECIPIENTS/CN=KSF1>
Sent: Monday, November 17, 2014 4:34 PM
To: Norman A Abrahamson <abrahamson@berkeley.edu>
Subject: RE: IPRP comments on SSC

Norm:

Steve presented the three fault geometry models in the morning…and Chris Wills asked him if he did the hazard sensitivity by giving full weight to each model. Steve answered in the affirmative and that Nick presented these at SSC SSHAC WS#3. We may want to expand or repeat some of Nick's presentation at the next IPRP meeting.

Also, they were suggesting 1/7 or 1/8 for next meeting. Do those dates work for you?

Kent

From: Norman A Abrahamson [mailto:abrahamson@berkeley.edu]
Sent: Monday, November 17, 2014 2:38 PM
To: Ferre, Kent S
Subject: IPRP comments on SSC

Kent:

I have been listening to the IPRP comments. Their basic comments seems to be that seismic data allow for a wide range of models beyond the range that were presented int he report. I think that these are reasonable comments.

I suggest that we add the sensitivity of the modeling of the faults in the Irish Hills (range of dips and depth and slip-rates) to the tornado plots for the Jan IPRP meeting. The constraints on the total uplift and the total SS slip for the region need to be applied.

I thought that Steve Thompson was already doing some of this, but I am not sure what is the status of those calculations.

Norm

Exhibit 54

A4NR-01444

From: Ferre, Kent S </O=PG&E/OU=CORPORATE/CN=RECIPIENTS/CN=KSF1>
Sent: Thursday, March 19, 2015 4:11 PM
To: Jones, Blair <BXJk@pge.com>; Jones, Thomas P. <TPJ2@pge.com>
Subject: FW: IPRP Report No. 8

From: Ferre, Kent S
Sent: Saturday, December 20, 2014 9:48 AM
To: Summy, Jeff
Subject: FW: IPRP Report No. 8

Jeff:

Not sure if you have received IPRP report #8 summarizing their review of the onshore seismic survey results. Overall a very positive report for PG&E. They do however recognize the challenges of imaging the complex geology in the Irish Hills and the difficulty of constraining geometry of the faults at depth. But they do give credit to the 3 tectonic models, developed in the SSHAC seismic source characterization study, as capturing the range of values and kinematics to explain uplift in the Irish Hills.

The IPRP also rejected Dr. Hamilton's hypotheses on the Diablo Cove fault and the Inferred offshore fault.

Kent

From: Winn, Valerie J
Sent: Tuesday, December 16, 2014 10:42 AM
To: Jacobson, Erik B (RegRel); Winn, Valerie J; Post, Jennifer (Law); Abrahamson, Norman; Nishenko, Stuart; Krausse, Mark; Strickland, L Jearl; Jones, Thomas P.; Ferre, Kent S
Subject: FW: IPRP Report No. 8

Here is IPRP #8 for your review. Thanks!

Valerie

From: Greene, Eric [mailto:eric.greene@cpuc.ca.gov]
Sent: Tuesday, December 16, 2014 10:13 AM
To: Nishenko, Stuart
Cc: Jacobson, Erik B (RegRel); Winn, Valerie J; Post, Jennifer (Law); Abrahamson, Norman
Subject: IPRP Report No. 8

Attached is IPRP Report No. 8 dated December 17, 2014. If you have any questions, please let us know. Thanks.

Eric

Exhibit 55

A4NR-00070

May 16, 2014

Kevin Coppersmith
Chair, DCPP SSC PPRP

Subject: Response to Participatory Peer Review Panel (PPRP) comments on DCPP SSC Workshop #3, Dated April 1, 2014

Reference: Participatory Peer Review Panel Report on Workshop #3, Diablo Canyon Seismic Source Characterization Workshop #3 from Dr. Kevin Coppersmith (Chair), Dr. Steve Day, Dr. Neil Driscoll, and Dr. Tom Rockwell

Dear Dr. Coppersmith:

Thank you for your comments and recommendations on the Diablo Canyon SSC Workshop No. 3 dated April 1, 2014. Our responses to the comments and recommendations are given below. The PPRP comment is provided in its entirety in italics, followed by the TI Team response. In addition, please find attached an updated schedule through completion of the project.

Thank you for your comments, and please do not hesitate to contact me at (415) 973-5291 if you would like to discuss the responses.

Sincerely

William R Lettis

William Lettis
SSC TI Lead

Response to Comments

Our responses to the PPRP's comments and recommendations are provided below. We have attempted to respond to all of the PPRP comments; the explicit PPRP comment is shown first in *italics,* followed by our response. Please do not hesitate to contact us if further clarification is required, or if we have inadvertently overlooked a comment requiring a response.

General Observations

We would like to thank and congratulate the SSC TI Team for a successful workshop. It was clear that much work was done prior to and during the workshop to cover the entire SSC model, its detailed implementation, and its technical justification. We also congratulate the PG&E team for making all of the logistical arrangements to ensure a smoothly run workshop.

Thank you. We agree that Workshop #3 was successful and provided important feedback information for the Integration and Model Development phase of the SSHAC process.

Specific Comments and Recommendations

1. SSHAC Level 3 Process

The goal of Workshop #3 within a SSHAC Level 3 process, as described in NUREG- 2117, is to provide the TI Team with feedback in two forms: 1) hazard sensitivity analyses that provide insights into the most significant parts of the preliminary SSC model, and 2) feedback from the PPRP regarding the technical support for the model and the degree to which the model captures the CBR of the TDI. Further, NUREG-2117 prescribes the specific roles that various participants should assume during the course of WS3. For example, all members of the TI Team are expected to participate in the presentation, discussion, and technical justification for the preliminary SSC model. We were pleased to see that this was certainly the case and this led to thought-provoking discussions and insights into details of the SSC model components, as perceived by various Team members.

At WS3 the PPRP is free to question members of the TI Team regarding details of the SSC model and the technical justification for model elements and the treatment of uncertainties. In this regard, the TI Team encouraged active PPRP participation and was responsive to the questions posed by the Panel. For example, the Team responded to the Panel's request for changes to the workshop agenda, which allowed additional time to discuss the approach to recurrence modeling. Also, in many cases, the Team positively considered the comments posed by the Panel and will use that information during the finalization of the SSC model.

