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TRANSCRIPT OF PROCEEDINGS

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P R O C E E D I N G S

DR. KAMMERER: Session 7, the final session of this workshop. Thank you all so much for sticking around to the exhausting end, I'm sure, for some of you.

So, this session is on “Tsunami Hazard Evaluation and Continued Discussions of the Current Seismic Studies at Diablo Canyon.” There is a small change from what's listed in the program. We're going have two presentations by Stu Nishenko of PG&E and Lloyd Cluff of PG&E. Dr. Stu Nishenko is a senior seismologist for PG&E's Geosciences Department. He's also chairman of the California Integrated Seismic Network Advisory Committee and chairman of the Government Relations Committee for the Seismological Society of America. He'll be starting off our session, and Dr. Cluff will be following. So without further ado, let me have Dr. Nishenko start.

DR. NISHENKO: Thank you, Annie. Good afternoon. As the anchor for this series of presentations this week, we thought we'd talk about something a little bit different this afternoon. And yesterday and today we were talking about seismology, strong ground shaking related to earthquakes and the effects on the plant, but earthquakes also can produce tsunamis. And this fact was made very evident in 2004 with the great Sumatra earthquake and tsunami that happened in the day after Christmas on Boxing Day. Well, that event refocused or reawakened everybody's appreciation for tsunami hazard facilities along the coast and especially for critical facilities.

So, PG&E decided to take another look at tsunami hazard issues at

Diablo Canyon -- okay -- and at Humboldt, our other facility up in Humboldt Bay, to bring new information that's been gathered over the last 20 to 30 years and kind of revise our understanding of what tsunami hazards are along the coast of California and especially how they relate to critical facilities.

So, this afternoon I just want to give you an overview of some of the work that we've done and kind of place this into context with other marine hazards. So, first, just as an introduction we'll kind of talk about the California tsunami inundation maps that were published by the California Geologic Survey about a year ago and then a brief discussion of winter storms and then get into the tsunami issue. And here, when we talk about tsunamis we usually break them up into three categories: distance tsunamis, which have origins greater than about 1,000 kilometers away; regional tsunamis, which are less than 1,000 kilometers, and these would be events that are originated from the Cascadia Subduction Zone, so the coast of Washington, Oregon and Northern California here on the west coast; and then local tsunamis, events that happen right here in the local stretch of coastline. And here we're talking about tsunamis that are generated by actual fault motion from earthquakes, and then landslide tsunamis. Landslide generated tsunamis really have been sort of another Renaissance over the last couple of years. There was a big event in Papua New Guinea in 1999 which served to demonstrate again the significance that landsliding could have for tsunami generation and local damage.

This is a slide of the tsunami inundation map put up by CGS for the Diablo Canyon area. And what I'd like to do is just draw your attention to the box here which surrounds Diablo Canyon itself. Point San Luis is down here in the lower left corner. And the red line shows the limit for tsunami inundation per

CGS's calculations, and they are very explicit that these maps are for information purposes only, for planning, for evacuation purposes, but certainly not to be used for code or building purposes.

When you look to the map around the Diablo Canyon area, the red line is actually located right at the base of the bluff here. And this is a photograph of Diablo Canyon, so the red line that you saw in the previous slide actually curves right here at the base of the bluff.

Now Diablo Canyon itself is located about 85 feet above sea level, so we feel fairly confident that the plant itself is fairly secure from tsunami threats and hazards. And this was investigated and studied during the original licensing of the plant, 30 and 40 years ago. However, when you look at the same California maps for the Pismo Beach area, and particularly here in Abila Creek and down in Pismo Beach, you'll see that there are areas that are delineated as having a potential tsunami threat, tsunami flooding threat. So it's not so much the concern for PG&E, but probably is more concern for the local residents of Avila Beach and Pismo Beach about what their exposure is to tsunami hazards, and specifically, how the tsunami warning system is working here in your neighborhood.

Now, I don't know how many of you had experience with the January Chilean tsunami that was well televised on CNN and all over the globe. Whether or not there were tsunami warnings or watches issued here for the coast of Central California is a part of that event. But this is how all this gets integrated into emergency planning and emergency management for coastal communities.

Well, what about winter storms? This is something that we all have

experience with and, in fact, about 30 years ago, there was an extreme winter storm in 1981 which took out the breakwaters in front of Diablo Canyon as well as a Chevron Oil pier here in Avila Beach. So these are relatively frequent events that we all have some kind of personal experience with and it provides a context for which we can look at the tsunami hazard.

The next slide here just gives you a table of two of the most significant winter storms in the historic record, one in 1905 and then the 1981 event we were just talking about, and the significant wave heights for these two storms. Now significant wave height is defined as the peak to trough height, so here we're talking about something about eight and a half to nine meters, so that's about 25 to 30 foot high waves. For comparison to the tsunami tables that I'll show you a little bit later, we just kind of cut that in half to look at the amplitude, but here we're talking about waves that are in the order of about 10 to 12, 13 feet high, so pretty significant and, as we've seen, with damage, capable of producing extensive damage along the coast.

In addition to those well documented events, there are other events in the history for the central coast which are a little less documented. And one is an event that happened in 1907 that took out another wharf in the town of Oilport, which was later to become Pismo Beach, I think. And here we have an issue, I think, of terminology and semantics. Some of the newspaper reports at the time in "The Daily Telegraph" talked about tidal waves coming in and taking out the pier. However, if you look at the description of what was happening on that day, it seems pretty clear that what they were experiencing was a winter storm. It wasn't a tsunami. In fact, we have gone back and looked at the records in the USGS Noah and Japanese to see if in fact there were any tsunamis in the Pacific

Basin at that time and no, there were not. So that leaves us to be pretty confident that what we're looking at here are the effects of winter storms and not some unknown tsunami.

But, again, these are significant events. And, in fact, one of the results of our analysis was that by far, winter storms pose a much greater threat to the coast of Central California than tsunamis do, and I'll show you the evidence for that in a moment.

But, after the 2004 Sumatra surveys, as I was saying, we elected to take another look at tsunami hazards along the Central Coast and develop our own tsunami study. And this consisted of a number of steps that we took, in addition to reviewing, compiling all the available marine data along the coast and putting this all into a geographic information system database. We constructed a high resolution digital elevation model of the sea floor out to the continental shelf. So this aided us in identifying and characterizing where some local tsunami sources were and here we're specifically looking at landslide sources. And we also used it then as a reference surface for their numerical modeling that we did to see the impact on wave heights at Diablo Canyon itself.

Once we have that accomplished, we started to evaluate the location and size of potential landslide sources along the continental slope and then develop a set of scenario events, so we could see what kind of wave heights you could realistically expect from these landslides. So, as part of that evaluation, we modeled things such as wave heights, run-ups, draw-downs, the speed of the water coming in and then how far inland did that water reach for inundation distance.

Taking all that information, then we used it to develop a framework

for what we call a probabilistic tsunami hazard assessment. This morning you heard about probabilistic seismic hazard assessment; this is sort of taking those same ideas and techniques and applying it to tsunamis as opposed to earthquakes. And this is sort of a developing field right now. It's not, shall we say, necessarily regulatory in terms of things that we have to address per the NRC, but it's something that we see coming down the road in that we're moving from deterministic analysis for natural hazards to probabilistic analysis for hazards. So we had a great success in addressing earthquake issues and now we want to transfer that success to look at tsunami and other natural hazard issues.

