STATE OF CALIFORNIA – THE RESOURCES AGENCY
BEFORE THE
CALIFORNIA ENERGY COMMISSION (CEC)

In the matter of,	
	) Docket No. 11-IEP-1J
	)
Preparation of the 2011	)
Integrated Energy Policy Report	)
(2011 IEPR)	)

Committee Workshop on
California Nuclear Power Plant Issues

CALIFORNIA ENERGY COMMISSION
HEARING ROOM A
1516 NINTH STREET
SACRAMENTO, CALIFORNIA

TUESDAY, JULY 26, 2011
10:07 A.M.

Reported by:
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COMMISSIONERS

Robert Weisenmiller, Chair and Presiding Member,
IEPR Committee

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Colette Kersten, her Advisor

Also Present (* Via WebEx)

Presenters/Panelists

Dr. William Ellsworth, US Geological Survey (USGS)
Dr. Sam Johnson, USGS
Chris Wills, California Geological Survey (CGS)
Charles Real, CGS
Mark Johnsson, California Coastal Commission
Loren Sharp, PG&E
Mark Nelson, Southern California Edison (SCE)
Carolyn McAndrews, SCE
*Mujid Kazimi, MIT
Alex Marion, Nuclear Energy Institute, (NEI)
Peter Lam, Diablo Canyon Independent Safety Committee
*Tom Cochran, NRDC
*Arjun Makhijani, Institute for Energy and Environmental
Research

Public Comment

1. Lloyd Levine, former Chair, Assembly Committee on Utilities and Commerce
2. Michael Monasky, Sacramento County Public Health Advisory Board
3. Rochelle Becker, Alliance for Nuclear Responsibility
4. Dr. Harry Wang, President, Physicians for Social Responsibility, Sacramento Chapter
5. Gary Headrick, San Clemente Green
6. Dan Berman, Davis, Coalition for Local Power
7. John Burton, Sacramento, Solar energy and Hot Water Business
8. Barbara George, Women’s Energy Matters
9. Ben Davis, Jr.
10. Bob Anderson
11. Richard Cohen
12. David Gray, Sierra Club California Energy and Climate Committee
13. Pedro Morillas, Legislative Director for the California Public Interest Research Group
14. David Weisman, Alliance for Nuclear Responsibility
15. Mary Beth Brangan, Ecological Options Network
16. Frank Brandt, San Jose
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18. Patty Davis, San Clemente

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P R O C E E D I N G S

JULY 26, 2011 10:07 A.M.

CHAIRMAN WEISENMILLER: I'm Bob Weisenmiller, the Chair of the Energy Commission and I certainly welcome everyone here today, and along with the Vice Chair, Jim Boyd, to my left.

I want to note Mike Florio to my right. And, Mike, do you want to say a few words?

MR. FLORIO: Yes. Well, it's a pleasure to be here today. We have some of these same issues before us in rate-setting proceedings, so it's an important chance to gather information.

I have with me my advisor, Sepideh Khosrowjah, and also at your far right is Colette Kersten, who's Energy Advisory to Commissioner Sandoval, who I believe will be here later today.

CHAIRMAN WEISENMILLER: Yes, I believe she'll be here around 11:00 today.

MR. FLORIO: Okay.

CHAIRMAN WEISENMILLER: Anyway, again would like to welcome everyone, so we have a lot to cover. Obviously, this is an area with a lot of public interest and attention. We -- one of the key roles of government and, obviously, some of this is split between the State and Federal government is safety and reliability. And,

certainly, these plants are a key asset for California but have implications, particularly given their location. So, today we're going to spend a lot of time on seismic issues and also the implications of the tragedy in Japan.

Jim?

COMMISSIONER BOYD: Thank you, Chairman Weisenmiller and let me add my welcome to the -- our fellow Commissioners and staff from the PUC, it's great to see them here.

I want to thank everybody for attending, particularly our many panel members, some of whom have traveled some distance to be here, so that's much appreciated.

I, not only as a long-time Energy Commissioners, I guess the longest standing one at present time, have been the State's Liaison to the Nuclear Regulatory Commission for the greater part of my nine and a half years here.

And so this other-duties-as-required, low-key job that was handed to me those many years ago has turned out to be anything but low-key, and interesting, if not exciting.

So, I'm anxious to hear the discussion of the day from our many guests and panelists to, frankly, to

continue to add to if not clarify our body of knowledge regarding California's nuclear plants, obviously, with particular emphasis for some of us on seismic questions.

Frankly, some of these questions regarding seismic concerns we, as an agency, have pursued long before the tragedy of the Fukushima Daiichi plant in Japan.

But I must say as a result of this tragedy our long-term concerns have been taken more seriously, actions to answer our questions are being pursued with more vigor and we look forward to assuring folks that California government is on top of the situation.

And as Chairman Weisenmiller indicated that our concern for the public health and safety, as well as the electricity reliability, for the folks in California gets addressed.

Our testimony to many agencies since the disaster in Japan, California agencies, Congress and what have you, have, of course, centered around the seismic issues, but there are a series of other issues that I want to make sure don't get lost. Certainly, spent fuel pool overheating, which is related to seismic, but not necessarily; station blackouts, evacuation planning, just a few of the issues that concern us.

I'm grateful for the whole concept of the Integrated Energy Policy Report, which we've been doing for several years in this State, every other year, odd-numbered years since the tragedy that California suffered a few years back, and it has provided us a forum to pursue a host of issues. And it has provided us a reason to look into nuclear power plant issues in California, a few years back, for the first time in almost 30 years, and we've been able to continue this dialogue through workshops like this since we began having IEPR hearings in 2003.

We've got older plants in California, we've got lots of spent fuel onsite, in pools, in dry casks. Our plants are located on the coast, in a very seismically area of the world. Hopefully, not as seismically active as has beset the folks of Japan.

So, I look forward to hearing from our panelists and, hopefully, putting to rest some of the questions that have concerned us for quite some time.

So, thank you, Mr. Chairman.

CHAIRMAN WEISENMILLER: Suzanne.

MS. KOROSEC: All right. Good morning, everyone, I'm Suzanne Korosec, I manage the Energy Commission's Integrated Energy Policy Report Unit. Welcome to today's Workshop on Nuclear Power Plant

Issues. It's being conducted by the Energy Commission's Integrated Energy Policy Report Committee.

Just some housekeeping items; for those of you who may not have been here before, rest rooms are out the double doors and to your left.

I do want to point out that our schedule today is very full and to get through our material this morning we're going to be breaking for lunch a little later than usual, from 1:00 to 2:00.

There is a snack room on the second floor, at the top of the stairs, under the white awning, if you need to tide yourself over into the lunch break.

If there's an emergency and we need to evacuate the building, please follow the staff out the building to the park that's kiddy-corner and wait there until we're told that it's safe to return.

Today's workshop is being broadcast through our WebEx conferencing system, so parties should be aware that it is being recorded.

We also have the media here, so you are being filmed, as well.

We'll make an audio recording of the workshop available in about two days on our website, and we'll post a transcript in about two weeks.

Given the number of attendees that we expect

today, we do have overflow space set up in Hearing Room B, across the atrium, that has additional seating space and you'll be able to see and hear the presentations there as well.

The Energy Commission is required to prepare an Integrated Energy Policy Report, or IEPR, every two years that includes assessments of energy supply, demand, price, delivery and distribution. And based on these assessments the Energy Commission makes policy recommendations to insure that Californians have affordable, reliable, and environmentally benign sources of energy.

As Commissioner Boyd mentioned and as Barbara will go into more detail in a few moments, Assembly Bill 1632 was signed in 2006 and it required the Energy Commission to assess the vulnerability of the State's nuclear power plants to a major disruption from a seismic event or aging and adopt this study as part of the IEPR.

The Energy Commission developed the AB 1632 assessment of California's operating nuclear plants and included specific recommendations in the 2008 IEPR update. These recommendations were also reinforced in the 2009 IEPR.

In the scoping order for the 2011 IEPR, that was

released in March of this year, the IEPR Committee again identified nuclear issues as a topic of concern and called for a status report on the recommended actions related to nuclear plants that were made in the 2008 IEPR update.

And consistent with that scoping order today's workshop will review progress by the California utilities in completing these studies and actions, as well as directives from the PUC during ongoing and future plant license renewal evaluations. And discussion seismic and tsunami hazards, particularly in light of the recent events in Japan.

Information from today's workshop will be reflected in the 2011 IEPR, the first draft of which is scheduled to be released at the end of September and will be the subject of an IEPR Committee hearing on October 12th.

We'll begin the agenda today with opening -- well, we already had the opening remarks from the dais.

Barbara Byron will provide an overview of the workshop and the AB 1632 report.

Next, we will have a panel to discuss earthquake and tsunami hazard scenarios, research, uncertainties and implications for Diablo Canyon and San Onofre.

Panel two will then discuss utility progress in

implementing the recommendations in the AB 1632 report, as well as lessons learned from the events in Japan.

We'll break for lunch after Panel Two, hopefully about one o'clock, depending on how the morning goes, and we have provided a list of restaurants within walking distance on the table out in the foyer.

After lunch we'll reconvene with our final panel, which will discuss the events of Fukushima and their implications for California's nuclear plants. And following that Panel we'll move to public comment.

Given the amount of public comment we expect today, we're asking that those who wish to speak fill out blue comment cards. These are available on the table out in the foyer, and also our Public Adviser, in the back of the room, has those available if you would like to get those from her.