Other aspects of the SSHAC Level 3 process were appropriately conducted. Training in the proper roles of the workshop participants was performed daily, and those roles were enforced. For example, the role of observers was identified throughout the workshop and adequate time was provided for observers to comment on the proceedings daily. An additional bonus, for which the PG&E team should be congratulated, was the organization of a special session at the end of each day to allow the general public to ask questions related to the scientific issues surrounding earthquake hazard analysis.

Typically, WS3 within a SSHAC Level 3 project occurs after the completion of the evaluation phase of the work such that proponent and resource experts are not present. An unusual aspect of this project is that data collection activities associated with AB 1632 are ongoing and the PSHA project must consider the results of those activities. Accordingly, PEs and REs were present and participated in the workshop to report their

findings. However, the TI Team was careful to define their role in the workshop and to make it clear how the Team would be considering the results of those studies in the future.

The preliminary SSC model was not complete at the time that hazard calculations and sensitivity analyses were conducted for the workshop. However, the PPRP concludes that a sufficient framework, and components of the model had been completed to provide a significant amount of useful feedback to the Team to assist them with the completion of the integration phase of the work. In order for the work to be completed according to the schedule, it is recognized that a significant amount of work will need to done—in a properly prioritized manner—to arrive at a final SSC model. Prior to that time, the Panel would like to continue to review the development of the model prior to the review of the draft PSHA report. Suggestions for the elements of that review are described below under "SSC products for PPRP review." Also, the impact on the schedule will be important and we discuss this below in "Need for PSHA Schedule."

We agree that new information has and will become available to the TI Team for evaluation and integration, as appropriate, into the Final SSC Model. We will continue to keep the PPRP appraised of our evaluation and integration of the new data and development of the SSC model. As per the attached schedule, we will convene a Final Briefing to review the model with the PPRP prior to submittal of the draft SSC report. In addition, the TI Team will convene several Working Meetings to finalize development of the Preliminary SSC model, in particular development of the recurrence parameters (effective Poisson rate). We will invite the PPRP to attend these Working Meetings, either in person or via teleconference call or webinar, and to provide feedback to the TI Team.

2. Need for PSHA Schedule

Given that the preliminary SSC model is not yet complete, due primarily to the need to finish the ongoing data collection program, we anticipate the need to carefully schedule and prioritize the effort to first complete the preliminary SSC model, obtain additional SSC products and hazard sensitivity results (see below), finalize the SSC model, and document the PSHA report.

Specifically, the elements of the schedule that we would like to see on the calendar are the following:

- *Completion of the preliminary SSC model*
- *Delivery of the preliminary SSC model Hazard Input Document (HID) to the PPRP*
- *Finalization of the SSC model*
- *Briefing with the PPRP to review the final SSC model*
- *Delivery of the Draft PSHA report to the PPRP for review*
- *Review of the Draft PSHA report by the PPRP (minimum six weeks required)*
- *Delivery of PPRP comments to the TI Team*
- *Delivery of Draft Final PSHA report to PPRP for final review*
- *Delivery of PPRP Closure Letter to PG&E*

We have incorporated these elements of the schedule into the updated Project Schedule, as attached.

3. SSC Products for PPRP Review

In order for the Panel to have a full understanding of the SSC model, we would like to request the following products be provided. We understand that all of these products are already part of the planning and deliverables anticipated by the project, but we would like to emphasize their importance to the Panel by listing them below:

- *Recurrence curves for rupture sources, particularly for the Hosgri fault*
- *Implementation of the WAACY model for linked ruptures (Mmax ruptures); how do you arrive at b-tail and tail offset?*
- *Approach to the use of non-Poisson recurrence models, the logic tree distribution of equivalent Poisson rates, and their impact on hazard and uncertainty contribution*
- *Impact of logic tree branches for Mchar and Mmax on hazard*
- *Impact of categorization of rupture sources as either Mmax and Mchar*
- *Discussion of what is aleatory and what is epistemic (e.g., Mmax logic tree, versus aleatory rupture sources)*
- *Hazard sensitivity for all of the above, including running the Shoreline Fault Report model with the new Hosgri rates*

The documentation will provide the TI Team's assessment of the above source characteristics, including sensitivity feedback on each of these issues. The TI Team appreciates the feedback from the PPRP at the Workshop on each of these topics, and will address each of these topics at the Final Briefing as well as in the project documentation.

4. TI Team Action Items

The TI team did an excellent job discussing/summarizing each day's results as well as developing a list of action items required to finalize the SSC model. The PPRP endorses such an approach. Here, we review the TI team's action items according to an overarching theme, not priority. The PPRP is NOT directing the TI team with regard to which action item or scope of work needs to be completed; such decisions are the responsibility of the TI team as they finalize the SSC model. It should be noted that some of the actions identified by the TI Team relate to immediate actions that are needed to finalize the SSC model, other actions relate to documentation that will be provided in the PSHA report. We include both types of actions in our comments below.

a. *Documentation of Piercing Points. Documentation of piercing points for offshore fault systems and age models is required. Specifically, the TI team should explain how the piercing points are used to*

constrain slip distribution along the fault with the full range of interpretations reported. When multiple piercing points yield different offsets and imply different rates, the TI team should document how the geologic slip rate distribution is characterized along the fault.

We agree. The documentation will include a discussion of how the distribution of slip rate is characterized along each fault, and how various piercing points are used to constrain fault slip rate, including assessments of data quality, distance along the fault from the DCPP site, age of piercing point, etc.

b. *Document Use of ONSIP Results. After the SSC model has been finalized, the TI Team should document how or if new ONshore Seismic Investigation Project (ONSIP) results are used to constrain fault geometry and locations in the Irish Hills. For example, will the dip of the Los Osos and San Luis Bay faults in the OV, SW, and NE tectonic models be constrained by the ONSIP data?*

   Results from the ONSIP study will be evaluated and integrated, as appropriate, into the SSC model. We anticipate that the ONIP data will provide important constraints on the down-dip geometry of some (but not all) faults in the OV, SW and NE tectonic models. The documentation will provide the TI Team's assessment of the ONSIP data and how the data are used to constrain fault geometry in the three alternative tectonic models.

c. *Document Definitions of Styles of Faulting. The three proposed tectonic models (OV, SW, NE) entail a rather large range of rakes on some of the individual faults (e.g., the San Luis Bay and Los Osos faults). The style-of-faulting (SOF) categorization of a fault for purposes of applying GMPEs depends upon its rake. We recommend that the SSC TI team coordinate with the GMC (SWUS) team to ensure that appropriate GMPE SOF classes are assigned to the faults, recognizing the SOF assignment for a given fault may vary depending upon which tectonic model it is participating in.*