So, I was talking before about developing this digital elevation model for our study. This is a map of the central coastal region from Point Conception -- whoops -- down here to the south, to just a little bit south of Monterey. Diablo Canyon is right here in the red dot. And this represents a digital map with about 90 meter horizontal resolution. And you can see from this map some of the basic physiographic features of the offshore region, the Santa Maria basin right here adjacent to Avila Bay and the Santa Maria escarpment and then, far off shore, the remnants of some of the seafloor that was subducting beneath the continental borderlands some 30 million years ago that Ralph Archuleta showed us pictures of yesterday. So this is an old spreading center called Davidson's Sea Mountain, and then there's an old fracture zone that basically got frozen in the process of being subducted when we switched plate motion from being a subduction zone to a transform fault, the San Andreas Fault system. So again, this gives us a spatial resolution on a scale about 90 meters. The cell size is about 90 meters. Now, more recently than that, as Lloyd Cluff

talked to you this morning, we've worked with the folks at the Monterey Bay Seafloor Mapping Lab to do high resolution multi-beam medthymetry [spelled phonetically] of the area offshore, basically the California state waters out to the 3 mile limit. And here we have an unprecedented data set with a one meter grid. So, with this level of detail, you could actually start to see, you know, the actual geology on the seafloor. There are many areas where the seafloor is not just covered with sand but there are outcrops of basement or bedrock, and you can actually trace geologic structures. This has been very valuable, for instance, in our evaluation of the shoreline fault zone that we were talking about this morning.

Interestingly enough, though, you see here between the coastline and the beginning of this bathometric data, this sort of white zone. This is the area where surf, shallow rocks and kelp growth make it extremely difficult to get boats in to do this kind of seafloor mapping comparable to what we see out here. And one of the things that we've been doing is working with the folks at the seafloor mapping lab to see how we can basically shrink that gap so we have seamless coverage from the deep oceans all the way up to the coastline. So there are just some logistical issues that we need to deal with when we're doing this kind of work.

So, in addition to getting a better understanding of what the seafloor topography looks like, you also have to understand what the response of different water bodies are to incoming waves. And this is a graph that was done back in 1966 when we were going through the original licensing, looking at the response from a point here on the open ocean near Diablo Canyon, to the response of a point here in Avila Bay on Avila Beach. And I just want to caution you that the graphs here, which are basically spectra of wave heights as a

function of wave frequency, they're offset a little bit. The 10 to the minus four line is here on this map, graph, and the 10 to the minus four line is here. But what this comparison is telling us is that the response in Avila Bay is about a factor of four to 10 times larger than the response is on the open ocean near Diablo Canyon. So in other words, lessons that you learn by looking at tide gauge records and historic accounts here at Avila Bay may not necessarily translate into the same numbers near Diablo Canyon. And you have to -- it's the equivalent of a site effect that we talk about in seismology. Each water body has its own particular resonance, characteristics, and periodicities that you need to account for when you're comparing behavior in one area with another area.

So, what about distant tsunamis? This is the first category in that hierarchy of tsunamis that we looked at. And this is a picture of some of the largest earthquakes that have happened in the Pacific Ocean in the last 60 to 70 years and most of them are located here in the northern Pacific, the coast of Alaska, the Aleutians and then Kamchatka in Japan, as well as the famous 1960 Chile earthquake that happened down here in the south. So this is the basis for the historic record of tsunami activity here in the central coast of California. There are some historic accounts, but these events all have tide gauge records of those wave heights generated by the tsunami. So this is, again, this is the equivalent of having seismograms or instrumental records of earthquakes as opposed to eyewitness accounts.

Now, the table here again just goes through -- oops, sorry about that -- what the wave heights at Avila Beach and Point San Luis were for those events that you saw on the previous slide. Sorry about this. And you can see that most of the wage heights -- this slippery guy -- most of the wave heights are

on the order of a meter or less, so that's three feet or less. This is a factor of four to 10 less than the winter storms that I was just talking about in the previous line. So there are some of those winter storms in the order of four to five meters in wave amplitude. Here we're talking about events for magnitude 9 earthquakes; say in Kamchatka that was 1.4 meters. So it's a factor four less than those winter storms. And it goes all the way down to a tenth of a meter or basically down to the limit of resolution of the tide gauge.

So in all, this, so far from what we've seen, and again, it's a limited historic record. It only goes back about 60 years, but in those 60 years what we've seen is the range of tsunami wave heights is less than or equivalent to what the tidal range is on a day to day basis which is about seven feet. So, this kind gives us a perspective on how to evaluate some of these threats.

Now, coming a little closer to home, in addition to considering distant tsunamis, we also want to look at regional tsunamis. And I mentioned before, probably the largest or the most significant earthquake source that we have that could generate tsunamis is the Cascadia Subduction Zone, which is located here: Northern California, Oregon, Washington and the British Columbia coastline. This subduction zone is thought to have generated a magnitude 9 earthquake in 1700 based on historic accounts that we retrieved from the Japanese records.

So, what would happen if that earthquake happened today? Now again, we don't have firsthand or instrumental accounts, so what we did was some numerical modeling and we took first, this model that you see here, which is based on the observations or -- oh, that one. Okay, okay.

FEMALE SPEAKER: [inaudible]

DR. NISHENKO: So this one, based on the observations in Japan, and ran that same model to see what would happen here in the central coast of California. So the barbs here along the coastline represent wave run-ups, or how far inland these waves or water would have penetrated. And again, what you see here is along the central coast where Diablo Canyon is located is, there is minimal effect, minimal run-up to the Diablo Canyon site, again, because it's sitting high on a bluff, and there's a relatively narrow shoreline or beach at the base of that bluff. However, when you get over here to Pismo Beach, there are estimated run-ups on the order of about four to five meters again. So think of four to five meter elevation inland from Pismo Beach and the water would reach up to that point.

We also took the 2004 Sumatra earthquake as a proxy for what would happen in Cascadia, and again, ran that same model, putting it where the Cascadia Subduction Zone is, and here you see somewhat larger rocks along the Pismo Beach area, maybe closer to five to six meters here. So again, it reinforces the idea that while tsunamis may not necessarily be a threat to Diablo Canyon, they are a real and present danger to the coastal communities here in Central California.

So what about local tsunamis? Those, luckily, are pretty few and far between, and in fact, the two major examples of local tsunamis that we have in Central California, one occurred in 1878 and is regarded as being an example of a submarine landslide that produced the tsunami, and then one was associated with the 1927 Lompoc earthquake at about a magnitude 7. So the Lompoc earthquake is one of the few examples along the coast of California where you actually had a tsunami generated by surface rupture during an

earthquake, whereas the 1878 event, again, seems to be related to a slide, again, by circumstantial evidence because it was a calm day. There were no storms at that time, and the best explanation for why this wave came up was that it was a submarine landslide. Now, it's also possible that this could have been an example of a rogue wave which is something that's becoming increasingly more documented around the world. And these are waves that are extremely high, usually about twice the high of the maximum local waves that occur in the world's oceans.

So, this picture here just kind of gives you an idea of the distribution of the damage and reports for the 1878 which is the orange circles and then the 1927 event, primarily did most of its damage here near the town of Surf.

One thing about tsunamis -- landslide-generated tsunamis is the area of maximum impact tends to be fairly restricted along the coast. As opposed to distant tsunamis that, say, come in from the coast of Japan or Alaska that affect hundreds to thousands of kilometers of coastline, landslide tsunamis are relatively localized. So the area of high run-up is on the order of a few kilometers, maybe 10 to 20, 30 kilometers, relatively localized compared to what you see for distant tsunamis.