Once you fill them out you can either give them to me or to her any time during the day.

Depending on the number of people who wish to make comments we make ask folks that are -- don't wish to make comments to move to the overflow room. We're not at that point, yet, we still have some seats available. But if that does happen later in the day, we'd like to leave room here, in the room, for the people who actually wish to make comments.

We do expect that today's workshop will go close to six o'clock, so if you have a time constraint in your comments please indicate that on your card, so that we can make sure that you speak earlier during the day.

During the public comments period we'll take comments first from those of you in the room, and then we'll talk to the folks that are on WebEx.

We're asking that you please keep your comments to three minutes or less. We will have a staff person hold up a yellow card when you're at one minute and a red card when your time is up.

I apologize for being so stringent about the time restrictions, but we do want to make sure that everybody has an opportunity to speak today.

When you're making comments please come up to the podium in the center of the room and speak into the microphone, so that the people on WebEx can hear you and that we can get your comments onto our transcript.

WebEx participants, you can use either the chat or raised hand function to let our coordinator know that you wish to speak and we'll open your line at the appropriate time.

We're also accepting written comments until close of business August 2nd.

And the workshop notice for today, that's on the

table in the foyer and also on our website, explains how to submit that to the docket.

So, with that, I'll turn it over to Barbara Byron.

MS. BYRON: Good morning, Commissioners, I'm Barbara Byron, the Project Manager for the AB 1632 Study, which was completed in 2008.

Before we get started this morning I wanted to provide a little background on today's workshop, and some of the seismic issues in the AB 1632 Study and its recommendations.

The purpose of the workshop today is to review PG&E's and Southern Cal Edison's progress in completing the studies and actions recommended in the AB 1632 Report and the 2009 IEPR, as directed by the PUC.

We also plan to discuss some of the uncertainties about seismic and tsunami hazards at Diablo Canyon, and SONGS, and discuss the implications of recent events in Japan for Diablo Canyon and San Onofre.

Here's Diablo Canyon, located along our beautiful coastline. Its construction permit was issued in 1968; it began operating in '85 and Unit 2 began operating in '86.

Here's San Onofre, near San Clemente. Its

construction permit was issued in 1973, it began operating in 1983 and Unit 3 began in ’84. Their operating licenses expire in 2022.

Diablo Canyon’s license expires in 2024 and 2025.

Now, just for a few, a brief coverage of the history of seismic issues for California plants, plant construction at Bodega Bay was halted in 1964 and the Humboldt Bay Power Plant was shut down in ’76 due to seismic concerns.

Shell Oil Company studies revealed the Hosgri Fault during construction of Diablo. And then, largely due to seismic issues, the operating licenses for Diablo Canyon were issued 15 years after the construction permits were issued.

In 1976 the USGS recommended the Hosgri Fault be considered capable of generating an earthquake of magnitude 7 to 7.5. Diablo Canyon was designed and upgraded for a 7.5 magnitude earthquake.

NRC made a condition of Diablo Canyon’s operating license that PG&E shall develop and implement a state-of-the-art program to revalidate the seismic design bases used for Diablo Canyon.

Construction costs at Diablo Canyon exceeded original estimates by about $5 billion, due to seismic

concerns, primarily.

SONGS' construction costs exceeded original estimates by about $4 billion.

Seismic concerns for coastal plants was heightened with the Kashiwazaki Kawerau Nuclear Power Plant earthquake incident in Japan, in 2007.

This was -- seismic concerns led to the enactment of AB 1632, by then Assemblyman Sam Blakeslee. It was enacted in 2006 and it required the Energy Commission to assess the potential vulnerability of large base-load plants, Diablo Canyon and San Onofre, to a major disruption from a seismic event or plant aging.

We were also required to adopt this study as part of our IEPR and then perform subsequent seismic updates as new information and understanding emerges.

The AB 1632 Study was done by a large, multi-disciplinary research team led by MRW and Associates. They completed their study and report in 2008 and then Energy Commission then adopted this study as part of the 2008 IEPR.

It involved a public process, with three public workshops, written comments by stakeholders on the drafts. It included -- one of the primary features was it was an independent assessment. Data requests were sent to the plant owners and then a study team

independently reviewed these data and other scientific and government documents.

In addition, we had a Seismic Vulnerability Advisory Team made up of California agencies, which reviewed the assessment.

Concurrent with adoption of the AB 1632 Report PG&E announced that the USGS had discovered a previously unknown fault offshore from Diablo Canyon, and which is the Shoreline Fault.

PG&E and the NRC concluded that Diablo Canyon's design could withstand the potential ground motions from this Shoreline Fault and PG&E completed a 2011 study.

However, the Shoreline Fault's major characteristics are largely unknown, its length, proximity to the plant, and relationship to the Hosgri Fault.

Now, to the AB 1632 Report, some of the key findings were that important data on Diablo Canyon's seismic hazard and vulnerabilities of the plant are incomplete or outdated. Also, PG&E's long-term seismic program has extensively explored the seismology and geology for Diablo Canyon.

However, Southern California Edison has no comparable program for SONGS. Data that's become available since SONGS was built has indicated that the

site could experience larger and more frequent earthquakes than was originally anticipated when the plant was designed.

Recent studies indicate ground motion near a fault could be stronger and more variable than previously thought.

In addition, major uncertainties for SONGS related to the earthquake potential of a nearby offshore fault zone and the fault that connects faults in Los Angeles and San Diego regions.

The report also found that additional advanced seismic research may help resolve uncertainties and change seismic hazard estimates.

In addition, spent fuel pools at Diablo Canyon and SONGS have been re-racked to increase storage capacity by placing spent fuel assemblies closer. Loss of coolant event from an earthquake or a terrorist attack on re-racked pool could cause radiation releases and contamination.

From these findings, the 2008 IEPR made a series of recommendations, including that PG&E and Edison should complete updated seismic and tsunami hazard plant vulnerability studies, three-dimensional seismic reflection mapping and other advanced techniques are needed to supplement seismic research at these plants.

And PG&E and Edison should assess the implications of evolving seismic standards since the plants were built.

In addition, the report recommended that PG&E and Edison should reassess the adequacy of emergency plans and access roads to the plants following a major seismic event, and that spent fuel pools should be returned to open racking arrangements as soon as feasible.

And, finally, PG&E and Edison should complete the studies, make the findings available for consideration by the Energy Commission and to the Public Utilities and the NRC during their plant license renewal reviews.

We also recommended that PG&E and Edison should not file license renewal applications with the NRC without prior approval from the PUC.

Since then the California officials have directed the utilities to complete these studies. The Energy Commission and the PUC, in 2009, directed them to complete them.

However, in late 2009 PG&E filed for Diablo Canyon's license renewal before they had completed these studies.

In addition, the California Coastal Commission

informed PG&E and the NRC that results from the AB 1632 Seismic Studies are needed to complete the Coastal Commission's Federal Consistency Review for Diablo Canyon's license renewal and review of PG&E's application for a coastal permit.

The local State and Federal officials, California officials have called for the utilities' completing the event seismic studies. All have called for PG&E to complete them for Diablo Canyon and that the findings from these studies be considered during license renewal reviews.

The PUC, in 2010, approved ratepayer funds for these studies for Diablo Canyon. They also established an Independent Peer Review Panel to review the study plans and findings. The panel includes scientists, many of whom are here today, including geologists and seismologists from CGS, Seismic Safety Commission, Coastal Commission, CalEMA, the Energy Commission and the PUC.

Edison has also applied to the PUC for funds for advanced seismic studies.

Given the events in Fukushima it has only heightened the importance of completing these advanced seismic studies.

And in summary, just for decades seismic issues

have been a major concern for these California plants; advanced seismic hazard vulnerability studies are important in light of recent events at Fukushima; major seismic uncertainties for these sites and new seismic information available since these plants were licensed.

California officials have called for the utilities to complete these advanced seismic studies and have them independently peer reviewed and made part of license renewal reviews.

In addition, PG&E and Edison should implement the other AB 1632 Report recommendations, including reassessing the adequacy of emergency plans in the event of an earthquake and addressing spent fuel pool concerns.

And before I begin introducing the next panel, I just want to leave you with this old Japanese saying; learn a lesson from the past.

And here's a site for the reports, if you're interested in seeing them.

And now I'd like to introduce our first panel of speakers. The first one is Dr. William Ellsworth. He's a Senior Research Geophysicist with the USGS, in Menlo Park.

Over the course of 40-year career with USGS he's conducted research on fundamental problems in

seismicity, seismotechtonics, probabilistic earthquake forecasting, earthquake source processes and earth structure.

He received his bachelor's degree in physics and master's in geophysics from Stanford University, and his doctorate in geophysics from MIT.

He's a consulting professor of geophysics at Stanford University.

Dr. Ellsworth.

MR. ELLSWORTH: Thank you very much for that introduction, Barbara, and also to the Commission for this opportunity to describe some of the work that's ongoing in California to reduce our uncertainty in the evaluation of seismic hazards.

And this is work that is being conducted not only by scientists at the U.S. Geological Survey, but also at the California Geological Survey, and through the Southern California Earthquake Center, through university researchers not only in California but, literally, around the nation and around the world.

I will go through my slides rather quickly since you have the handouts that cover the same material.

The work of the USGS is, of course, part of the National Earthquake Hazard Reduction Program which is a multi-agency program that is designed to assess seismic

hazards and help the nation reduce its vulnerability to earthquakes.