   We agree. The TI Team will coordinate with the GMC (SWUS) TI Team to ensure that the Final SSC model and HID describe the appropriate rakes for use for each fault in applying the GMPEs. We are aware that the style-of-faulting and rake may vary, both along strike in a particular tectonic model, as well as between models.

d. *Carefully document/compare with UCERF3. The PPRP agrees with the TI team's action item to compare the slip rate models, linked rupture models and rupture participation rates to the corresponding UCERF3 results. The SSC model is based on a more current data set for the local faults than is the UCERF3 model, so agreement is not necessarily to be expected. Rather, the objective should be to document the comparison, pointing out any important differences and explaining why they arise.*

   The documentation will include a comparison of the SSC model to the UCERF3 model results, including rupture participation rates for those fault "sections" closest to DCPP. We agree with the PPRP that agreement is not necessarily expected, but our documentation will include an assessment of any differences and an explanation of why they arise.

e. *Documentation of Slip Allocation and Budget. It is critical that there be complete documentation on how slip is allocated among the various rupture sources and various models to construct the final slip*

budget. The allocation of slip budget to various earthquakes in the final model will drive the ultimate shape/form of the MFDs, which are the basic input to the hazard model.

The documentation will include the TI Team's assessment of how slip rate is allocated among the various rupture sources within each tectonic model, and how the slip budget for the combined rupture sources adds up to equal each fault slip rate. The TI Team recognizes the importance of this assessment for allocating slip budget to various earthquakes, and significance to the hazard model.

f. *Explain Differences in Hazard with that of the Shoreline Fault Report. It was clear during multiple/various presentations that the current assessment of hazard is consistently lower than that presented in the Shoreline Report, possibly based on updated information on fault slip rates. This is a significant feedback issue and will need to be understood prior to finalization of the SSC model, and will ultimately need to be completely documented.*

   The documentation will include a comparison of the SSC model hazard results to the Shoreline Fault report hazard results, pointing out any important differences and the TI Team's assessment of why they arise. The comparison also will be made using the updated SWUS GMPE model for the DCPP site.

g. *Age Model in the Offshore. The PPRP was pleased to see a coherent age model presented by various PEs and members of the TI team for use in the assessment of slip rates for the offshore faults illuminated by the LESS studies. This represents an improvement over earlier presentations and indicates a maturation of the offshore age model that is now being applied in the assessment of slip rates. The PPRP has increased confidence that the final slip rates that will be assessed and completely documented by the TI team in the final report will rely on a mature, defendable age model.*

   The documentation will include the TI Team's assessment of the offshore LESS study for use in constraining the distribution of slip rate along offshore faults. Results from the LESS study will be finalized in June, 2014, and will be evaluated and integrated, as appropriate, into the Final SSC model. We agree that preliminary results from the LESS study have described what appears to be a coherent, well documented age model using sequence-stratigraphy correlation dating methods. The TI Team recognizes the importance of carefully evaluating the LESS study results for assessing and constraining both fault location and distribution of fault slip rate.

h. *Documentation of Hazard Sensitivity to Fault Models. The three primary fault models could represent different hazard levels at DCPP. It will be important to document the hazard sensitivity of these various models to establish whether one model represents a substantially higher hazard than others, and to be sure that all assumptions are well-founded and applicable uncertainties incorporated.*

   The documentation will include hazard sensitivity analyses comparing each alternative tectonic model, and elements within each model. The assumptions and technical bases for each model will be described in the SSC report. The epistemic weighting given to each model, and elements within each model, however, will be based solely on the technical assessments and not on the level of hazard that each model represents.

Exhibit 56

A4NR-01582

From:	Nishenko, Stuart <SPN3@pge.com>
Sent:	Tuesday, February 17, 2015 8:55 AM
To:	Strickland, Luther <LJS2@pge.com>; Halpin, Ed <E1H8@pge.com>
Cc:	Ferre, Kent S <KSF1@pge.com>
Subject:	RE: Board Meeting

Ed
Here's my take –
The three SSHAC models (outward vergent, SE vergent, and NE vergent) are all variations on the same theme. The basic Outward Vergent models contains both SE and NE vergent faults and the CCSIP Report further refined the subsurface mapping and identification of the Los Osos and San Luis Bay faults. The role or activity that each one of these individual faults plays varies according to the model (e.g., SE vergent – San Luis Bay fault is dominant while in the NE vergent – the Los Osos is dominant). As Kent said, at this point there is no preferred model based on available data.

Stu

From: Ferre, Kent S
Sent: Tuesday, February 17, 2015 8:39 AM
To: Strickland, Luther
Cc: Nishenko, Stuart
Subject: Re: Board Meeting

Jearl:

Three faults models were developed by the TI team to explain the uplift of the Irish Hills: 1) outward vergent (most similar to the LTSP model) 2) southeast vergent (shallow dipping San Luis bay) and 3) northeast vergent (shallow dipping los osos); this is intended to capture the center, body, and range. There is no preferred model based on available data
Kent

Sent from my iPhone

On Feb 17, 2015, at 8:23 AM, Strickland, Luther <LJS2@pge.com> wrote:

> Can you give a one paragraph explanation that I can us in a call at 0900?
>
> Sent from my iPad
>
> Begin forwarded message:
>
> > **From:** "Halpin, Ed" <E1H8@pge.com>
> > **Date:** February 17, 2015 at 7:12:50 AM PST
> > **To:** "Strickland, Luther" <LJS2@pge.com>
> > **Cc:** "Harbor, Cary" <CDH2@pge.com>, "Nugent, Pat" <PxN2@pge.com>, "Nelson, Eric P (DCPP)" <EPN1@pge.com>
> > **Subject: Re: Board Meeting**
> >
> > I will need to really understand this one:
> >
> > - The IPRP does not see a strong reason to favor the single tectonic model presented in the CCCSIP report over the two alternative models presented by Dr. Thompson at the IPRP meeting on November 17, 2014. The Dr. Thompson

approach is used in the SSHAC.