This again is just a table of what that wave height was at the Port San Luis tide gate station based again on reported observations. And our best estimate is on the order of about a little more than three feet, three to 4 feet high.

With regards to that 1878 event, some of the eyewitness accounts talk about waves overtopping the spits at Morro Bay and here is an interesting case history in using morphologic or geomorphic features to help gauge the size of events like tsunamis. Morro's spit is a very active dynamic feature. It gets

built up and then torn down during winter storms and then rebuilt again many times during the year. So, what we managed -- we found was a topographic map of the Morro Bay area that was done in 1897 and the contour interval on this map is 50 foot. So you can see from this slide here that most of the typography on Morro Bay at the time of that earthquake in 1878 was probably less than 50 feet high as opposed to the typography in current mapping of that spit in Morro Bay which is, in some places, more than 100 feet high. So looking at historic account and then looking at Morro Bay and hearing about how waves overtop the spit, doesn't necessarily mean that the spit was 100 feet then like it is today, so you have to kind of put historic accounts into context with the geology and what was happening at the time of that particular event.

So, submarine landslides are really the main focus for the study that we've done. And to do this we took that digital elevation model that I just showed you and overlaid it with information that we got from ship surveys that were done in the area over the last 50, 60 years. So the blue line shows the ship tracks and as you can see, the area of coverage of these ship tracks isn't necessarily very dense. In fact, some of these tracks are in the order of, you know, five to 10 kilometers between ship tracks, so your spatial sampling is limited. But nevertheless, we tried to do the best we could with the data that we had. And, what we did was, we took information from the ship tracks in terms of actual images of submarine landslides along the Santa Maria escarpment, the edge of the continental shelf, along with information about the local geomorphology and the bathymetry, to kind of rank or characterize the submarine topography in terms of what was its potential to produce a submarine landslide. Some areas here, for instance the Santa Maria basin, are relatively

flat with slopes of only about one to two degrees where other areas along the escarpment are much steeper, on the order of about 12 degrees. And, in fact, where we see most of the evidence for submarine landsliding is at the foot of the Santa Maria escarpment where the land is dipping the steepest.

Now, probably the most recent submarine landslide that has occurred along this section of the coast occurred off of Big Sur about 6,000 years ago and this is called the Sur Slide and you can see the mapping of that slide right here in the image. So this is the most recent event and we thought that we could perhaps find evidence for the run-up from that slide along the Big Sur coast so we ran some numerical simulations for what would the wave heights be associated with that Sur landslide, given the dimensions of the slide that we saw on the sea floor? And again, as I was talking before, the area of maximum inundation for these submarine landslides is relatively limited. Okay, so this is Monterey Bay here, for scale, so that maximum tongue of high wave is fairly limited to maybe about 10, 15 kilometers along the coastline.

There is a location sort of right down the barrel from that high wave area called the El Sur Ranch where we went in to see if we could find, basically, paleo tsunami record for that particular event. As of this date, we haven't had any luck finding it. It's river drainage, so it's quite possible that all the evidence, all the tsunami sands that were deposited, then 6,000 years ago, either have been cleaned out by river drainage or just covered up with gravels and other deposition from the river. But it kind of gives you an idea of what you can do trying to pull together numerical modeling, then with the actual geology to validate the models and then provide some basis for moving forward with decision making.

Another slide that we were concerned with, it was called the Pismo Slide. And this was mapped back in the 1970s and '80s as this red area here in the middle of the Santa Maria basin right off shore of Diablo Canyon. So this is obviously a region of specific concern to us. And we went back and pulled up some of the submarine profile records to just get a better idea of what the Pismo Slide was all about. Here, again, the sea floor is sloping at about one to two degrees so it's relatively flat and what you see when you look at the submarine profile records is evidence of a ripply sea floor surface. And this had been interpreted by folks as either evidence of in-place slumping and rotation of blocks of sediment, or in fact it has nothing at all to do with landsliding, but in fact is a depositional feature, and basically what we're looking at is current ripples on the surface of the sea floor. There is an analogous situation to this off of Eureka near the Eel River, where a similar kind of topography was identified and then with much more research it was bound to be in fact a depositional feature and not a ground failure feature.

So we feel that this provides a good proxy for what we're seeing here in this area that is called the Pismo Slide. It may be misnamed as the Pismo Slide. If, in fact, it isn't a depositional feature and in fact if it does represent blocks of sediment or sea floor that slumped and rotated in place, the amount of differential motion that probably happened when those blocks rotated was very minimal and certainly not enough to give you a significant tsunami along the coast anyway.

But, looking farther west along the coast, this is inset map here, there is Diablo Canyon, Avila Bay, looking along this profile that goes along the Santa Maria escarpment -- or Santa Lucia escarpment, we see evidence for

some significant landslides here where the slope is steepest. And one of the questions that we had to answer, when you do a probabilistic tsunami hazard assessment is, not only what is the size of the tsunami, but how frequently do they occur? So, here we don't have the benefit for a very long historic record, but in the sediments at the base of the slope, there is good evidence for, again, repeated landsliding as seen in the acoustic stratigraphy from these marine profile records. So the areas that I have highlighted here in yellow represent very different acoustic signature in the marine profile of record. Rather than being flat lying continuous layers like you see above and below it -- sorry about this -- rather than being flat lying layers that you see above and below it, the sediment inside these yellow zones are rather disturbed and incoherent, which we take as example for basically landslide deposits in the toe of the landslide.

So by understanding and knowing what the rate of sedimentation is and how fast is sediment deposited in this region here, we can look at the difference in depth between this horizon and this horizon to come up with an estimate about how frequently those events occur. And based on a sedimentation rate of about 15 centimeters per thousand years, our best estimate is that those massive landslides along the base of the continental shelf occur on the order of 200,000 to one million years. Again, this is all preliminary, based on the amount of information that we currently had when we did this study.

So, we did was took all this information and try to integrate it into a probabilistic hazard analysis. So here we included the uncertainty or the variability in all these tsunami sources around the Pacific, Cascadia, as well as the local sources here in the California coastline, included the effects of landslides in addition to earthquakes themselves, and then also added in the

effects of storms and tides so we can compare and contrast the effects.

Now here's the kind of plot that you hopefully are used to seeing now after this morning's presentations, where basically we plot the annual rate of exceedance as a function of wave height. And the different colors here represent the contributions to that marine hazard curve from local earthquakes in red, distant earthquakes in blue, and then the local storms and tides here in purple. The green line represents the contribution from landsliding. And you can see in the plot that, for certainly wave heights greater than about six meters, the majority of the hazard comes from these winter storms. It's only when you start to get wave heights greater than six meters do landslides start to dominate the hazards. But based on the information that we currently have, the frequency of those types of events are on the order of one in 100,000 to one in a million years. So in shorter terms, it is the winter storms that dominate the marine hazard along the coast as opposed to distant tsunamis, local tsunamis, or these deeper landslides.

This is currently an active area of investigation and work and, with time, these kinds of curves are going to be improved. We'll be able to put in more specific definitions about what the uncertainty is and hopefully more specific characterizations of some of these specific landslides, as well as actually the characterization of great earthquake sources around the circum Pacific. There's a lot that we still don't know about the occurrence of magnitude 9 earthquakes in the Pacific basin, so with time we'll be adding to this body of knowledge and helping improve our understanding of tsunami hazards in a probabilistic framework. So thank you for your attention.