Since the USGS is a research, not a regulatory agency, our job is to develop the best scientific practices and to make those available.

Seismic hazard analysis can be broken down into two parts, one of which is what we call the earthquake rupture forecast. And it is the part of the problem that defines where the faults are, what their levels of activity are and assesses the size of the earthquakes that might be generated by them.

But to get to an assessment of the hazard it is also necessary to couple that assessment of the earthquake rupture with what the earth does when the fault moves. This is the earthquake shaking model.

And in the shaking model we understand, for earthquakes of different sizes and of different types, what the level of ground motions that will be generated when they rupture.

We put these two things together and from that we can generate a seismic hazard analysis.

Uncertainties in certain seismic models can often lead to seismic requirements that are conservative, in other words biased too high. And, of course, this increases the cost of seismic safety.

So, one of the goals of the research is to reduce the uncertainties in either our analyses of the earthquake rupture forecast or in the earthquake shaking model.

And this slide, in more or less cartoon fashion, illustrates the effect of comparing forecasts that have the same mean probability but different dispersions about the mean. When we get all the way to expected losses there's a striking difference; not only has the mean loss, the expected loss increased, but if we want to provide margins of safety, the confidence levels are very different.

So, by conducting research that attacks either the earthquake rupture forecast or the understanding of the earthquake shaking model we can build information which is of much greater value to society.

One of the projects that's been going on for a number of years, led by the Pacific Earthquake Engineering Research Center, in partnership with USGS, Southern California Earthquake Center and the California Geological Survey is called the Next Generation of Ground Motion Attenuation Models Project.

And its goal has been to collect the best observations of earthquakes from around the world and use those to redefine the ways that we understand

earthquakes shake the ground.

These are so-called empirical relations at the present time and are data driven.

At the same time, research is going on to develop physics-based models of earthquake shaking. This is largely going on within the Southern California Earthquake Center and is a major activity of USGS and National Science Foundation report work.

A couple of years ago the first results from this NGA project were released and they have really transformed our understanding of earthquake shaking.

This slide illustrates some curves that show the level of spectral acceleration expected for a magnitude 6.5 earthquake on the left, or a magnitude 7.5 earthquake at a distance of 10 kilometers from the fault. And these results are shown as a function of the period of motion.

So, at the long period end this would affect very large structures, perhaps tall buildings. As we get to the short period end they would reflect what might affect individual houses or perhaps critical elements in a reactor design.

I'd like you to note that there are five different models that were produced here by different groups, they use slightly different equations. And

there's really very good agreement between them, they differ by about a factor of 1.5 on average.

And this indicates that we have a new and I think very confident understanding of the motions from strike slip faults.

The situation is not quite the same with reverse faults, shown here, the same size earthquake, same differences. I'll toggle back, you can see that for the reverse slip faults the expected motions are larger and, also, there is now more dispersion between the curves.

This epistemic uncertainty is something that we want to reduce through further research, and that work is currently going on through this Peer NGA Project.

One of the very important results that came out of the 2008 results was the realization that at all periods these new ground motion equations predict significantly smaller motions than the old models.

For example, here I'm showing the results from my colleague, Dave Boore, at the USGS, and Gail Atkinson. These show there are curves of spectral acceleration at a period of .2 seconds on the left and a period of 3 seconds on the right as a function of distance.

And one thing you'll notice is that as we go to larger magnitudes in general the level of ground motion

increases. But particularly at short period that ground motion saturates. It means that as we get larger the shaking from earthquakes does not continue to increase without bound.

And this we can understand very simply that the way that a magnitude gets larger is, in principle, the fault gets longer. But the shaking near a particular site is controlled by the ground motions that occur on that segment of the fault nearby.

What the data is telling us is that ground motion begins to saturate sometime between about magnitude 7 and magnitude 8.

Now, there's new data being collected from around the world, these equations are, of course, still under study. And one of the key results, one of the key objectives, now, is to increase -- to decrease the uncertainty in these relations.

Let me turn, now, to the other component of the Seismic Hazard Analysis, this is the Earthquake Rupture Forecast. And this is, again, the challenge of figuring out what the probability that an earthquake will occur at a particular location that may affect a particular facility.

There are four main components that are required to make an earthquake rupture forecast. The first is

the fault model, that's to identify where the active faults are. But simply knowing the faults is not enough, we need to know their activity rates and we typically do this by understanding what their geological slip rates are or what the rate of straining of the earth around them is.

From that we can construct models that give the long-term rate of earthquakes on those faults, what size earthquakes will they produce, how frequently were those earthquakes produced.

And, finally, we have to get all the way to a probability model that tells us, over some exposure period, what is the likelihood that any of these earthquakes will occur?

And until we have all four of those components, it's not possible to enter a fault into a meaningful seismic hazard analysis using probabilistic methods.

So, the kinds of data that go into this are illustrated here. We use geodesy to track the motion of the crust. This is the buildup of elastic strain that is released infrequently in earthquakes.

We also do studies to identify where the active faults are and to understand their level of activity using geologic studies, such as paleoseismology.

We also study the locations of earthquakes, they

help us map the faults underground, but they also help us identify areas for which we don't see the earthquake faults at the surface. And these are really critical in terms of understanding that it is more than just the few active faults, that there are faults that are undiscovered that we have to consider in the hazard model.

And when we're done, we end up with a composite forecast that describes, for example, the production rate of earthquakes in California.

Now, the most recent study, the most comprehensive study was released in April 2008, it goes by the name UCERF-2, the Uniform California Earthquake Rupture Forecast.

The working group on California Earthquake Probabilities is now midway through the study that will produce UCERF-3. This report is expected in June 2012.

We're trying to update the information that was in the 2008 report because much has been learned, and we're also addressing methodological issues that we believe will make this a much more accurate forecast.

One of the things that is being done is to include more faults in the model. This figure on the right shows the faults that are actually included by name in the UCERF-2 model and you can compare that with

all the colored faults on the left, which are those that have moved in California within at least the last 1.6 million years.

Chris Wills will be discussing this in greater detail in his presentation.

One of the shortcomings in the UCERF-2 model was really our understanding of hazards along the coast and, in particular, the central coast.

And this is something that both we were aware of, as well as PG&E, and we decided that we would work together on basic data collection through a Cooperative Research and Development Agreement. this is a formal Federal government process that allows the Federal government to work in partnership with private entities.

We have worked with them to collect data on aeromagnetics, gravity, marine magnetics, seismic reflection, high resolution bathymetry, geologic mapping, geodesy and seismicity.

And let me stress that our work is joint data collection, but our interpretations are entirely independent and, indeed, they're not always in agreement, as you will hear.

One of the key things that we have been doing the past several years is improving the quality of the geodetic data that is available in the central coast.

This is a reanalysis of old data and collection of new data. This is a map provided by my colleague, Jessica Murray-Moraleda, at the USGS, showing the current state. These vectors here represent the annual motion of coastal California with respect to stable North America.

One thing you will note is that the vectors get longer as you move toward the coast. This reflects the accumulation of strain energy in the earth's crust that will someday be released in earthquakes.

Now, most of this strain energy is related to the San Andreas Fault, which is located here, but some of it is also available to drive other faults.

Another thing you'll note is that as soon as we get offshore there are potentially active faults, but the geodetic data, currently, will do very little to resolve them.

There are some very promising developments that I should mention. One of these is the possibility of doing sea floor GPS geodesy. This was done very successfully by the Japanese in the region of last March's Tohoku Earthquake and it is something, I think, that really needs to be looked at very seriously in this country because without it, it's going to be very difficult to assess the capability of some of these offshore faults.

Another area in which quite a bit of progress has been made on the central coast is in the analysis of the seismicity data. We're fortunate that we have very good seismic coverage along the central coast through the combination of the networks operated by USGS, UC Berkeley, Cal Tech, the California Geological Survey and the Pacific Gas & Electric Company.

PG&E has made all of their data available to the California Integrated Seismic Network and it is jointly analyzed and available through the Northern California Earthquake Data Center.

These triangles here show the locations of stations. And, basically, it's important to have many stations on top of the area where the earthquakes are occurring so that we can accurately locate them in the earth's crust.

My colleague at USGS, Dr. Jeanne Hardebeck, has taken on the reanalysis of these data using advanced techniques. And these are some of her results, for example, you can see this very sharp line, alignment of epicenters here directly on the San Andreas Fault. That's no surprise.

But what was important was her ability to locate earthquakes on the Hosgri Fault, through this area on the San Simeon Fault, and also the discovery of

additional structures, one of which is the Shoreline Fault, which you can see here by this alignment of epicenters. You've heard much about that.

These are some of her findings from the Seismicity Report. I won't go over these in details. But she has been applying objective methods to understand the geometry that's suggested by the hypocenters and she finds that in this work the Shoreline fault is well represented by a single plane at seismogenic depths.

Now, these are depths that would go down to as deep as 14 kilometers and would not start shallower than about three or four kilometers. That's the area of the crust where the energy is being stored that will be released in earthquakes. So, that's the critical area to understand in terms of seismic capability.

In many ways what we see at the surface is along for the ride. It's an important ride, and as we'll hear in Sam Johnson's presentation, we can use that information to better characterize the nature of the activity of these faults.

The situation's a little different in Southern California. We're looking here at a bleak view of the Southern California Coast. Here is Los Angeles, for example. And shown here is these drape curtains in red

are the locations and the depths of the strike slip faults that cut the California borderland.