Thanks

Ed

Sent from my iPhone

On Feb 16, 2015, at 5:30 PM, Strickland, Luther <LJS2@pge.com> wrote:

> The IPRP does not see a strong reason to favor the single tectonic model presented in the CCCSIP report over the two alternative models presented by Dr. Thompson at the IPRP meeting on November 17, 2014. The Dr. Thompson approach is used in the SSHAC.

Exhibit 57

A4NR-01559

From: Ferre, Kent S </O=PG&E/OU=CORPORATE/CN=RECIPIENTS/CN=KSF1>
Sent: Saturday, February 28, 2015 6:05 PM
To: Strickland, Jearl <LJS2@pge.com>
Subject: RE: Seismic

Jearl:

The GMRS presented a couple of weeks ago was preliminary and did not have the final seismic source characterization model as an input. The biggest change between the GMRS shown a couple of weeks ago and now is the greater contribution from the background source in the Irish Hills. This background source now contributes ~5-15%, depending on the frequency range and hazard level. For example, as shown in Figure 2.2.2-1 of the SPID report (Reference Rock Hazard by Source for 1 Hz Spectral Acceleration) the background source contributes about 8% to the total hazard at a 10-4 annual hazard. In Figure 2.2.2-2, in a similar curve except that it is for 10 Hz, the background contribution contributes ~15% at 10-4 annual hazard. The latest GMRS exceeds the Hosgri at 1.3 Hz (by a few percent). At 10 Hz, Hosgri bounds the GMRS.
The Technical Integrator team used the best scientific method to characterize the background source. Their method was presented and accepted by the PPRP. It is a technically defensible approach. The background source model from the Shoreline study resulted in a lesser contribution to hazard, but the model did not reflect the current technical approach. Since the AB1632 report is based on a deterministic comparison, a background source is not applicable.

Keep in mind, the GMRS in the SPID is not final. Norm will rerun the hazard with the final *WAACY* Magnitude-Distribution model. Norm has said that based on his preliminary runs, the WAACY will result is a slight increase in the high frequency range (~1-2% increase) but a negligible change in the low frequency. The final GMRS is expected to be completed mid next week.

Kent

From: Strickland, Jearl
Sent: Saturday, February 28, 2015 4:22 PM
To: Ferre, Kent S
Subject: Re: Seismic

That's correct. It was the spectra Norm provided Nozar a couple of weeks ago.

On Feb 28, 2015, at 12:04 PM, "Ferre, Kent S" <KSF1@pge.com> wrote:

> So it was the probabilistic and not the AB1632 deterministic spectra compared against Hosgri?
>
> Sent from my iPhone
>
> On Feb 28, 2015, at 11:57 AM, Strickland, Jearl <LJS2@pge.com> wrote:
>
>> He showed the initial GMRS when the Irish Hills contribution was 1 to 2 percent.
>> Before comments resulted in a rerun and a 10 to 15 percent contribution to the hazard.
>>
>> On Feb 28, 2015, at 11:37 AM, "Ferre, Kent S" <KSF1@pge.com> wrote:
>>
>>> Will have something Monday morning. Just I know what was presented
>>> to the board?

Sent from my iPhone

On Feb 28, 2015, at 10:40 AM, Strickland, Jearl <LJS2@pge.com> wrote:

> Kent
>
> Can you put together a concise write up that explains what changed and have it to me early Monday morning? Please let me know that you got this request.
>
> Thanks.
>
> Jearl
>
> Sent from my iPad
>
> Begin forwarded message:
>
>> **From:** "Halpin, Ed" <E1H8@pge.com>
>> **Date:** February 28, 2015 at 10:29:05 AM PST
>> **To:** "Allen, Barry" <BSA8@pge.com>, "Strickland, Jearl" <LJS2@pge.com>
>> **Subject: Seismic**
>>
>> I'm also going to need to understand what changed from my briefing at the board to a new GMRS where we now exceed. I'm not picking on anyone. I just need to be able to explain it.
>>
>> By Monday please
>>
>> Thanks
>>
>> Ed
>>
>> Sent from my iPad

Exhibit 58

A4NR-01881

From: E1H8@pge.com
Sent: Monday, March 2, 2015 2:09 PM
To: Strickland, Jearl <LJS2@pge.com>
Subject: Re: Seismic

Ok

Sent from my iPhone

> On Mar 2, 2015, at 2:43 PM, Strickland, Jearl <LJS2@pge.com> wrote:
>
> Safe travels....On the phone now with Geosciences trying to lock down the GMRS.....
>
> -----Original Message-----
> From: Halpin, Ed
> Sent: Monday, March 02, 2015 1:43 PM
> To: Strickland, Jearl
> Cc: Allen, Barry
> Subject: Re: Seismic
>
> Thanks Jearl
>
> Ed
>
> Sent from my iPad
>
>> On Mar 2, 2015, at 6:41 AM, Strickland, Jearl <LJS2@pge.com> wrote:
>>
>> Ed.....
>>
>> The GMRS presented a couple of weeks ago was preliminary and did not have the final seismic source characterization model as an input. The biggest change between the GMRS shown a couple of weeks ago and now is the greater contribution from the background source in the Irish Hills.
>>
>> This background source previously contributed 1-2% to the hazard level and now contributes ~5-15%, depending on the frequency range and hazard level. The latest GMRS exceeds the Hosgri at 1.3 Hz (by a few percent).
>>
>> The SSHAC Technical Integrator team used the best scientific method to characterize the background source. Their method was presented and accepted by the PPRP. It is a technically defensible approach. It consider three postulated (different) models for the Irish Hills while the AB1632 studies only consider one. The CPUC IPRP noted in their comments that there was no strong evidence to prefer the model that was used in the AB1632 studies and that the uncertainty of the three models should be considered.
>>
>> The SSHAC has two teams working on; the Seismic Source and then the Resulting Ground motion. Norm used the contribution for the Irish hills that he used in previous hazard evaluations. He revised his model when he received the final input from the Seismic Source team.
>>
>> Completion of the SSHAC seismic source should have been completed late last year to avoid last minute changes like this. The GMRS will not be locked down until tomorrow after Norm finished the final set of runs.
>>
>> Let me know if you need more information.