[applause]

DR. CLUFF: This morning both Norm and I adjusted our presentations for session five to incorporate some additional material. But since we were on this, I thought I'd take the opportunity to reflect on some things I said this morning and take into account some events.

DR. KAMMERER: So I take it it's only on your stick?

DR. CLUFF: Yeah, it's right -- let's see, try "Other."

DR. KAMMERER: September --

DR. CLUFF: No, that's -- no, no. Let's try and go over. That's right. Under NRC file, yeah.

DR. KAMMERER: Here?

DR. CLUFF: Yeah, now it's "Other Data." And there, go ahead, try that one. Okay.

DR. KAMMERER: Does that look right?

DR. CLUFF: Yeah, that's it.

Just thought I'd show what's been in the news and some professors from the geologic community in Christchurch, New Zealand, talking about this magnitude 7 earthquake that is -- I'd spent some time in New Zealand, about 30 years, 35 years ago looking at all our active faults and in the flat plains near Christchurch are a few. The Marlborough fault propagates through that area and there's what they're now saying is a brand new fault that no one ever thought existed, and so I pulled last night out of the summary of the electric system performance. No power plants were damaged, the main electric generation transmission systems had very little damage. Full power was back on. The earthquake occurred at 4:33, I think, in the morning, and by 8:33, four hours after the earthquake, the full power supply was back on. Over half of the electric

systems stayed in service throughout the earthquake. And overall, the total electric system performed well. In the ground accelerations, this was the largest for anything in New Zealand, was 1.25 G. They were quite surprised at this, and the next one was .93 at a substation with very little damage.

And so, what the news always shows is, they never show the good performance. It's only the bad performance. But the fact that the earthquake occurred at around 4:30 in the morning, most people were home and even if this is a home -- it looks like a home -- the un-reinforced masonry falls into the street. So you have injuries, but you don't have -- there were no deaths from this earthquake. Same size earthquake as the Haiti earthquake with 220,000 people killed, where there were no deaths in this one at the time of day. And the wood frame structures caused this building not to collapse. It's another home. Again, it's a mess, it will have to be demolished, but the bricks all generally fall out in the street.

So these are some commercial buildings in Christchurch, stores, and office buildings, and then the Christchurch City Council building, the interior. You can see it was a good thing City Council was not in session when this earthquake occurred. And then this is the university, the library at the university, poorly anchored shelving, not a big mess, it's non-structural, and then some of the other commercial buildings in downtown Christchurch where, had there been people on the streets or in the buildings, there would've been quite a few deaths.

So I just thought I would share that. The University of California at Berkeley, the gear funded by NSF, a team is already on its way down there and even though their local geologic people said this is a new fault, once we dig some trenches down there I think we will be able to find that this fault and its

recurrence is probably tens of thousands to even 100,000 recurrence between magnitude 7 earthquake. It comes back to what Norm said, you've got to consider the likelihood of earthquakes occurring. So I just thought I would share this thing that's in the news. You'll see a lot more of this next week. Thank you.

[applause]

MR. MAIER: Thanks a lot, Dr. Nishenko and Mr. Cluff, and that brings us to our final question and answer session for today and for the workshop. And I would also like to invite Dr. Abrahamson and Ms. Byron to come up to the podium as well, since this is intended to be a follow on to any questions that may have not been asked from the previous session, which was the new seismic studies and the shoreline fault. And --

MALE SPEAKER: Just leave it there.

MR. MAIER: -- I see that Sherry is still waiting to follow up on the last question from the last session. I'll give you a chance to do so.

MS. LEWIS: Thank you. Dr. Abrahamson --

MALE SPEAKER: It's on, but we need more amplification.

MS. LEWIS: -- you were mentioning at the beginning of your talk that this would be technical and so people would have -- some people could have difficulty in understanding it, which brought to mind then, who was your intended audience, or what is the intended audience for this entire workshop? It's, I assumed, for non-technical people. If it does include technical people, I mean, most of the people here I believe are related, I may be wrong, PG&E or NRC. That's what it looked like on the attendance list that I saw on the computer. I should think they would probably know all of this stuff already, or a lot of it. Or -- actually, I even spoke to some NRC people who had themselves trouble

understanding some of these things. So, as far as technicality goes and your apologizing for it, who's your audience?

[low audio]

MR. ABRAHAMSON: I will -- hello? Is that working? No.

FEMALE SPEAKER: There you go.

MR. ABRAHAMSON: All right. My intention is to start to be able to have people outside of PG&E or the NRC that the public can rely on to give them independent reviews, for example, your professors at Cal Poly. I've begun to talk to them about just the basics of seismic hazard analysis so that they can understand it. You know, you have Ralph Archuleta here from UC Santa Barbara. Those kinds of people can provide the community with -- what I think you need or want is, an independent review as well as, for example, if anyone from -- we had a couple people here from the U.S. Geological Survey.

If we stand up here and just say, the plant is safe, trust us, and go home, it doesn't get anywhere. I think we have to start to tell you what is going on. Why do we believe the plant has adequate safety? What is the technical basis for it? Moving forward in the next several years as we talked about this -- our hazard study will be done under this very structured Shack [spelled phonetically] process which is intended to be open, transparent, and so that at least the technical community can clearly follow what was said, that you can have again somebody other than PG&E and the NRC that can answer your questions and evaluate the technical things that we're saying.

At the same time, if I had given my talk to a purely technical audience it would have been very different as well. So I've tried to keep it as simple as possible so that you would have -- get an idea of what we're doing, yet

really you can't learn this stuff in a day or two, it does take years, but you need to have some local expertise, I believe, outside the NRC and outside PG&E that you as a community can rely on and trust.

FEMALE SPEAKER: [inaudible]

MR. ABRAHAMSON: So I get to keep going here. I think so. They are supposed to watch out for you, but I've been to enough of these public meetings where I've heard you say, “We don't trust the NRC. We want somebody independent to do this. We want the GS to come check this,” and so forth, which everything we do ought to hold up to scrutiny from any technical review. That's, as a scientist, we are -- we have -- we're happy to share all the details of what's going on, and we should have no problem withstanding a review by any group that's working through this.

So, if it's too difficult still, maybe what we need to do is to really start to have some more workshops that are geared back towards -- not quite as fast, Earthquakes 101, moving along -- to bring you up to speed technically. Otherwise, how do you know what to do other than saying, “All right, we will trust the NRC,” or “No, we want the USGS as an independent reviewer,” but we have to start to, I believe, present technical basis for what we're saying and why.

MR. MAIER: I'd also look like to make a plug for the feedback forms. If folks feel there are issues with the workshop that you observed that you would like to feed back to the Nuclear Regulatory Commission, who in turn would feed it back to PG&E to let them know what some of the feedback was, put that on that feedback form and get it to a person, an NRC person, before you leave. They are also self addressed so you can mail them in, if you want to take them home and do a nice, quiet time fill out of that form. Questions on Butch's side?

MR. BURTON: I see none.

MR. MAIER: I saw Judith first, so I'll go to Judith.

MS. EVERED: I'm still Judith Evered from Santa Barbara. Is this on?

MALE SPEAKER: It's on.

MS. EVERED: I didn't get an answer from the experts of the solution to the problem that we have with all nuclear plants, actually, because this research that people living within a certain distance of a nuclear plant are much more susceptible to cancer. Well, this is a big problem because it's not a good thing. It really isn't. And the solution could be changing nuclear power to alternative power, and I'd like to ask the panel what they're thinking would be as regard to solutions to the problems.