And then shown in these light blue areas here, these are low angle faults that have been identified in seismic reflection data.

We know that there is the capability for earthquake faulting of several kinds that can occur across this borderland, but it's very difficult to assess, again, because of the lack of information.

And one of the key challenges is trying to assess the level of activity of the offshore faults and, in particular, these low-angle blind faults.

This map shows, again, that same area going from about the San Pedro Shelf. The SONGS Power Plant is located about here, this is the San Diego area here.

And shown in gray is at least one -- one geologist group's interpretation of the Oceanside thrust and also the 30-mile thrust. These are again capable -- these are thought to be capable sources, but we lack the critical information to assess them.

We don't, as yet, have unequivocal evidence of late Pleistocene to Holocene activity of these faults and there is quite a bit of uncertainty in terms of what their capability may be in the future.

So, one of the key objectives in the future is

going to be to gather more information not only about the strike slip system but, also, the potential capability of these faults.

My colleague, Holly Ryan at the USGS, and others have been studying some of these faults, they have been doing some very detailed work off San Mateo Point. Again, the SONGS Power Plant is located in this area.

By using data that has been available, made available to us from industry, it's possible in this seismic section here to see the detachment surface that is the Oceanside thrust. And the question is, is this fault currently active?

In this area here is where the Newport/Inglewood Fault comes through that we know is active, so that's near the shore, this fault here that is a concern.

The question is what are the capabilities of this fault, particularly as it dips under the land?

One way of getting at that is with very high resolution seismic data. Sam Johnson, again, will be showing some of this.

This was data that was collected using the AUV from MBARI. It indicates that there are horizontal sediments that are being laid down at the base of the scarp in this area. So, one interpretation would be that this basal area here is probably inactive at the

present time.

There's also an area here showing an emergent fold and detailed data, collected by USGS, suggests that this is possibly active. So, this is an area where much more work needs to be done.

Some of the present limitations are with the seismic data. This is a map showing earthquake locations from the -- from the California Earthquake Catalogue, relocated by Caltech and USGS. It shows many of the active faults, such as the Sal Jacinto and the Elsinore system here.

You'll notice that there are relatively few earthquakes located in the general region of the southern coast. This is in part because of a lower level of seismicity, but it's also because of a lack of data.

And that's illustrated in this slide. The same area shown, the little points here represent the locations of seismic stations. Many stations along the San Jacinto, many stations in the L.A. Basin, but relatively few stations along the coast.

And this really limits our ability to reanalyze the seismic data. The kinds of studies that were done to identify the Shoreline Fault would be very difficult to do without additional information.

The same thing goes for geodetic monitoring. This is the continuous geodetic network in Southern California. It's been -- the L.A. area has been very heavily instrumented to try to understand some of the low rate faults that are located in the center of the urban area, but there are relatively few locations along the coast. And, again, very little offshore, a few stations on the island.

So, a few conclusions I think can be drawn as we make a review of where the data needs are to improve our understanding of hazards along the fault.

We need to do a better job of identifying the active faults and there are a number of technologies that are readily available, including high resolution bathymetric surveys, air magnetic, marine, land, gravity surveys, reprocessing of industry seismic data that's now available to us. And then, of course, the augmentation of land-based seismic stations and the potential for ocean bottom stations.

That identifies the faults but we're not there, yet. We need to understand their seismic potential. To do that we need to do detailed geologic investigations to establish the slip rates of the fault and this can be helped in places by augmenting existing land-based and island GPS stations. And I think we need to seriously

look at the possibility of adding ocean floor GPS to the mix.

To improve of our understanding of recency of faulting we need, again, to conduct detailed geologic investigations. We again need those high resolution seismic surveys.

But, indeed, we also need to improve our baseline geologic understanding, such as can be done by developing much better histories of the marine deposition.

So, these are among the kinds of studies that are being recommended to the USGS as we look at improving our understanding of the hazards on the central coast, on the California coast.

So, thank you very much.

MS. BYRON: Thank you, Dr. Ellsworth.

COMMISSIONER BOYD: Thank you, Mr. Ellsworth. Can you entertain a question or two? If I might, Mr. Chairman?

CHAIRMAN WEISENMILLER: Sure.

COMMISSIONER BOYD: Dr. Ellsworth, could you elaborate on the significance of the USGS finding that: “There is no objective evidence for any discontinuities or segmentation at seismogenic depths of the Shoreline Fault.”

And further, “That the Shoreline and Hosgri Faults are most likely connected at seismogenic depths and a possibility that a rupture on the Shoreline Fault could trigger a rupture on the Hosgri Fault, or vice-versa.”

MR. ELLSWORTH: I think what this is saying is that in terms of evaluating the potential hazard from the fault we should consider its full length, as it’s currently defined, and we should consider the possibility that it could link up with a rupture on the Hosgri Fault, or probably coming in from the north.

This is a -- I think Chris Wills will talk a little bit more about some of the issues involved with this, as to how we would go about developing a probabilistic model that considered those scenarios.

But in terms of looking at the dimension of the fault, the data that we have looked at suggests that it should be considered a single capable structure.

We know that in many places the fault surface -- the fault trace seen at the surface can be quite complex, but the underlying structure revealed by seismicity can be remarkably simple.

COMMISSIONER BOYD: Thank you. One last question; as you mentioned, there are only a few seismic monitoring stations in Southern California near SONGS

and, as you indicated, detailed studies that led to the discovery of the Shoreline Fault are not possible at present in the SONGS area. And you mentioned the GPS Network appears to only have a few stations near SONGS.

Are there sufficient studies planned or underway to fill this gap or would you recommend that more needs to be done that isn't now anticipated?

MR. ELLSWORTH: Yes, I spoke to the people who run the Southern California Network at -- both at USGS Pasadena and at Caltech and they indicated that they have no plans at this time to add additional stations, there are no resources to do that.

I think that if we want to better characterize the tectonics there, there really is no solution other than making a commitment to long-term seismic studies. these cannot be done in a year or two, they will take a decade to really gather the information that's going to be required.

COMMISSIONER BOYD: Thank you.

CHAIRMAN WEISENMILLER: A couple of follow-up questions, too. One question is how large is the USGS budget for seismic research?

MR. ELLSWORTH: The total budget that covers the Earthquake Hazard Program in the USGS is currently at about $55 million, and that includes the operation of

all of the Seismic Networks, both operated by USGS, as well as significant funding to partners, such as Caltech, UC Berkeley.

So, the research program is a much smaller piece of that budget. Currently, we are spending several million dollars a year being invested in the UCERF-3 Study.

CHAIRMAN WEISENMILLER: And is California the location of your greatest concerns for earthquake hazards in the U.S.?

MR. ELLSWORTH: We certainly have the highest exposure in the U.S. in California. It's an area that we study intensively because the active faults are on land. But, of course, our concerns stretch across the entire nation.

We're just coming on the bicentennial of the earthquakes that struck the Central U.S., in the New Madrid Region, so our concerns are really national.

CHAIRMAN WEISENMILLER: Okay, thank you.

MS. BYRON: Thank you. Our next speaker is Dr. Sam Johnson, he's a Research Geologist, also with the USGS and Coastal and Marine Science Center in Santa Cruz and Menlo Park.

He currently designs, coordinates and conducts research projects that focus on sea floor and benthic

habitat mapping.

He helped plan and is the USGS lead for the multi-agency California Sea Floor Mapping Program and is Co-Chair of the Sea Floor Mapping Action Team for the West Coast Governor's Agreement on Ocean Health.

Dr. Johnson.

MR. JOHNSON: Thank you, and thanks to Bill for the great introduction to what I'm about to talk about, which is more focused work offshore of Diablo Canyon.

I'm a Marine Geologist and I'll be describing the work that we have underway and some of the unknowns and needed research.

So, I borrowed this slide from Bill and it basically shows the different components needed for probabilistic earthquake forecasting.

On the mid-left, right in here, I actually put the parameters that field marine geologists try to define to help constrain hazard assessments. And those include fault location, fault length, the dip of the fault or the angle that it's oriented, vertical or sub-horizontal, its slip rate, and then the earthquake history and recurrence intervals.

So, we're doing work to try to constrain some of those parameters.

In the area that we're focused on, the box right

here, obviously, the key faults that you've heard about are the Hosgri Fault and the Shoreline Fault, and I'll also throw in the Los Osos Fault right here.

So, our work has really -- and this has been conducted in part through the PG&E "CRADA" and is focused on a couple of different kinds of data acquisition. Shown on the left is the track lines for a very closely spaced high resolution seismic reflection survey. This is actually two surveys collected -- data collected in 2008 and 2009.

The slide on the right shows the marine magnetic data that we collected simultaneously. And this basically shows the magnetic properties of rocks and typically long linear patterns, like the one you see right here outline faults. That's the Hosgri Fault. The Shoreline Fault is actually complex, it's wrapped up in this band of anomalies right here. Los Osos Fault corresponds to this linear trend right in here.

So, I just put this slide in. Bill showed a couple of seismic reflection profiles. For those who aren't familiar with looking at these data, I like to describe them as if it's something that you're driving through the mountains and you look up at this momentous outcrop, road cut.

And so, you're essentially looking at a cutaway

of the crust that's showing the structure. So, notice that there are banded sediments right here, these are near horizontally dipping sediments, they're juxtaposed against a more massive geologic unit across what we interpret are faults. And the uplift of that fault zone has created a barrier so that a small, little basin is formed behind the uplift.