>>
>> ...Jearl
>>
>> -----Original Message-----
>> From: Halpin, Ed
>> Sent: Saturday, February 28, 2015 10:29 AM
>> To: Allen, Barry; Strickland, Jearl
>> Subject: Seismic
>>
>> I'm also going to need to understand what changed from my briefing at the board to a new GMRS where we now exceed. I'm not picking on anyone. I just need to be able to explain it.
>>
>> By Monday please
>>
>> Thanks
>>
>> Ed
>>
>> Sent from my iPad

Exhibit 59

A4NR-02004

From: Ferre, Kent S <KSF1@pge.com>
Sent: Wednesday, March 18, 2015 4:38 PM
To: Jones, Blair <BXJk@pge.com>; Strickland, Jearl <LJS2@pge.com>; Jones, Thomas P. <TPJ2@pge.com>; Winn, Valerie J <VJW3@pge.com>; Nishenko, Stuart <SPN3@pge.com>
Subject: RE: Claims to discuss at 5pm

One comment that was not captured before...on the presentation of 3 fault models in the Irish Hills

---

From: Jones, Blair
Sent: Wednesday, March 18, 2015 4:02 PM
To: Strickland, Jearl; Ferre, Kent S; Jones, Thomas P.; Winn, Valerie J; Nishenko, Stuart
Subject: RE: Claims to discuss at 5pm

Some thoughts before our 5pm call, draft overall message and responses to the claims:

Key message:

"Diablo Canyon is a seismically safe facility and the plant was designed to withstand the forces from earthquakes that could occur in the region. Because of our Long Term Seismic Program and decades of industry-leading research, the seismic region around Diablo Canyon is among the most studied and understood areas in the nation. PG&E and the IPRP have collaborated exactly as the CPUC expected, and the IPRP's feedback to date on the advanced seismic studies was incorporated and considered in the separate and independent third party process that recently updated the seismic hazard in the region of the plant. The results of this analysis demonstrates the plant's earthquake design is appropriate and safe. We recently received final comments from the IPRP on the advanced studies and look forward to evaluating and responding."

Claim -- Gibson and Blakeslee are saying that PG&E has failed to use the most conservative analysis of the seismic data around the plant and is, thereby, underestimating the danger quakes pose to the plant. They point to several aspects of the seismic data. The most significant is the estimate of site amplification which is the rate shaking would either be enhanced or hindered by the geologic composition around the plant. Gibson said PG&E uses a "fudge factor" to always find the plant to be within the ability to withstand a strong quake.

Gibson -- "Every time PG&E identifies a threat, they sharpened their pencils and determine that the plant can withstand that threat." Blakeslee agrees. Instead of saying fudge factor, he called it serendipitous: "A more conservative approach to the problem would have come up with significantly larger shaking calculations," he said. "When I think of a nuclear power plant, the more conservative approach should be taken."

- PG&E has always used advanced, state-of-the art methodologies to assure that the plant is seismically safe and operating within its design and licensing basis.
- Because of our Long Term Seismic Program and decades of industry-leading research, the seismic region around Diablo Canyon is among the most studied and understood areas in the nation.
- As a result, we have continuously improved the science and engineering procedures for earthquake source characterization and ground motion modeling.
- For example, significant amounts of empirical data have been obtained since the plant was constructed, including through the recent advanced seismic studies.
- Because of this research, and advances in ground motion prediction from earthquakes, we have more detailed information about how the site would respond in an earthquake than any other plant in the nation.
- As such, we have presented an updated and accurate site-specific analysis, rather than simply relying on older generic models and outdated procedures. Furthermore, PG&E does not act unilaterally on seismic safety issues. Our work is subject to independent NRC review.

Claim -- Gibson also said PG&E has consistently ignored the IPRP, even going so far as to cancel a meeting to go over the panel's findings.

- PG&E and the IPRP have collaborated exactly as the CPUC expected.
- We value the IPRP's feedback on the advanced seismic studies and have met with them on multiple occasions to solicit their feedback.
- This has included .....number of times met....
- Explain how we agreed to respond to reports 7-9....
- Furthermore, the IPRP evaluations of the advanced seismic research that were available were provided to the SSHAC, and SSHAC members attended and/or reviewed IPRP meetings to gather their point of view as part of the larger independent effort to update the overall seismic hazard.
- For example, **a seismic source characterization Technical Integrator (TI) team member presented** three **fault** models of the Irish Hills that the **IPRP** considered **in their evaluation of the Irish Hills seismic reflection data** .
- The IPRP recently provided their final comments (Report #9) on the advanced seismic studies and PG&E will address these comments.
- This could entail evaluating the IPRP's comments and feedback through our existing Long Term Seismic Program (LTSP), which is a requirement of our operating licenses and continually assesses seismic safety at Diablo Canyon. It also could entail updating the seismic hazard re-evaluation with their comments for the NRC's overall evaluation.

Claim -- The final IPRP report says PG&E has not addressed recommendations the panel has made regarding the site amplification data. The IPRP report says the panel has 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 site-specific term.

- Because of our Long Term Seismic Program and decades of industry-leading research, the seismic region around Diablo Canyon is among the most studied and understood areas in the nation. As a result, we have continuously improved the science and engineering procedures for earthquake source characterization and ground motion modeling.
- For example, significant amounts of empirical data have been obtained since the plant was constructed, including through the recent advanced seismic studies.
- Because of this research, and advances in ground motion prediction from earthquakes, we have more detailed information about how the site would respond in an earthquake than any other plant in the nation, including recordings from actual earthquakes occurring near the site.
- As such, we have presented an updated and accurate site-specific analysis, rather than simply relying on older generic models and outdated procedures.
- We will address these IPRP comments by......

From: Jones, Blair
Sent: Wednesday, March 18, 2015 1:34 PM
To: Strickland, Jearl; Ferre, Kent S; Jones, Thomas P.; Winn, Valerie J; Nishenko, Stuart
Subject: Claims to discuss at 5pm

All,

The San Luis Obispo Tribune is doing a weekend story on the advanced seismic studies and the IPRP. The focus is on Bruce Gibson and others like Sam Blakeslee, who are criticizing "our lack of response" to the IPRP, claiming we have disregarded and not been responsive to their feedback, that we didn't use conservative data in our analysis and that more data is needed to support our site amplification conclusions.

Below are the claims to consider on our 5pm call:

Claim -- Gibson and Blakeslee are saying that PG&E has failed to use the most conservative analysis of the seismic data around the plant and is, thereby, underestimating the danger quakes pose to the plant. They point to several aspects of the seismic data. The most significant is the estimate of site amplification which is the rate shaking would either be enhanced or hindered by the geologic composition around the plant. Gibson said PG&E uses a "fudge factor" to always find the plant to be within the ability to withstand a strong quake.