Now, I'm not technical, but I do read the L.A. Times, and the California Institute of Technology, the Lucy Jones prediction and the Mexicali earthquake built up stress away from the earthquake center. It released stress there, but at the other end of the Rincon and the San Andreas Faults, it built up stress so Lucy Jones and her colleagues predicted a large earthquake during the rest of this year. So, I consider their thinking important, too, and so I'd like to get the panel's response.

MR. MAIER: Thank you, Judith. I don't know if anybody wants to address the alternative power. Is there anybody on the panel who would like to field that question? I think Ms. Byron will.

MS. BYRON: Since 2003, the state of California has had -- it's called a loading order priority of meeting increased electricity demand and it places the first priority on the cheapest, which is energy efficiency, cost effective

energy efficiency. And then the second is on renewables and alternatives and distributed generation. And then the last is clean fossil fuels. And as you know we have a moratorium on nuclear power at new plants in California, so the loading order is based upon the available technologies to California.

MR. MAIER: And would someone like to address that seismic question that Ms. Evered --

DR. NISHENKO: Well, before we go to seismic, I just would like to add, too, that there is an expectation that more and more of the portfolio of power companies use renewable energy resources. So now we're talking about 10, 20, 30 percent of our portfolios being made up of renewable resources like hydro wind and solar power within the next few years. So there is a shift in that direction.

MR. MAIER: How about the last part?

MALE SPEAKER: Wrong button, sorry

DR. CLUFF: Wrong button, sorry. The kind of thing that Lucy Jones and others in Southern California were talking about is the tectonic stress transfer from one fault to another fault in the environment that might release a big earthquake. And we see the big Chilean earthquake in 1960, what they thought was the main shock was a magnitude 7.8 earthquake and then a day later a 9.5 earthquake occurred. And that was tectonic stress transfer. And so, we won't be surprised to see a large earthquake on the southern end of the San Andreas Fault or some of the nearby faults in that area that are part of this tectonic stress build up and released, but that's not going to have any affect up here. We're too far away. And only an earthquake on the San Andreas Fault might have some tectonic stress transfer on the smaller faults in the vicinity of Diablo Canyon. And

we've already take that taken that into consideration.

MR. BURTON: Okay. We have one here.

MS. MOFFATT: Carolyn Moffatt, Port San Luis harbor district. I have to agree that this has really been a crash course today. I've missed a lot, but I've also learned a lot. I'd like to suggest that perhaps a glossary of acronyms and technical terms might be available with the handouts as we come in, and I think that would help us keep up with the presentations a little bit better. Thank you.

MR. MAIER: Thank you. Very good. We're taping this so it's captured, but please use this feedback form if you can to provide that feedback as well. And Mr. Wardell?

MR. WARDELL: Oh, here's the mic. Ferman Wardell, Diablo Canyon Independent Safety Committee. Can you hear me?

MALE SPEAKER: We can't hear you.

MR. WARDELL: Ferman Wardell. Can hear me now? Okay. You know who I am. We're interested, our committee, in your report obviously on the shoreline fault, and we've been reviewing it for some time. And Dr. Abrahamson, I'm not sure if your slide was in our handout. The print is so small; it's hard for me to read it. But did I hear you say that one of your sensitivity analyses was the three segments of the shoreline fault ruptured together, along with the Hosgri Fault? Question one.

DR. ABRAHAMSON: Yes.

MR. WARDELL: I thought so. And two, if I recall, it was well within the Hosgri spectrum except for the high frequency part. And it was a little bit higher, I think you said 10 percent, perhaps.

DR. ABRAHAMSON: [inaudible] That's correct.

MR. WARDELL: Okay, I'm just trying to get a recap. And that that was fairly inconsequential as far as plant damaged, the higher frequencies, compared to say, the lower frequency in the range you showed us in yellow.

DR. ABRAHAMSON: Yes, our whole PRA is based on three to eight and a half hertz, which is the frequency that most of the structures respond in.

MR. WARDELL: And I know it's preliminary, but when your report comes out in November, is it, or end of the year, will that be in the report as a conclusion or a sensitivity analysis?

DR. ABRAHAMSON: The report.

[loud bang]

Yes, let me just say that.

[laughter]

MR. WARDELL: And one of your conclusions was, well one of your, the end of your slides said that you kind of put more emphasis on the higher frequency ground motion. I was curious why you were focusing on that when the higher frequency ground motion was not all that significant as far as plant damage goes?

DR. ABRAHAMSON: Sure, the -- this is back to your glossary of terms, what does high frequency mean? And to an engineer or a seismologist those are very different things. When I said the work we're doing on numerical simulations has to focus on the high frequencies, currently most of the research in the universities has focused on less than one Hz. That's not even close to the moderate frequency. We need to get that up at least to 10 Hz. Okay? Because

three to eight and a half Hz is key. The 30 Hz is not where we're going to be trying to -- is not the key issue for improving the simulations. It's from the one to 10 Hz range where they have to get more of the focus of the research to work on validating the numerical simulations in that with maybe moderate frequency range, which is what the engineers would call that. But to seismologists, that's high frequency.

MR. MAIER: Question from -- question from Eric.

MALE SPEAKER: We got it. Yeah, I'm using the word frequency in a very different context now in terms of periods of recurrence of earthquake events, which also came up. I don't think the real concern behind one of the questions was dealt with, the question about whether the seismic data needs to be gathered prior to and fed into the re licensing. What I think we heard was that the plant is not designed for extreme amplitude, extremely low frequency events. But the chance of such events is not zero. And the longer the period of operation, the farther from zero the recurrence of such -- or the likelihood of such an event is. And so, in the context of that concern, why is it not relevant, a) if we're talking about extending the lifetime of this plant to move into the highest amplitude, lower frequency events, and b) not to be sure that that data is available prior to extending the lifetime of the plant?

MR. MAIER: Is that directed to any panel member in particular?

MALE SPEAKER: Well, whoever can handle it.

[laughter]

DR. KAMMERER: Yeah, I'll go ahead and start. As was mentioned earlier, in regulatory space the work that's being done to assess the hazard and reassess safety of the plant as has been discussed is a separate

licensing activity and licensing track from re licensing. So re licensing and safety review are two separate processes within the NRC because there are two separate processes within the Code of Fed Regulations to which we work.

Now, in the probabilistic analyses that we perform, as I mentioned, we're working to the annual probability of exceedance of the ground motion of ten to the minus four to 10 to the minus six is what we're reviewing which is one in a 10,000, 100,000 in a million year likelihood of ground motion. And that is actually an extreme event compared to other -- particularly coupled with the performance criteria under those extreme ground motions compared to something like a building code where you're looking at life safety at four times 10 to the minus four as was mentioned. So it actually is considered an extreme event.

MALE SPEAKER: Okay. Think we've got one here.

MS. BECKER: Oops, thank you. Rochelle Becker, again, Alliance for Nuclear Responsibility. Annie, you've talked about two separate processes several times and this is sort of a preface to think about while I'm reading my statement. But we, many of the people in this room have read my rather pointed letter back to the chairman after he denied our request for a stay for the license renewal process. And so I wanted to get back to you today and let you know how I felt about these, this workshop that you put on. And I'd like to invite the NRC to consider this “phase one” and then return to your headquarters and support the Alliance request to collaborate with local, state and appointed agencies and representatives and experts to review PG&E's AB 16.32 [spelled phonetically] seismic studies in mapping.