So, again, this is the kind of information that we're collecting with the seismic reflection profiles and this is information that we're using to help map faults.

The other piece is the high resolution bathymetry. A large part of this has been collected through the State-funded California Sea Floor Mapping Program, of which USGS is a major partner. And it's about 20 percent of the data that you'll be seeing actually was paid for by PG&E and donated to the California C4 Mapping Program.

So, I'm going to show you an animation, a short animation that sort of gives you a flavor for what these data actually look like and what they can tell you.

So, again, we're looking at very high resolution on the order of 1 meter pixel size bathymetry of the sea floor. And it's the grooves or the lineaments in the sea floor that help define faults.

So, for example, as we approach the Diablo Canyon Power Plant right there you will notice that it's there are these linear patterns in the bathymetry of the sea floor. Those are used to help map faults, along with the magnetics and the seismic reflection.

So, we'll be going a little bit further. You'll be seeing more lineaments in the rocky shelf offshore Point Buchon. This pattern right here, this truncation right here has also been mapped as a fault.

We can see some low stand river channels. These were cut during -- about 20,000 years ago when sea level was 120 meters lower than present.

This uplift right in here is along the Hosgri Fault. The Hosgri Fault cuts through right here, again, this is a little uplift associated with the bend in the Hosgri Fault zone.

Probably get a little vertigo right here as we spin around.

Okay, now we'll be going up the axis or going up along the trend of the Hosgri Fault right in here. Again, it cuts right through here. This is the pop-up associated with the bend in the Hosgri Fault.

The Los Osos fault actually crosses through coming northwest and these uplifts, rocky uplifts in Estero Bay are associated with the trend of the Los Osos

Fault.

The value of these data is not only showing where faults are or helping to show where faults are in association with the other datasets, but they also help you show where faults are not.

So, for example, this is a beautiful scarp that's developed along the Hosgri Fault right in here and in this massive area to the right, which lacks similar kinds of lineaments and scarps we can say that there aren't faults.

So, this is about as good as it gets in terms of a sea floor scarp -- a fault scarp on the sea floor.

Okay, so I'm going to escape there and then come back to the Power Point. And let's see, here I go.

Okay. So, basically, what we're trying to do is use the bathymetric data with the seismic reflection data and in this case the seismic profile is the one that was collected along this white line right here, crossing the fault scarp, showing a little ponded basin behind the uplifted fault.

The multibeam there, the high resolution bathymetry data are also very useful in some areas for defining faults that we don't see on seismic reflection data so that you can see them. These faults here are all structures that are in very shallow, nonreflective

bedrock, so they're a good way of mapping faults in areas where the seismic data aren't conclusive.

Here's that pop-up area, again, where you can see uplifted bedrock flanking a slope and bounding another basin here.

So, basically, what we're doing is we're collecting these data, the high resolution bathymetry, the last of it has just become available in the last three months. So, now we're putting it together to develop a range of products including a geologic map. PG&E has developed one independently for this area. Ours will be going from the Pismo Beach area up to Piedras Blancas, and a set of peer-reviewed research papers. So, that's work that's underway right now.

So, in terms of what we're sort of trying to figure out here, I think, are some of the major unknowns about the Hosgri Fault in particular, which has been a particular focus of mine. First, how long of a rupture is possible?

What I'm showed on the right -- on the left is a map with the fault segments shown in the UCERF-2 Report that Bill referred to. And it essentially broke this system of faults, which includes the san Gregorio Fault, and the Hosgri, and the San Simeon Fault through here into one long fault system, broken up in two areas, in

Monterey Bay and between Piedras Blancas and Point Sur.

There are actually no known gaps in the fault zones in these areas and these are gaps that might limit rupture. Rather, these are areas of unknown geology.

So, in order to really figure out how the Hosgri is connected to the San Gregorio Fault, one has to do the kind of detailed mapping that we've done offshore of Point Buchon.

So, it's a little ironic that you have to go farther away to get a better assessment of the hazard presented by this fault zone. And USGS actually will have a crew in this remote Big Sur area in September to do the kind of mapping that we've just done, that we've been doing off of the Morro Bay/Point Buchon area.

There are still significant questions about how fast the Hosgri/San Gregorio Fault slips. Some reports suggest rates of 1 to 3 millimeters per year, favoring the lower rates of 1 millimeter per year.

Two GPS-based studies, published in 2005, each modeled the rate at about 4 millimeters per year. That's a fourfold difference. UCERF split the difference and assigned a rate of 2.5 millimeters a year for the Hosgri Fault.

It's important to note that the rate estimated for the San Gregorio Fault, to the north, is actually

about 7 millimeters per year. And so, the models actually require that the rate diminishes as one goes south. One way that could happen is by transferring slip to branching faults, like the Los Osos Fault, or the Shoreline Fault, and there are many other places where that could happen, too, along the way.

That's just a model, however, it's never really been shown how that happened or where that slip was distributed and that's another significant unknown.

Finally, we don't really know the earthquake history for the Hosgri Fault. If, for example, we knew that earthquakes happened every 500 years and that the last earthquake occurred 490 years ago, then we'd have a very different assessment of the hazard than if the last earthquake had occurred 20 years ago.

So, getting that information will be critical, we don't have that right now. We're hoping that we can identify places with the mapping data that we can core to develop earthquake histories.

Okay, I just have -- threw a few additional slides in, because I'm such a proselytizer for sea floor mapping.

This is actually around the corner in the Santa Barbara Channel and this shows a couple of -- a major landslide, called the Goleta Slide. Three different

lobes have been identified. And their failure has been modeled to generate tsunamis of -- sort of local tsunamis affecting tens of kilometers of coast, of five to ten meters high.

The next slide is a close up, it's showing this area right in here. And it's the new, high resolution mapping of the shelf break in the area offshore of Oxnard. And what it's showing is a crack in the sea floor where a slide might be generated in the future, showing creep down the shelf -- or down the upper slope. It's showing a buried scarp, possibly from an older landslide. It's showing pockmarks, these are areas where gas escapes from the sea floor and could generate -- are known to create weakness in sediment, perhaps leading to landslides.

And then, finally, we have this cone-shaped feature here, which is a landslide, and it's about a quarter of the size of those Hueneme slides.

So, this is the kind of information that we can actually collect with the new, high resolution bathymetric mapping. And then I just put these slides in to basically show what the coverage is offshore of Central California where we don't -- you know, we basically go from the very high resolution mapping out to three miles within State waters, and then low

resolution mapping, very low resolution mapping farther offshore.

So, I guess the point there is that to fully appreciate tsunami hazards from submarine landslides that this kind of mapping's probably critical.

So, that's the extent of my presentation. Thanks very much for your attention and for the opportunity to be here today.

COMMISSIONER BOYD: Thank you. If I might, Mr. Chairman, a couple of questions for you, Dr. Johnson.

To you, is there any evidence that the faults in the region of Diablo Canyon or San Onofre could act together with other faults to produce an earthquake more powerful than the plants to built to withstand. And you referenced a lot of the faults, we've got Shoreline to Hosgri, we've got Hosgri to San Simeon, et cetera, et cetera, et cetera, and down south, of course, there are a series of faults.

Do you have an opinion or thought on that?

MR. JOHNSON: Oh, I think that that's a significant unknown. I actually think that information on that very topic will probably end up being the most valuable thing that we get from this proposed 3D Seismic Reflection Survey, so that we'll actually be able to image in far greater detail than we can right now, or we

might be able to, how the faults do connect.

So, I think right now nobody really knows, to be honest with you.

COMMISSIONER BOYD: Okay. Well you answered another of my questions about the 3D surveys that are going to be taken. So, let me ask you one more, triggered by these absolutely stunningly beautiful pictures you have of models, let's say, of the sea floor, of marine terraces. We didn't talk about that, but they're identified offshore Diablo Canyon.

Some say they don't appear to be significantly offset by faulting. Some say they're quite old, as much as 75,000 years and that, therefore, applies a very low rate of vertical motion.

Are there any other possible interpretations of the ages of these terraces and are there any alternative models that imply the rate of vertical motion on the offshore faults is different than presently presumed?

MR. JOHNSON: Okay. Well, that was a long question, so I'll just say --

COMMISSIONER BOYD: I'm good at long questions.

MR. JOHNSON: I'll say a couple of different things. First of all, the work you refer to is designed to determine the vertical amount of slip along a strike slip fault and because that ratio can vary dramatically,

in other words a fault that's primarily moving this way, whether it goes up or down, because that ratio can vary dramatically -- I guess I don't even -- I think there's debate possible about how effective determining the vertical rate of a particular fault actually is in forecasting the lateral rate of slip. So, that's kind of an open question to begin with.

And then I think for the work defining the offshore platforms I, personally, have a different perspective where I think they're predominantly fairly young. And I think that, again, that's -- I know that other people have suggested that they're old. I think that's a very good example of work that needs to be independently peer reviewed before any judgments are made on the -- on what that data -- what those terraces mean.

COMMISSIONER BOYD: I see. Thank you very much.

CHAIRMAN WEISENMILLER: Yeah, I guess my question was in terms of trying to understand the quality of the data off of San Onofre compared to what we've seen here?

MR. JOHNSON: Well, it turns -- well, I think that the -- we're a little bit luckier here in that we've got more dramatic sea floor topography or bathymetry offshore. There's more rocky uplifts than

there are off San Onofre, where the shelf is more sandy. So, you actually see more with the high resolution bathymetry.