Gibson -- "Every time PG&E identifies a threat, they sharpened their pencils and determine that the plant can withstand that threat." Blakeslee agrees. Instead of saying fudge factor, he called it serendipitous: "A more conservative approach to the problem would have come up with significantly larger shaking calculations," he said. "When I think of a nuclear power plant, the more conservative approach should be taken."

Claim -- Gibson also said PG&E has consistently ignored the IPRP, even going so far as to cancel a meeting to go over the panel's findings.

Claim -- The final IPRP report says PG&E has not addressed recommendations the panel has made regarding the site amplification data. The IPRP report says the panel has 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 site-specific term.

Exhibit 60

A4NR-01870

From: E1H8@pge.com
Sent: Thursday, March 19, 2015 5:01 PM
To: Jones, Blair <BXJk@pge.com>
Subject: Re: Final question from SLO Tribune

Ok good ....still

Sent from my iPhone

On Mar 19, 2015, at 4:54 PM, Jones, Blair <BXJk@pge.com> wrote:

Slight update after discussing it with other information sources. Going with this:

Q. Was the seismic hazard re-evaluation at all altered based on feedback from the IPRP?
A. The SSHAC considered a number of data sources to inform the seismic hazard re-evaluation, one of the these sources was the seismic studies. An example of how IPRP feedback was incorporated had to do with the Irish Hills. The seismic studies indentified a single preferred fault model for the Irish Hills. The IPRP, after receiving additional insight from the SSHAC team, supported that multiple models be utilized. The SSHAC accepted the IPRP's input and utilized three separate, equally-weighted models to characterize faults in the Irish Hills. Also, the IPRP had direct feedback on the advanced seismic studies plan and it was altered based on their feedback.

From: Halpin, Ed
Sent: Thursday, March 19, 2015 4:32 PM
To: Ferre, Kent S; Jones, Blair
Cc: Jones, Blair; Strickland, Jearl; Nishenko, Stuart; Jones, Thomas P.
Subject: Re: Final question from SLO Tribune

Agree Blair. Thanks for your leadership

Sent from my iPhone

On Mar 19, 2015, at 4:23 PM, Ferre, Kent S <KSF1@pge.com> wrote:

Looks Good

From: Jones, Blair
Sent: Thursday, March 19, 2015 4:22 PM
To: Ferre, Kent S; Strickland, Jearl; Nishenko, Stuart; Halpin, Ed; Jones, Thomas P.
Subject: Final question from SLO Tribune

All – I have a quick question and answer in need of response for the SLO Tribune story.

Q. Was the seismic hazard re-evaluation at all altered based on feedback from the IPRP?

A. The SSHAC considered a number of data sources to inform the seismic hazard re-evaluation, one of the these sources was the seismic studies. The IPRP's reports on the advanced seismic studies were provided to the SSHAC and an example of how feedback was incorporated had to do with the Irish Hills. At the second IPRP public meeting, a SSHAC member presented considered fault models on the Irish Hills for the IPRP's understanding and feedback. The IPRP supported the use of the models in the SSHAC process. Also, the IPRP had direct feedback on the advanced seismic studies plan and it was altered based on their feedback.

Exhibit 61

A4NR-00546

From: Klimczak, Richard <RLK1@pge.com>
Sent: Friday, July 18, 2014 8:39 AM
To: 'Norman A Abrahamson' <abrahamson@berkeley.edu>; Nishenko, Stuart <SPN3@pge.com>; Post, Jennifer (Law) <JLKm@pge.com>
Subject: RE: PRIVILEGED and CONFIDENTIAL

Norm,

Thanks. I uploaded this into SharePoint.

A couple of questions:

Are you still planning on providing an updated tornado plot this afternoon?

Please review and edit the following for the conclusion section:

- *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.*

The Shoreline fault report (2011) included a San Simeon-type earthquake beneath the Irish Hills and DCPP where the San Luis Bay fault (50° - 80° north) and the Los Osos fault (45° - 75° Southwest) intersect at depth. The SSC SSHAC logic trees will consider various fault models to explain the uplift of the Irish Hills, including a San Simeon-type earthquake model.

I would like to talk with you this afternoon, I will call you at 3:00, ok?

Rich

From: Norman A Abrahamson [mailto:abrahamson@berkeley.edu]
Sent: Friday, July 18, 2014 8:19 AM
To: Nishenko, Stuart; Klimczak, Richard; Post, Jennifer (Law)
Subject: PRIVILEGED and CONFIDENTIAL

Revised hazard sensitivity chapter.

Main changes:
1. small changes to magnitudes (based on final lengths and dips). Change is 0.0 or 0.1 mag unit. This was part of adding the documentation on the computation of magnitudes.

2. Used the same approach for ground motion as used in the 2011 report. Improved methods that I tried to use are not ready yet.

3. Corrected some errors found by the QA.

4. Changed the 1977 HE to be for freq > 1 hz (consistent with the license) , with a dashed line showing the extension to lower freq

5. deterministic spectra for both powerblock and turbine building are bounded by the 1977 Hosgri for all scenarios, including the linked SHoreline scenario.

Norm

Exhibit 62

A4NR-00660

DCPP Seismic Hazard Update Summary

Results from a 12/6/13 CNO Seismic Update meeting:

1. CEUS GMRS results were reviewed and we discussed EPRI's effort to provide a method to present the results other than a simple comparison to the SSE. Norm explained that one method being considered is a comparison to the plant's HCLPF (High Confidence of Low Probability of Failure – 95% confidence of less than 5% chance of failure) curve (acceleration vs. frequency). A plant's HCLPF represents the plant's seismic capacity. Comparing the GMRS to the plant's seismic capacity addresses seismic safety.