Our community has been given a chance to listen and to question those who may be involved in the peer review and/or those that are doing the

NRC and PG&E seismic review. Therefore, this is a great deal of value in this NRC meeting if it is phase one, and the NRC commits to regaining its reputation of seismic oversight in California. You are asking this community to live with, PG&E payers to invest in, and California to rely upon 2,000 megawatts of generation from two controversially designed reactors with two major active earthquake faults lying within three miles offshore. We are asking that you work with our state to insure that you understand the costs of inadequate oversight and over dependence on utility experts.

MR. BURTON: I'm sorry. Can -- I know -- do you have a question at some point?

MS. BECKER: No. I'm making a statement. Last February, a month before we met with Chairman Jaczko, we read a speech by the chairman and in his presentation he quoted Ben Franklin: "It takes a great many good deeds to build a good reputation and only one to lose it." The NRC's reputation on earthquakes in Diablo is historical tarnished. There may be disagreements on the reasons why, but there is little dispute. We thank the NRC for this step in repairing the trust that has been damaged. We ask for you now to take the next in assuring the AB 16.32 seismic requirements are resolved in the best interest of all stockholders. The CEC has already expressed a willingness to work with the NRC. Senator Blakeslee expressed a willingness this morning. The Coastal Commission has contacted you with their seismic questions. The Alliance would like to request that you follow this seismic information workshop with the creation of an NRC USGS panel of experts once PG&E completes its seismic study requirements for safe, reliable, and cost-effective regeneration, and then the NRC's reputation the state's economy cannot afford the past mistakes. Now,

would be a really good time to agree not to repeat them.

MR. BURTON: Okay, thank you. We appreciate the comment.

MR. MAIER: Thank you, Rochelle. And I have a question from Jane.

MS. SWANSON: This is kind of four parts, but some of them are really short so don't be frightened. First of all, I second the motion. Thank you, Rochelle, brilliantly said. Secondly, I have six questions in my hand which I will hand you, because I know you don't want to be here till 6:00 p.m. Part three: Not to speak for Mr. Blakeslee, but those of you who are able to be here at the beginning of the day I'm sure were -- your ears must have been caught as mine were when he said to the NRC, I heard it this way, as, “Don't just do a checklist. Make sure the work is all meaningful and directed appropriately toward public safety.” I was very impressed with that short speech he made.

And my own observation of this total workshop is, there certainly is a disconnect between at least some of us in this room who live near Diablo Canyon or downwind. You have quite a contingency from Santa Barbara that drove two hours to come to this workshop. So there is a big gulf between some of us and at least some of the NRC representatives. And this statement that -- this was triggered by the statement that the seismic, the long term seismic program and all these seismic studies are totally separate from license renewal decisions. Now, if that isn't an example of doing a bunch of check boxes but not connecting things that should be connected, I don't know what is. So, I had to make that statement.

And I have a very short, short factual question. So I'm asking anybody, probably a seismologist, to please explain the process and your view of

the importance of peer review of the seismic studies that have already been completed and those that will be done between now and 2013. I know peer review is part of it, but I don't understand it, so I'd like to know who's going to be doing the peer reviewing, from what agencies or institutions, and how does that process work? Like, how does the back-and-forth work? I'm very interested in knowing about peer review of seismic studies. Thank you.

MR. MAIER: Thank you, Jane.

DR. KAMMERER: Well, thank you for the comments and the questions. You know, getting back to your first point, unfortunately, all I'm doing is expressing the way the Code of Federal Regulations is written. It is what it is. And so that's the processes that we work under and they are what they are.

In terms of the NRC peer review, of course, NRC staff is responsible for bringing all the information, it's being accumulated in house to do an ongoing review of the information to assure that no point do we feel that the information that's been gained signifies a safety significant issue such that we need to take immediate actions. We are reviewing it on a constant basis.

In terms of how the peer review was going to happen, we're in discussion with certain groups, the U.S. Geological Survey, of course, is a group that we work with quite a bit, and there are many different offices in different parts to that, to the USGS. They're a large organization. We've also, you know, had some discussions with other agencies so I think in terms of the full scope, to some extent it's still to be determined on our part, but certainly the NRC will be leading independent review to make sure, because it is our responsibility that we are satisfied with all of the elements of the seismic hazard study.

MR. MAIER: Any other members would like to comment? Ms.

Byron?

MS. BYRON: In addition, as part of the California Public Utilities Commission approval of their, of PG&E's request for $16.7 million to do their advanced seismic work, they have established an independent peer review panel that includes California agencies including the California coastal Commission, the California geologic Survey, and the Energy Commission and the Public Utilities Commission and the California Seismic Safety Commission, if I'm remembering all of them. They've already met once, last August 31, they're going to be meeting again. They're reviewing the plans for the advanced seismic studies and they will then provide comments to the Public Utilities Commission and then, at the end of the study, which I believe is going to be completed in 2013, this independent peer review panel will also review the study findings and make comments. So there, is at the state level, there is provision for some independent review by our California agencies' seismic experts.

MR. MAIER: Thank you, Ms. Byron. Any other comments on peer review?

DR. ABRAHAMSON: Sure. The process that we are, will be working under, there is, as I said, is very formal and structured and there's documentation that you can get on these Shack processes and how they work. But peer review is a very important part of it, but we use participatory peer review, that is, it is ongoing through the project. We don't do the work and then hand them the report and say please review it. It is too late at that point to do anything about it. So throughout the process we will be getting feedback, peer review, and addressing that as the project goes forward.

MR. WEISMAN: David Weisman, Alliance for Nuclear

Responsibility. I'm not sure which question to ask first. I could ask someone how far along PG&E is on completing these studies or the information requested in the federal consistency review for the Coastal Commission, including an updated study of the -- let me get it right for you -- the deep crustal structures ground shaking you expect on the side from the crustal structures beneath the plant but that probably -- I don't know if that's an appropriate question for this time. Or, if the question to ask is, why, if the results of the shoreline study are due out by December 31, 2010, we didn't wait to have this meeting till after that so we'd actually have a piece of paper in front of ourselves to actually then discuss what would be a finality of the results that Mr. Abrahamson mentioned earlier in response to Mr. Wardell's question, why the meeting wasn't scheduled then, if that's the question to ask.

But maybe, instead of that -- and I wish I had a PowerPoint. I know we saw a lot of PowerPoint today but it reminded me of something .o. I don't know how many of you heard the news earlier this week, sadly, to report the death of the very famous political cartoonist in Los Angeles at the age of 86, Conrad, whose political cartoons had been featured in the Los Angeles Times for decades. I don't think he ever did PowerPoint. He had just a single pen and an eight by 11 sheet of paper and yet I was amazed, aren't we all, at the best editorial cartoonists and how well they can do.

So in lieu of a question or a PowerPoint, I'll give you my PowerPoint. See, I have a single frame, and it may help shed light on the history that was so abbreviated this morning in those presentations. And so, for the late Mr. Conrad, let's remind the audience of how he treated the Los Angeles Times readers back 30 years ago to the subject. Now, we don't have a camera,

apparently, that can aim at this here. I'll have to show it to you. Have you got a camera? Unfortunately, you can't -- can you panel that into projector?

MALE SPEAKER: No.

MR. WEISMAN: That's really unfortunate. But we can let the audience at home take a look at this original. And this is the actual signed original cartoon by Mr. Conrad, and for those who can't see it, I'll just sort of read it to you. Let's give it a quick look to this side of the room. And a quick look there to that side, and what you see is a sculpture, a contemporary bronze sculpture obviously of a nude figure, and one breast is coming out the front, one breast is coming out the back. And the caption on the plaque of the statute says, "Woman, built by the engineers, from the engineers who built the Diablo Canyon plant." And it's signed by Conrad. And I think in one frame, that kind of sums up the history. There are reverse blueprint errors in there, a lot of that stuff and in one neat frame.