That being said, the offshore data quality, the high resolution bathymetry and the seismic reflection database are not nearly as extensive as they are offshore of Diablo Canyon.

CHAIRMAN WEISENMILLER: Thank you.

Mike?

MR. FLORIO: You mentioned the planned 3D seismic imaging, is -- are we putting our money where we should be in terms of the studies that are ongoing? Are we doing the right things, in your opinion?

MR. JOHNSON: That's another tough question. I think everybody needs to realize going into that that it's a high-risk kind of data acquisition.

I think, you know, it's no secret that the basement rock in this area, at least east of the Hosgri Fault is predominantly this geologic unit that we call the Franciscan Formation, which is typically very complex structurally. It includes many different rock types that have been internally faulted against each other and that's the kind of rock that typically yields the worst imagery in seismic reflection studies.

And so it's a risk. I mean, this kind of survey

may produce spectacular imagery of how these faults connect or don't connect or it could be a lot of money paid to produce data that aren't that useful. And I think that's a -- you know, other people may disagree with me, that's my personal opinion.

But I think everybody recognizes the problem that the basement rocks in these areas are not especially amenable toward yielding high-quality data.

On the other hand these are amazing new tools and it's amazing new technology to produce this 3D seismic imaging, so it's an experiment with an unknown outcome.

CHAIRMAN WEISENMILLER: Well, just a follow up. In terms of the research agenda, beyond these studies what are the top two things we should do?

MR. JOHNSON: The top things we should do in terms of research?

CHAIRMAN WEISENMILLER: In terms of further research on these issues?

MR. JOHNSON: Well, I'm not sure what these things, what you exactly meant. I think it's quite important to try to get an earthquake history for the faults in this particular area.

So, for example, for the Hosgri Fault, again, I alluded to the fact that we don't know when the last

earthquakes were or what the earthquake recurrence interval is. And if we can somehow figure that out, that will enhance the probabilistic hazard forecast significant. That's one thing.

And then, actually, there are places in, for example out in here, along the Hosgri Fault, where we don't actually have the high resolution bathymetry mapping because the fault goes farther offshore than three miles.

And I think filling those gaps and then also extending that coverage out to the shelf break, like the point I made in my last couple of slides, to get more information on submarine landsliding, I think that would also be important.

MR. FLORIO: What would be involved in getting the earthquake history that you're talking about? Is that something that's readily done or is it extremely costly and complex?

MR. JOHNSON: Well, here's the deal. It's normally done on land and in trenches. And there have been some trenches -- this fault system goes onshore in the San Simeon area, for example, and then goes offshore again. It goes back onshore around Point Sur.

But, anyways, there have been trenches dug in those areas and paleoseismological studies conducted.

They were inconclusive, they were done in the -- I'd say the early to middle stages of paleoseismology, which is a relatively new field. And I think it's high time people probably went back to some of those sites with the insights gained over the last 15 years or so and sort of reopened them, you know, redid some of those investigations, that's on land.

Offshore, I think it's possible that with these data we'll be able to find sort of little ponded basins, of the kinds that I showed, that we might be able to core, that might have earthquake histories within them.

So, every time there's an earthquake a little sand bed is generated, or an event horizon is generated and you have a little stratigraphy that may tell you an earthquake history. But that's also experimental, too. that really hasn't been done in too many places offshore.

CHAIRMAN WEISENMILLER: Thank you, I think this has been very helpful.

MR. JOHNSON: Thank you, again.

MS. BYRON: Thank you. Our next speaker is Chris Wills. Dr. Wills is a Supervising Engineering Geologist with the California Geological Survey in Sacramento. He's responsible for projects that involve seismic hazard estimation, earthquake fault rupture and

geologic mapping.

MR. WILLS: Thank you, Barbara and thank you, Commissioners for asking me to give this presentation. I always have to correct the Dr. Wills part. Thanks for the honorary degree, didn't get one.

But these are -- you'll see some slides you've seen before. This is based on largely the Uniform California Earthquake Rupture Forecast, Version 2. This has been a very large group. Bill showed a number of these slides. He's been Chair of our Seismic Review Panel for the UCERF for the last -- UCERF-2 and now for UCERF-3. I was a member of the Executive Committee for UCERF-2 and now part of the Management Oversight Committee for UCERF-3.

And this is a very large development of seismic hazard model and I'm going to try to go through some -- what's included in a seismic hazard model and where these are going, just to give you a flavor for what kind of information we need in putting together seismic hazard estimates for any place, and then some details for both the Diablo Canyon and San Onofre areas.

So, you've seen both of these slides, these are our probabilities of rupture and kind of how we put together the model. I'm going to go through a little bit more detail in how we put together the model.

As Bill mentioned, we have a fault model which then becomes a deformation model by adding the rates of movement. Then we calculate the production of earthquakes from that deformation model and then, finally, do probabilities of earthquakes.

And this is all part of a seismic hazard analysis in which each different possibility has a weight. And so we look at the possibility of are they this kind of fault or that kind of fault, or our deformation model has -- dominated by slip on the San Andreas or on a different fault in Southern California, for example.

and then through all these different branches on the logic tree to come up with a summary probability of earthquake rupture.

So, to give you the start of this, this is the fault model, this is fault model 2.1 and we get some basic information about where the fault is, what its trace, and dip, and upper seismogenic and lower seismogenic depth are. That's the most basic information.

But there's not the type of information that everybody agrees on and there are places within our fault models where, for example in the Santa Barbara Channel, we have one group of geologists who looked at

all the data and say that there are these low-angle faults that are dipping beneath the coast. And there are these other groups of geologists who looked at very similar data and say, no, there are high-angle faults dipping the other way.

And so we have to be able to weigh the probability that the data suggests those two types of faults to different people and those have different implications for seismic hazard. So, those are both possibilities when they're supported by data or in the model.

Then we need to go to our deformation model, how fast are each of those faults moving? And that's largely developed from slip rate studies done by geologists on these active faults, where a geologist goes out with -- and looks for a stream channel or some other geologic feature that's been offset by a fault, gets a data of that and it's been offset by a certain amount, and calculate how fast the fault is moving over the last 10,000 years or something, some kind of time frame that's representative of the current seismic hazard, seismic environment.

And so we have a deformation model and there's a couple different versions of that because there's disagreements about slip rates on some of the faults as

well.

But in general we know where the most active faults are. We know that the majority of the overall slip is on the San Andreas Fault and there's lesser slips on the other faults around California. But there's a substantial amount both east of the Sierras and through the Coast Ranges.

So, we generally have a pretty good handle on where the overall slip is through the deformation model.

We can also look at that deformation model, because it's largely from geologic data, and compare it to geodetic data.

And this is the slide that Bill showed that where -- it's very similar to the slide that Bill showed. Where if we assume that the center of North America is stable, different parts of California are moving at different rates off to the northwest, and that rates of movement changes dramatically across the San Andreas Fault and somewhat across other faults.

And so we can look at the implications of that and compare the rates of movement on the faults from the geodetics to the rates of movement from the geologic data.

And then we build in places where they don't quite match, in northeastern California and in the

Mojave Desert. But throughout most of the Coast Ranges they do match pretty well.

We also have to look at the rate of earthquakes throughout the State and we look at the rate of recorded earthquakes around the State and then build a piece of our model that accommodates all of the earthquakes that we've recorded, whether or not they're on active faults and then we smooth that out.

And that largely covers all those places where there are very small faults that produce earthquakes, and typically small ones, and then there are also places where there are unknown faults that could produce major earthquakes.

So, we put all these pieces together and we've talked about the kind of paleoseismic studies where you get earthquake rates, and that's what a type A fault is. We know pretty clearly what the rate of earthquakes is going back into pre-history, from paleoseismic studies on the type A faults.

Type B faults we have a slip rate value, but we have to use just a generic rate of earthquake production for that.

Type C is these things we have geodetic rates, but not really good geologic rates, and then we have background seismicity.

And when we put all those pieces together we get a magnitude frequency distribution and so I want to go through this in a little bit of detail. All those different parts of the model are in the different colors here and the total model is showing the black curve.

And that gives you a rate of -- a rate of earthquakes for everything from magnitude five up to eight and a quarter, which is the largest earthquake allowed in our model.

And it compares the total rate against what we've observed historically, which is the red line and these little red pluses.

And so, when you compare the total rate of earthquakes throughout California from geologic data, compared with the geodetic data, the rate of earthquakes matches the seismicity data. And so we think we've done a pretty good job of capturing the rates of earthquakes throughout the -- throughout the State.

One thing that's important here is you can see that the black line, the model, passes above the red line and just barely below the red plus here at magnitude six and a half.

That ways we are over-predicting the rate of six and a halfs in our model and that's almost a factor of two there. It's underneath the 95 percent confidence

bounds so we're consistent with seismicity.

But we look at that and say, well, our model isn't quite consistent with the seismicity. How can we reduce the rate of magnitude six and a halfs and make it more consistent with what we know about seismicity?

One of the ways to do that is to look at our fault model and say many of those faults could actually connect. And if you have faults that connect, you can make larger earthquakes, but not very many of them, and reduce the number of magnitude six and a half earthquakes.

This is something we did. Just to show you the kind of motivation to realism behind this, the poster child for connected faults is the Denali 1999 earthquake, which began on the Susitna Glacier Fault, ruptured along the Denali and then branched down to the Toschunda Fault.

So, there's two different types of faults and then a rupture through what we might have considered a segment boundary in past models.