2. DCPP's GMRS, to be issued March 2015, is expected to be enveloped by the 1977 Hosgri spectra with some low and high frequency deviations.
    a. Before we send the GMRS to the NRC, Seismic Projects (LTSP SSCs) and Geosciences (slope stability and ASW liquefaction) will have performed an evaluation of critical SSCs for any GMRS deviations to the 1977 Hosgri. The expected result of the evaluation is that the affected SSCs can perform their safety function. This task would be our <u>immediate interim evaluation</u> of the impact of the GMRS.
    b. The EPRI Augmented Approach to address the effects of the GMRS on seismic safety will be completed in 2016. We consider this a <u>delayed interim evaluation</u> of the GMRS that precedes the SPRA results in June 2017. All plants are committed to perform the augmented approach evaluation. This evaluation verifies that equipment identified as critical (determined by Westinghouse w/PG&E's concurrence) to seismic safety can perform their safety function. If not, the equipment must be modified by end of 2018 or 2019 if outage dependent.
    c. Ultimately, the new seismic hazard curves and updated SSC fragilities will be input into the updated SPRA (Seismic Probabilistic Risk Assessment) due June 2017. The results of the updated SPRA will be SCDF (Seismic Core Damage Frequency) and SLERF (Seismic Large Early Release Frequency) values. Based on these results the NRC will decide if changes to our licensing basis are required.

3. Plan for a preliminary SPRA (pre- June 2017):
    a. Preliminary seismic hazard curves available August 2014 (Geosciences)
    b. Preliminary SSC fragilities available August 2014 (Seismic Projects)
    c. Preliminary SPRA (w/o Flex equipment) available in December 2014 (PRA)
        i. SCDF and SLERF values calculated
        ii. Identification of SSCs that have the most impact to SCDF and SLERF
    d. Evaluate which SSCs can be modified to provide additional seismic margin (lower SCDF and SLERF)

4. Presentation of AB1632 Results:
    a. The June 2014 report will summarize all of the AB1632 funded work.
        i. LESS (Low Energy Seismic Surveys) offshore studies
        ii. Onshore seismic studies – Addressing Diablo Cove Fault
        iii. Geologic Mapping report of area around DCPP
        iv. OBS (Ocean Bottom Seismometers) project summary
        v. Shear wave velocity profiles at the power plant site report and Norm's additional analyses that support the use of his site factors (addresses IPRP report #6)
        vi. HESS (High Energy Seismic Survey) offshore studies – Summarize why we don't need to perform them
    b. The June 2014 AB1632 report will compare results of slip rates and fault geometries identified as critical to seismic hazard (tornado plot provided to IPRP) to those used in the 2011 Shoreline Fault report. Note: There was no linkage between faults in the Shoreline Fault report.
    c. The June 2014 report will also have deterministic ground motion spectra plots for the Hosgri, Los Osos, San Luis Bay and Shoreline faults based on multiple faults linkage.
        i. Hosgri will be linked to faults up to Mendocino Triple Junction (located offshore N. California)
        ii. Los Osos linked to Hosgri
        iii. San Luis Bay linked to Hosgri
        iv. Shoreline linked to Hosgri
        v. Linkage of faults allows for larger magnitude earthquake possibilities that have low probability of occurrence
            1. Deterministic plots are <u>not</u> based on earthquake recurrence rates
            2. A hybrid approach, deterministic criteria with probabilistic earthquake magnitude recurrence consideration, will be taken in that our plots will be based on magnitudes at 10-6 annual recurrence rate. This approach addresses fault linkage that is acknowledged by the technical community as possible based on the analysis of earthquake data without overly penalizing ourselves with large magnitude earthquake possibilities with very low probability of occurrence.
                a. Justification of the use of 10-6 would be it is a reasonable cutoff for deterministic analysis, less than 1 in a million chance of exceeding the selected magnitude of an earthquake on each fault.
                PRA group (Nathan) has provided justification for the use of 10-6 as follows:
                A recent reference that defines design basis accident scope can be found in INL/EXT-10-19521 "Next Generation Plant Licensing Basis Event Selection White Paper". This paper describes the frequency based categories for licensing basis events (LBEs). These categories are anticipated operational occurrences (AOOs), infrequent design basis events (DBEs) and beyond design basis events (BDBEs).
                - AOOs - greater than 10^{-2} per plant-year.
                - DBEs - $< 10^{-2}$ and $> 10^{-4}$ per plant-year
                - BDBEs - $< 10^{-4}$

For seismic events, definition of a lower limit on BDBEs can be aligned with the concept of the "maximum credible earthquake" or MCE (NUREG-0800 Rev. 2). The MCE represents the level of ground motion for which a nuclear power plant must be designed to safely shut down and is defined as the "largest earthquake that can be reasonably expected to occur on a geologic structure in the current tectonic region". An accepted quantitative measure of the credibility or reasonableness of severe accident consequences has been established as a frequency of core damage of less than 10^{-6} per year (Regulatory Guide 1.174). This criterion can be conservatively applied to the frequency of earthquake occurrence for the purposes of identifying the characteristics of the MCE. Also supporting the determination of a 10^{-6} per year frequency of occurrence criterion for the MCE is PRA scoping guidance from Regulatory Guide 1.200 which states that an external event can be screened from a plant probabilistic risk assessment (PRA) if a conservative analysis shows that the event's contribution to CDF is less than 10^{-6} per year. Therefore, a seismic hazard frequency of 10^{-6} per year conservatively meets the RG 1.200 external event screening criterion.

b. Plots at magnitudes based on 10-7 annual recurrence rate will also be developed but, not included in the report
c. The report will also note that there is a probabilistic seismic hazard update in process that considers all possible magnitudes of earthquakes at any annual recurrence rate.

d. The RIL letter requires an update to the NRC if the Shoreline Fault is found to be more capable. Linking the Shoreline Fault (SLF) to the Hosgri will allow for a higher magnitude earthquake on the SLF and thus be more capable. The other three faults in the SLF report will also be more capable due to linkage. Need to decide how this information is to be passed on to the NRC with Regulatory Services and the Law department.
e. J. Conway's M8 deterministic request:
   i. Norm has provided plots of M8 earthquakes on the Hosgri, SLB, Los Osos and Shoreline.
   ii. It was decided to only evaluate the "critical" SSCs in any frequencies of exceedance ranges to show they can perform their safety function. Action by Seismic Projects.
   iii. This is an internal evaluation only

Exhibit 63

A4NR-00098

From:	Klimczak, Richard <RLK1@pge.com>
Sent:	Thursday, January 9, 2014 9:56 AM
To:	'Carola DiAlessandro' <carola_dialessandro@geopentech.com>; Abrahamson, Norman <NAA2@pge.com>; abrahamson@berkeley.edu
Subject:	RE: Draft SWUS GMC Workshop #2 Proceedings for your review/approval by Jan. 10, 2014

Carola,

Thank you for the explanation. I understand that the spectral accelerations significantly increase from a rupture on the SLB or LO when they are linked to the Hosgir/San Sim but, when the contribution of each fault and low rate of occurrence for these linked ruptures are accounted for in the development of the hazard the impact is small.