Anyway, just pointing out this is not anything new. It wasn't to the people in this room, mostly. This is the original. Interestingly enough, this was given to us by a benefactor, and what we're probably going to do, regrettably, because we haven't the money to hire attorneys, seismologists, and the like to deal with these issues -- citizens are often at that disadvantage -- is, we'll probably be putting it up for auction to raise money to take our case before the Public Utilities Commission. I'll wind it up. Thank you very much. And you know --

MR. BURTON: Thank you.

MR. WEISMAN: Take the mic away. That's exactly what happens here today. That’s exactly what happens here today. This is not about science

and technology; it should be about process and democracy. Sherry hit the nail on the head with that one. You can take our microphones, but in the end you will not -- you will not be able to silence us.

MR. MAIER: Thank you, David.

MR. BURTON: Thank you.

MR. MAIER: We had a question over here.

MALE SPEAKER: This is a follow up on the question of renewable energy. And I know the topic can be considered a slight tangent so I'd like to rephrase it a little bit. And that's, Ms. Byron and I think it's Mr. Nishenko's responses, you did mention that it is a priority of California to develop and expand our use on renewable energy and for the RPF standards for utilities. But you did kind of assume that that's considering the continued operation of Diablo Canyon, and I think what some people are talking about is phasing it out and replacing it with renewable energy, especially as there's the historic crossover between solar power and nuclear energy and it's becoming more and more economically possible, let alone, safety.

And so my question, you know, is considering that this is possible now, and Diablo Canyon has an additional 15 years of operation before it really does have to relicense, is it not worth considering, you know, in the face of all this discussion of seismic safety, because, I mean, let's face it, in the last couple of days we've heard a lot of unknowns, of uncertainties, and with anything, you know, even bee stings and flea bites, there is a certain margin of risk that we can't be sure of and we can't be safe of so wouldn't it make sense to transition, not to more renewable energy but away from nuclear power to renewable energy and then we wouldn't even have to, you know, bring the circus to town to try to

convince us otherwise in the first place? I mean, what's the worst that can happen? A windmill falling on a cow, rather than, you know, a complete disaster that -- it can be completely ruled out at Diablo Canyon, so isn't that worth considering?

MR. MAIER: I think Ms. Byron, would you like to answer the question?

MS. BYRON: I think, as we mentioned earlier, and as Senator Blakeslee mentioned this morning, both of these plants, San Onofre and Diablo Canyon, are important. They slowed plants currently, but as we've just now mentioned, we are, through the RPS program and greenhouse gas reduction goals, the state is moving toward the, and as PG&E mentioned, the utilities are moving toward more alternative energy already and increased use of renewables. So I think it's happening. It is happening, and there is a priority being placed on renewables and alternative energy.

But currently, these plants are important base load plants and some of them, for example, San Onofre because its position in the grid, it's an important stabilizing to the grid. So it's -- there are a lot of factors to consider. There's waste disposal issues, there are greenhouse gas emissions benefits, there's all kinds of -- every technology has its pluses and minuses, and that's what goes into this energy portfolio planning, and a lot of complicated planning efforts by the California Energy Commission and the Public Utilities Commission, and other agencies.

MR. BURTON: Okay, looking at the time I think we can probably take a couple more questions before we --

MR. MAIER: I've got one from Geof here, in the back ...

MR. BARD: First of all, I want to thank the commission and the academics and the industry representatives for making this for a possible. I look forward to more future more productive ones.

I'd like to remind everyone quickly, NRC is our watchdog. They're there not to promote or protect the industry from uncovering errors and omissions but rather to uncover them. And this is not a place to decide policy on nuclear verses other forms of energy.

That being said, though, I would like to, I'm going to throw a hard question out, and if you can't fully answer it tonight, maybe next time around you can be better prepared. It's been brought to my attention there's concern with pool water which could allegedly -- people fear -- people in the community are afraid that this water can be lost due to pump valve malfunction, piping failure or simple brownout, or that an earthquake could simply slosh the water out of a pool. Now for the lady in the audience with the non specialists, the concern is indicated that the loss of the pool water could cause zirconium alloy cladding to combust spontaneously and this would release cesium 137 into the air. You know, that's pretty scary stuff. So, can you reassure us that there are adequate safety measures being taken with regard to these spent fuel rod pools, vis-à-vis the National Academy of Sciences study also?

MR. MAIER: Do any of the PG&E panelists feel --

MALE SPEAKER: This isn't our field of expertise. Someone else from PG&E --

MR. MAIER: Okay, I won't ask you to hang yourself on that. Is there -- I figured that Goutam would have something to say about that so let me go over here to Goutam. Please stand.

MR. BAGCHI: I wanted to share little bit of what I know about spent fuel pool, the main spent fuel pool. For pressurized water reactors they have found that at least at the surface or partially embedded, that gives them lower amplification, lower oscillation when there is an earthquake ground motion. There is a least 15 feet of water on top of the reactor fuel, the spent fuel, which has a very low rate of activity. Now, if there is an earthquake, the oscillation can be calculated. They have been calculated. There is free board that would accommodate that oscillation.

Now that said, if there are stronger than designed basis motion, some water could spill, but these spilled fuel pools are built with very thick walls. They have steel liners. I have been a coauthor of this exact issue for a [inaudible], -- I can't remember the name of the [inaudible]. I took care of the seismic portion of it. And my firm belief is that there cannot be enough or substantial a crack for the water to drain out of the pool. If the water isn't completely drained out, I don't see a scenario where a zirconium fire could happen before somebody could come in with a fire pump and just put in water. It doesn't take moment -- you know, instantaneous failure. There is plenty of time to replenish the water.

MR. MAIER: Thank you, Goutam.

MALE SPEAKER: [inaudible]

MR. MAIER: Was there anybody who else? Butch, get over here, would you? Will go to Jane first and then Judith.

MR. BURTON: We've got one over here.

MS. SWANSON: I'll be brief and a little bit incomplete but in response to the question that Geof raised, my understanding from reading

documents that I'm not allowed to mention here because they have to do with legal arguments so I won't mention the source of them, but anybody can ask me later, is that the NRC itself has decided that the Western plants -- somebody can add to this, I'm sure -- Western plants must be assessed and treated differently than other, the spent fuel pools at the Western plants, meaning California because of our earthquakes, must be treated differently, assessed differently than those in the rest of the country. So I think a big statement about spent fuel pools are fine and dandy. You can't make a big statement about that and include the San Onofre and Diablo Canyon plants and that's from an NRC source.

And the second thing is, again, I'm not an expert, and I didn't have time to look it up on my laptop, but my understanding from hearing an attorney whose name can be mentioned here, at a legal hearing, is that the water above the height of the spent fuel at Diablo Canyon, I think that height, as I recall -- could be wrong -- was about 32 feet. And if you uncover the top of the rods you can have that spontaneous combustion that Geof mentioned. And I say that for those in the room who are not experts, because until I was at this hearing, I didn't know. I thought you had to uncover most or all of the spent fuel rods for that fire that would release radioactive particles downwind. I thought you had to uncover all of them. But it's only the top portion because it's the way the water circulates the natural heat from the hot radioactive things, goes up the rods and needs to be released into the water that's saturated with boron. And if even the top of the rods are uncovered, that process is interrupted and then you have -- and again, go to the National Academy of Sciences report on this. You don't have to listen to Mothers for Peace. The National Academy of Sciences has done a lot of work on that so uncovering the top of the rods is really, really dangerous, in my

understanding.