And so we've looked at that in the UCERF-2 model and we looked at what faults have essentially the same slip rate and the same orientation. And noticed that the Newport/Inglewood/Rose Canyon is really all part of the same system.

And if you consider that three different faults, which we had before, we called them Newport/Inglewood, Newport/Inglewood Offshore, and Rose Canyon, and each of those had a magnitude -- a maximum magnitude of about a magnitude seven, but mostly produced earthquakes in the magnitude six and a half to seven range, you have one rate of earthquakes.

If you consider that all one fault, it has a maximum magnitude of about seven and a half, and so it can produce earthquakes everywhere down from magnitude five up to seven and a half.

That actually lowers the seismic hazard for Coastal Southern California by putting more of the energy into bigger earthquakes and so creating many, many fewer small or moderate earthquakes.

So, we have to do this fairly carefully because we've looked at the possibility that these faults could connect with the Santa Ynez Fault and some other faults around California. And this was one possibility we considered in the UCERF-2 is that some faults do connect.

In UCERF-3 we're still looking at our UCERF-2 model, over-predicting magnitude six and a half earthquakes, compared to the seismic record, and saying, well, what other faults could connect?

We've look at -- the general rule of thumb from historic large earthquakes that earthquakes could rupture in gaps in a fault system up to about a size of five kilometers, a gap between faults.

And one of the problems is when you look at our fault model in Southern California, particularly, everything shown in green is within five kilometers, its end point's within five kilometers of everything else shown in green.

So, if we're going to start connecting faults, and some of these may have drastically different slip rates or style of movement, and so we have to be very careful on what faults we allow to rupture together and at what rates.

So, this is -- the detailed implementation of this concept still needs to be worked out. It's something that we are currently working on for UCERF-3. We expect to have more linkages of faults in UCERF-3 than we had in UCERF-2 and that will be part of the issue we're trying -- part of our attempt to solve the issue of our over-prediction of magnitude 6.5's on a statewide basis.

I'm going to go through a little bit of detail for the faults in both the Diablo Canyon and Coastal Southern California areas.

Just to point out, there's several steps along the way. This is our 2010 Fault Activity Map of California, showing -- this is a screen shot from a CGS webpage, just to give you an orientation to what the faults are, where they are in the Diablo Canyon area.

We've heard about the Hosgri Fault. This is the Los Osos Fault. This is our 2010 map, which is missing the Shoreline Fault.

There's other faults onshore called the Edna, and San Miguelito, and Ostiano Faults and so on.

The ones in oranges we know have been active in the last 11,000 years, since the last Ice Age, in the Holocene.

The ones in green are -- we have evidence for activity in the late Pleistocene, the last few hundred thousand years.

And in purple in the Pliocene, the last couple million years.

So, all of those are things we should be looking at for their -- whether they could be seismic sources to put into our hazard model.

So, this is just a simplified view of that from the faults from our Fault Activity Map, this is the same image that Bill showed earlier.

So, obviously, we can include the San Andreas

and many other faults in the seismic hazard model.

These are the faults that have been simplified for the seismic hazard model so far.

The ones in blue are faults we don't have the slip rate for and if we don't have a slip rate on a fault, we can't project the rate of movement, we don't have the energy in the system, we can't project the seismic hazard.

So, some of these there have been some slip rate studies. There's a -- the Shoreline Fault is shown in blue, meaning we don't have a slip rate for it, but I know there is a slip rate proposed in the Shoreline Fault, a report by PG&E. That's something, as Sam said, needs to have careful peer review before we include it in the model.

Southern California we have a similar issue, we have a lot of faults. We've simplified them into the seismic hazard model.

And then we have this group, John Shaw and his colleagues at Harvard, who have proposed these major thrust faults, the Oceanside, the 30-mile Bank thrust.

This is the same image that Bill showed from a presentation that I gave at a UCERF workshop last spring.

But the point is we need to know not just where

these faults are, but we need to know if they're active and we need to know how fast they're moving before we can include them in a seismic hazard model.

And in the case of these faults we have a pretty good handle on where they are in some places, and not so great in others. We have a couple of pieces of evidence to suggest they're active and we do not know how fast they're moving, we don't have a slip rate. So, it's very difficult to include that in a seismic hazard model.

As Bill said, the geodetics is one way to get a handle on that.

So, incorporating these faults in our seismic hazard model for Southern California, the black is what we included so far and then there are -- there are all these blue faults, which we don't know the slip rate on and so we can't include them in the hazard model and project rates of earthquakes and then rates of ground motion.

There's other possibilities of ways to connect these faults and there's -- we may end up with branches in our logic tree or alternative fault models because there are alternatives to how the faults can connect between this version and that version, there's a little bit of difference there.

And we need to be able to factor in our uncertainty about where these faults are, how fast they're moving and in order to get at the seismic hazard for this region.

And in case you missed some of the words in Bill's final slide, I think these are all exactly the same words.

But in order to understand the seismic hazard at any point and particularly here, along the coast, we need to know where the active faults are. That's fairly simple and Bill went through all the details of that.

We need to know which faults offset recent geological materials, and that can be done either onshore or offshore, depending on where the fault is.

We need to know the recency of activity and, finally, we need to know the seismic potential, which really comes from the rate of movement on those faults. That's the key piece of evidence we need and that we don't have for many of these faults.

Thank you.

COMMISSIONER BOYD: Mr. Wills, a couple questions. Can you talk a little bit about fault segmentation models and to what extent the Tohoku Earthquake changed scientists' views about fault segmentation, if at all?

MR. WILLS: Well, in our -- in our models, each one of these separate panels we treat as a segment. And in older models, back in the late eighties and early 1990s, many segments were assumed only to rupture independently.

In UCERF-2 and in the previous models from the Working Group on California Earthquake Probabilities, most segments have a set probability of rupturing with the adjoining segments.

So, although we still -- in the UCERF-2 we include what's called characteristic earthquakes on segments as the basis for the model.

We also allow segments to rupture with their neighbor, or with many of their neighbors, particularly along the San Andreas Fault and the other major faults.

And so although for many faults the typical style of rupture is for a single segment to rupture by itself, all of the major faults have the potential in our model to rupture with, sometimes, several of their neighboring segments to produce larger earthquakes.

I think that's basically the lesson of the Tohoku Earthquake, is your seismic hazard model has to do that, you have to allow numerous segments to rupture together in order to capture the range of possible ruptures.

COMMISSIONER BOYD: Thank you. One other quick one; is there any evidence of possible thrust faults either beneath or behind Diablo Canyon, or SONGS, and are there any studies to pursue that further, that you're aware of?

MR. WILLS: So, the thrust -- the Los Osos Fault is a south-dipping thrust fault in the valley that's on the other side of the hills from Diablo Canyon. It dips towards Diablo Canyon and it -- we don't really know what it will intersect underneath those hills. Those hills are being uplifted by -- probably along some kind of series of faults.

I would expect there to be reverse faults or thrust faults somewhere in those hills. And how active they are, I have no idea.

PG&E is planning, and I believe it's this fall, a series of seismic profiles across those hills a couple different places and a couple of different directions, that I think will give us a lot of new evidence for where high-angle faults might be underneath the hills there. And I think that's probably one of the key pieces of evidence they need there.

Down in Southern California there are these proposed very large thrust faults, which dip towards the coast, which we don't know very much about, especially

their activity or rates of activity. And there we need to do some more detailed studies of the type that Sam was describing to be able to trace out those faults and show whether they offset young material on the sea floor, and how much they offset young material on the sea floor to try to get a slip rate.

COMMISSIONER BOYD: Thank you very much.

CHAIRMAN WEISENMILLER: Thank you.

MS. BYRON: Okay, our next speaker is Chuck Real, he's a registered Geophysicist in California. He's working -- he's a Supervising Engineering Geologist with the California Geological Survey where he helped establish and currently manages California's Seismic Hazard Zonation Program.

MR. REAL: Thank you Mr. Chairman and members, very pleased to be here and share with you some insights on the Tsunami Hazard Program.

It's a cooperative, a Federal/State Cooperative Program under the National Tsunami Hazard Mitigation Program. And as a partner in California it's managed by the California Emergency Management Agency. We are a mapping partner in that effort and a science adviser.

It's principally aimed at developing products that can assist in both land use planning and development down the road that hasn't been done, yet,

but also to develop products that can assist in emergency preparedness and planning.

I think a point that I'd like to make at this hearing is the fact that these -- that we have maps out there now that are aimed at the preparedness planning readily available on the internet, and in printed copies, that that's easy to misinterpret those.

So, I want to make a point of what those maps are and what they're not.

The maps that are available now cover much of the California coastline, about 50 percent of the coastline from Santa Barbara north and about 90 percent of the coastline south of that.

The maps are based on modeling efforts that was done under contract by the Tsunami Research Center at the University of Southern California. A big effort there was to pull some workshops together to decide what the maximum earthquakes that could happen on the various sources of tsunami, both distant and local sources, what those characteristics are.

The maps are based on a mean high tide, so they're very conservative. So, the flood height from those maps, from the modeling efforts, is basically added onto a high tide, mean high tide.

The maps were released in the fall of 2009, as I

mentioned they are available on our website, the CalEMA myhazards website.

They do supersede a previous set of maps in that they have higher coverage, higher resolution coverage. Principally, the flooding taken on land, the inundation part uses higher resolution topographic information on land, and meter resolution elevation models.

This kind of illustrates, this figure illustrates the inappropriate use of these kind of maps. First of all, the inundation line is the result of an ensemble of earthquake sources around the Pacific, that's distant sources as well as nearby sources.