Rich

-----Original Message-----
From: Carola DiAlessandro [mailto:carola_dialessandro@geopentech.com]
Sent: Wednesday, January 08, 2014 5:01 PM
To: Klimczak, Richard; Abrahamson, Norman; abrahamson@berkeley.edu
Subject: RE: Draft SWUS GMC Workshop #2 Proceedings for your review/approval by Jan. 10, 2014

Ouch, I just noticed a mistake in my explanation for your question #1.
The relative change in predicted spectral ordinates in around 150%! That's why we refer at the change as LARGE.
The percentage value I mentioned (4% to 20%) are the relative contribution of the SLB case to the total hazard, and then you have to account for the low rate of occurrence of large ruptures that break faults segments with different rake and dip along strike.
When you account for all the elements above, your resulting changes in GM at 10-4 is relatively small (2%-5%).
Sorry for the misleading previous statements.
Cheers,
--C.

From: Carola DiAlessandro
Sent: Wednesday, January 08, 2014 4:36 PM
To: Klimczak, Richard; Abrahamson, Norman; abrahamson@berkeley.edu
Subject: RE: Draft SWUS GMC Workshop #2 Proceedings for your review/approval by Jan. 10, 2014

Hi Rich,
Thanks for your feedback.
Let me try to take the first stab on question 1 and 2, and a portion of 3, allowing Norm to address question 3 more in depth and provide his inputs on the first two questions at his convenience.

1) If you look at Jennifer's table describing the change on predicted spectral acceleration for selected periods, you can notice that the percentage change can be as big as 20% (for PGA) down to 4% (at 0.5 Hz). This percentage change is not negligible. The easier way to look at this effect is as if you had two ways of plugging in parameters in the same GMPE, and depending on which parameter you choose, you obtain predicted spectral acceleration that can differ up to 20%.
However, when you account the contribution of this complex rupture to the total hazard (thus moving from the ground motion space to the hazard space), the low rate of occurrence of the complex case brings the overall

impact to the hazard quite small, on the order of 2-5% as you noted.

2) The Table that Norm distributed at the Workshop did not contain status for those 2 cells, and I faithfully inserted his version - If needed, I can look at the presentation voice recording and fill up the missing entries.

3) Norm's comment is that Heaton's concerns are really "downstream", once fragility is to be accounted. Out of the concerns Heaton listed, we are currently addressing the statistical distribution of our data (both simulations and empirical recording) to evaluate if the normal distribution is applicable, or if the tail of the distribution is fatter/skinnier. Bob Youngs presented his evaluation for his empirical data at last working meeting, and we plan on expanding on the topic at then January 29 meeting (you can see the agenda items that were sent earlier today).
Not only to address these comments, but also for other reasons (ask Norm), Norm is planning to engage Heaton is a one-on-one meeting sometimes in the future - I do not know more details on this plans, sorry.

Hope this helps!
Cheers,
--Carola

From: Klimczak, Richard [RLK1@pge.com]
Sent: Wednesday, January 08, 2014 4:05 PM
To: Carola DiAlessandro; Abrahamson, Norman; abrahamson@berkeley.edu
Subject: RE: Draft SWUS GMC Workshop #2 Proceedings for your review/approval by Jan. 10, 2014

Carola and Norm,

I have reviewed the subject document and have two comments and one question:

1) Topic 8, pg. 17 contains the following statement regarding Jennifer Donahue's Complex ruptures at DCPP work:

"While the potential impact on ground motion for a specific scenario can be large, the expected impact on hazard is low due to the relatively low rate of occurrence of complex ruptures."

I looked at Jennifer's presentation and she presented results for the SLB rupturing with Hosgri and San Simeon and LO rupturing with Hosgri and San Simeon and reported a 2%- 5% increase in GM at 10-4 for both cases. The above sentence describes that the potential impact on ground motion can be LARGE. Why do we describe a 2% - 5% increase as “large”.

2) The Data Needs from SWUS Workshop #1 table, Appendix A has two items, 3A and 5A, with no status reported.

3) How do you intend to address the items brought up in Tom Heaton’s memorandum (Appendix B)?

Rich

-----Original Message-----
From: Carola DiAlessandro [mailto:carola_dialessandro@geopentech.com]
Sent: Tuesday, January 07, 2014 11:46 AM
To: norman abrahamson; Douglas Dreger; Chris Wandell; Klimczak, Richard; katie.wooddell@gmail.com; Bob.Youngs@amec.com; Ferre, Kent S
Cc: jennie.watsonlamprey@gmail.com; John Barneich; Linda Al Atik; mcguire@lettisci.com; Nick Gregor; Melanie Walling; Steve Day; Tom Rockwell; ken.w.campbell@comcast.net; brian_chiou@comcast.net; Andrew Dinsick
Subject: Draft SWUS GMC Workshop #2 Proceedings for your review/approval by Jan. 10, 2014
Importance: High

Dear SWUS GMC TI Team and Sponsors

CC: Hazard Analysts, PTI, PPRP, TI Team Staff, Management Team

Enclosed please find draft Proceedings for the concluded Workshop #2 held in October.

Please provide your comments and/or edits by the end of the current week (January 10, 2014). Make sure to read carefully the Technical Summaries and the draft Reply to the PPRP Commentary Letter, where your feedback is critical.

Once finalized, the current .doc file will be converted into .pdf, will contain the embedded links to the online Workshop #2 presentations, will be uploaded into the project website @ PG&E, and its release will be announced with a massive e-mail blast.

Additionally, once approved, the reply to the PPRP will be signed in the final document and transmitted as a stand alone letter to the interested parties.

Should you have any question, feel free to contact me at your earliest convenience.

Best regards,

Carola Di Alessandro, Ph.D.

Project Manager for the SWUS GMC SSHAC

GeoPentech, Inc.

525 N. Cabrillo Park Drive, Suite 280

Santa Ana, CA 92701

Mobile: 510-491-6713

Fax: 714-796-9191

Office Phone: 714-796-9100

Email: carola_dialessandro@geopentech.com<mailto:carola_dialessandro@geopentech.com>