If I've just made something that is factually not accurate I'm happy to be corrected but I that's a big picture. Happy to have it on the webcast, and I hope that gives Geof more leads.

MR. MAIER: Was there a question in there, though, Jane?

MS. SWANSON: There was not a question in there. I've been -- I'm a layperson. I have no Ph.D. after my name, but as many of you, the Mothers of Peace have been working on these issues for 37 years so we're not entirely ignorant. And even though those present here, because of their job descriptions, nothing personal, your job description is, you do this, do you do that, never the twain shall meet. I understand; it's okay; nothing personal.

But I do other things. And I got this information at a hearing called by the four -- at that time -- Nuclear Regulatory Commissioners. They wanted to hear this. And I heard this discussion between PG&E, NRC staff, and Mothers for Peace, one attorney. And that is my source of information, and if that has no validity then there is no democracy, and the public is locked out of this process, and the NRC does not want to interact with the public. So, if that's not worth your hearing, you can erase it from your memory.

MR. MAIER: Thank you, Jane.

MR. BURTON: I got one over here.

FEMALE SPEAKER: It's me next.

MR. MAIER: We'll get you after this person over there, Judith.

MS. ZAITZ: So, a change of topics. Oh, sorry, Kristin Zaitz. I have more of a technical question, I guess for Norm or Lloyd. So all of the scientific research that's been going on in the last 10 years or more, seems like it's

resulted in kind of a refinement of our estimation of ground motion, but not a big change to it as it translates into design of buildings. As we saw in your PowerPoint presentations for the Diablo Canyon site, it seemed like the new ground motions predicted were pretty much underneath those already analyzed, and I know for building codes, the recent ground motions I've seen are all around the same as what we've been designing for for the past 10 years or so. Are there any scientific issues on the horizon that you see that have the potential to make a change to these ground response specters?

MR. BURTON: Good. Thank you.

DR. ABRAHAMSON: The answer is yes, but I will give you, unfortunately, a very technical answer. I'm seeing frowns looking at me. The biggest change that is coming in ground motion models in the next five to 10 years, is the model of the standard deviation of the ground motion. I think that we have gotten a pretty good robust handle now on what the medians are. You will see, though, the effort to really start to look at how much of the -- let me step back. When we take our data sets, we bring in data from all around the world and we lump it together because we don't have enough data from one particular spot to build a complete ground motion model.

So if I want to look at ground motion from big earthquakes closely I have to see, what do I know from Turkey; what do I know from Taiwan; what do I know from California, New Zealand and so forth and sort of bring all that together. As a result, we sort of are mixing differences that might exist between those regions are all blurred into our standard deviation. And the big effort that's going on in the next 10 years is really to refine that and to build models that are more region specific. We might have a California only model or a Northern

California model versus a Southern California model, and that will be supplemented with more data as well as the larger use of numerical simulations to be able to distinguish between regions.

So that's the big fundamental change. What we're going to then see is a likely -- the hazard curves are going to steepen up because our standard deviations are almost likely to come down. So they'll be steeper, but they will be shifting to the right and left as we might find Northern California has lower ground motions than Southern California on average, and we will start to correct that.

So there's actually a whole lot going on. This is really up at Berkeley, the heyday of ground motion modeling. I've told people the amount of work that's going on right now is just tremendous. We haven't had this much action going on in years and you are going to see really some big significant changes. However, I think they'll all be taking conservatism out of what we're doing right now.

MR. BURTON: Okay. I had said two more questions, four or five questions ago so, let's -- oh, I'm sorry. Did you want to --

DR. KAMMERER: I was just going ask a follow-up question to that response. Are you talking about applying a non aerogatic [spelled phonetically] assumption to the region and do think you have to have enough data to do that?

DR. ABRAHAMSON: The answer is in five to 10 years, yes, we are planning to do just that.

MALE SPEAKER: Seismic talk.

MR. BURTON: Last one?

MR. MAIER: I'm looking forward to a final question from Judith.

MS. EVERED: Is it not true that renewable energy is not funded

properly? And just thousands going to sun and wind technology and building, isn't it true that we're starved with the rational course of this energy? And how can you make this process more democratic? You can have an evening session because people -- generally in this town who oppose nuclear energy don't get a day off to be able to talk about it. And so next time, I hope you have an evening session. It worked very well in February and March, evening sessions.

MR. MAIER: Thank you, Judith. Ms. Byron is there any response for that?

MS. BYRON: Judith, I think it's shifting, I think, nuclear energy was, it's true. It has been heavily subsidized especially in the early years, but I think there has been a shift to encouraging renewables, definitely and now the new energy technologies are being encouraged. R&D is funding -- there are federal funds for that. There are federal loan guarantees for nuclear but there are also considerable incentives for new renewables offered by the state as well as at the federal level. So I think it's shifting with more encouragement and financial incentives to shift to renewables. Pierre, did you -- anyone else have any?

MR. MAIER: Well, thank you. I think we -- we're at the end, right, Butch? I think we're at the Academy Award acceptance speech part of it where we thank everyone for everything.

First, I'd like to thank you two guys in the back, AGP Productions, an outstanding job of keeping everything on track, as usual.

The lady standing in the purple, I'm going to out her right now. That's Agnes Chan [spelled phonetically]. She's the site administrative assistant. She was the face you saw when you came to register, as well as the other site inspection team there, Tony Brown and Michael Peck [spelled phonetically], for

their help.

I don't want to steal too much of your thunder, but I also appreciate the work of the two ladies sitting down there. Anything you see that happened here is due to their toil and sweat and that's Kristi Denison [spelled phonetically] and Megan Williams [spelled phonetically].

[applause]

And before I turn it over to Roy, I want to thank my co facilitator, Mr. Butch Burton. Sir, you have truly earned your Three Musketeers bar.

[laughter]

MR. BURTON: Thanks. He knows I like Three -- Oh, I don't get both?

MR. MAIER: We're going to kind of toast.

MR. BURTON: Oh, I see. Okay.

MR. MAIER: And with that, I'll turn it back over to Roy for some closing remarks.

MR. CANIANO: Thank you, Bill. Again, it's been a long two days, a lot of topics were discussed. And you know, we heard a lot of comments. I solicited a lot of feedback just walking the crowd during lunchtime and during some of the breaks and everything, looked at some of the cards that we've got, looked at some of the feedback forms already that we've got. There are some consistencies in there. We will take a look at them for future seminars and workshops that we have here. But one thing that resonated with me just a little while ago was Rochelle making a comment that she hopes that this may be phase one. And you know, we should consider having maybe additional workshops, maybe a workshop after the study is completed to again to discuss

some of the PG&E results. That's a possibility. We can do that.

But again, I appreciate everyone's attendance. It was two long days. Did we agree with everything here? No. And that's okay. We did this, again, one of the purposes of this was to seek input and to see comments and everything. We're going to take a look at the comments.

Hopefully we're going to have the video that's going to be available within a week to two weeks. It will be on the NRC public website. Any documents that were provided to us today, I know this morning there was one the was handed to us, we're going to post that on our website, too, because there was a specific request to make that part of the record. And we will do that.

So again what I want to do is thank everybody again for their diligence, their patience on occasion and I hope that we were responsive to some of your questions. So again, thank you very much.

[applause]

[Whereupon, the proceedings were concluded]