And those sources, each, are assumed to have the largest earthquake that can conceivably happen on that source.

And so several models are run, one on each of these sources, to see what the contribution to this line is. But the line is an envelope of this ensemble of high-maximum run up.

And the reason for that is because the use is primarily for evacuation planning. When one hears a tsunami warning you don't want to try and figure out what source it comes, that might be responsible for that tsunami, you just know that you have to leave the area.

They are not an evacuation map, themselves,

these maps are a resource that's used by local emergency planning agencies, who are familiar with the local geography, streets and so forth that end up developing the evacuation map.

Again, these inundation maps do not represent a single scenario. No single event, even the largest on any one of these sources, would produce this kind of inundation. So, it's important to keep that in mind, this is an ensemble, high-line envelope of all sources.

The modeling, itself, is very coarse resolution, it's 90 meter. That is the modeling of the bathymetry. And the bathymetry, the ocean bottom has a very strong effect on where energy can be concentrated or disbursed in a tsunami.

So, again, for application to looking at hazard at a specific site, you need a site-specific study that has higher resolution data.

I will say that one of the important aspects of this partnership is there is a lot of effort being put into certifying tsunami models. There's published, well-vetted standards for assessing the valid performance of tsunami models. There's at least a half a dozen out there now being used.

A workshop was held in Texas, in Austin, Texas a few months back and there are still some models in the

process of being validated as a result of that workshop.

The other contribution to the overall program is what you've heard a lot about this morning. You know, what really drives a tsunami is fault movement on the ocean floor and that -- that depends, as we know, on the size of the earthquake, and there's a lot of discussion that's been going on about linking fault segments together in estimating the size of potential events.

Of course, there's a possibility, too, that the shaking, itself, either onshore or offshore, can induce a landslide. The tsunami produced by a landslide has been modeled. It's been modeled in the California border land at a few locations. It's much more localized, however, it can produce considerable wave heights if one were to occur.

Looking at the kind of work that's been going on with local sources, I think it's been mentioned a number of times this morning by the various speakers that a lot is yet unknown about offshore sources.

There are faults that have the vertical movement, thrust faults that are still not well understood. It's changing with time, the opinions as to whether or not they are active or how large an event could potentially be produced.

Something else I didn't mention about the

inundation maps for evacuation planning is there's no time element in the generation of those maps.

So, when we look at all those sources, they're assumed to happen.

And to go to the next step of producing the kind of product that could be used for land use planning, development situation would require an element of time being folded into the process to produce probabilistic tsunami maps.

And that's something we're just now embarking on. We had a workshop last week at the Pacific Earthquake Engineering Research Center to examine the most recent work on the sources that could have the greatest impact in California, trying to settle in on the source characteristics, as well as the models that are being used.

One thing I might mention in terms of the likelihood of hazard, we need to understand, again, how active the offshore faults are. And considering landslides, the work to date seems to indicate that these features that you saw on some of the previous speakers' slides are several thousand years' old, but more work needs to be done to definitely identify the ages of these offshore slides.

This last slide kind of sums up the most

damaging and important sources that affect the California coastline, at least from Cape Mendocino south. This -- the height of the bar shown on this map indicate how important or the importance of the contribution of fault movement along these sources to the generation of a tsunami that would impact the southern part of the State.

And you can see that Alaska and the Aleutian Islands are the biggest contributor. And it has to do with the orientation of that source zone, along with the potential for very large earthquakes, subduction zone earthquakes much like the Tohoku that caused the catastrophic earthquake in Japan.

But also sources in the Kermadec Islands to the west and all South America are also important contributors.

As you go north of the Cape Mendocino area, Cascadia is another important source, but because of its orientation for the southern part of the State, it really contributes very little.

But as you go north of Mendocino, on up to Crescent City, it is the primary source and it, again, is also a major subduction zone capable of a magnitude 9 plus event.

And so part of the intent of that workshop last

week was to try and pin down how large of an event and the timing of events on the Cascadia Zone for the northern part of the State.

So, I guess an important point to make here is that we believe more work needs to be done on local sources; you've heard a lot about that this morning, both landslides and offshore structures.

But we do not have a major subduction zone type geologic environment near our coastline and so we simply don't expect to receive any hazard or tsunami of the dimensions of the Tohoku.

Thank you.

COMMISSIONER BOYD: Well, one quick question. In light of the tsunami in Japan, is there any significant rethinking of the estimation methods and just the whole idea as tsunamis as it relates to California? You kind of really touched on that in your last slide here, but I just wondered if it's anything might change as a result of what we saw in Japan?

MR. REAL: Well, I think we heard about it in the last speaker and that's simply that we need to really take a close look at how these source zones are segmented and really take in the realistic possibility that there can be multiple segment ruptures and a much larger quake than we previously thought.

COMMISSIONER BOYD: Thank you.

CHAIRMAN WEISENMILLER: Thanks, again.

Actually, we're going to change things a little bit. I promised Commissioner Sandoval, when she got here, she could make her opening comments.

MS. SANDOVAL: Well, thank you very much. Thank you very much, Chairman Weisenmiller, and thank you to the California Energy Commission, our partners in the Integrated Energy Policy Report Committee, and to Commissioner Florio.

So, I was at an event in San Diego, so forgive my late arrival.

So, really appreciate the opportunity to be here today. This analysis is very important. I am glad that we're not only doing the due diligence due to nuclear power plants in California, but also really looking to learn the lessons of Japan.

Sadly, it's created an opportunity to look at whether or not the assumptions that were made are still appropriate.

And as we look at that previous map and see Alaska, as well as Chile, which does have some subduction zones, it raises a lot of questions.

I know, for example, one of the questions that's being looked at by the power plants is about backup

power and the assumptions about how long the plants are going to be off the grid.

So, I'm very glad that we're taking a very serious scientific look at these issues and I look forward to working with you. Thank you very much.

CHAIRMAN WEISENMILLER: Thank you for being here today, and with your advisers.

Please, the next speaker?

MS. BYRON: Thank you. The last speaker in this Panel 1 is Dr. Mark Johnsson. He is a Staff Geologist for the California Coastal Commission for the past 11 years. His role at the Commission is to serve as a technical adviser to the Commission and its staff on geotechnical issues related to the development in California's Coastal Zone.

He received his PhD from Princeton University before joining the USGS as a research geologist.

Dr. Johnsson.

MR. JOHNSSON: Thank you. Good morning Mr. Chairman, Commissioners.

I don't have a formal presentation and I'm not going to repeat a lot of what has already been said by my -- in the presentations of my colleagues.

What I would like to do is to explain how the Coastal Commission, as a principal State regulatory

agency involved in the relicensing of these plants will use those data. And, of course, I'll be available for any questions.

The Coastal Act requires that the Coastal Commission make findings that new development is sited and designed to minimize risks to life and property in areas of high geologic, flood and fire hazard.

The term "development" is very broadly defined in the Coastal Act and the Commission staff has determined that the license extensions at SONGS and Diablo Canyon constitute new development and will require a Federal Consistency Review and Coastal Development Permits.

In addition, the studies, themselves, that have been proposed constitute development and will require Coastal Act review. A great concern with the 3D, high-resolution 3D seismic images is submarine noise and its potential impact to marine mammals.

As identified by the AB 1632 report, there are some important data gaps and those are the types of information needs that the Coastal Commission will have to make use of in their review.

Soon after the Tohoku earthquake I prepared, at my executive director's request, a brief report assessing the likelihood of a similar event affecting

any of the State's three coastal nuclear facilities.

I believe that you've provided with a copy of that report. And Ms. Byron asked me to provide a few words summarizing that report.

First, I want to emphasize that the Tohoku earthquake was a very large earthquake. We have had three very large earthquakes in just the past decade or so, but those are exceedingly large earthquakes. The Tohoku earthquake is tied for the fourth largest earthquake in the world.

So, many of the effects from that earthquake are just the result of it being a very large subduction zone earthquake resulting in intense ground shaking and, of course, the large tsunami.

And it's important to understand that the vast majority of faults in California, including the San Andreas Fault, just could not produce a magnitude 9 earthquake. A magnitude 9 earthquake requires rupturing of fault surface thousands of square miles in area and the shallow faults making up most of California's fault systems just simply do not have the area to generate such an earthquake.

An important exception to that is the Cascadia Subduction Zone which has many similarities to the large earthquakes that have occurred in the last decade.

In the northern part of Coastal California, north of Cape Mendocino, as well as all of Coastal Oregon, Washington, and part of Coastal British Columbia is susceptible to an earthquake and a tsunami event very similar to that of the Tohoku earthquake, and emergency response scenarios and land use planning must take this into account.

Finally, another main conclusion was that a nuclear emergency, such as is occurring in Japan, is extremely unlikely at the two operating nuclear power plants. The combination of the strong ground motion and the massive tsunami that occurred there just can't be generated by those faults, as we understand them.

Nevertheless, as I think you've heard this morning, the geologic conditions near those plants are very likely different than previously believed and the ongoing studies, such as recommended in the AB 1632, are warranted.

So, those types of studies, as well as those going into the UCERF-3 model are exactly the type of information that the Coastal Commission will need to consider as it evaluates the size of risk, the geologic stability, in Coastal Act parlance, of those two plants.

Of particular concern are better constraints on the Hosgri shoreline and Los Osos Faults, as well as a

fault we haven't heard much about today, the San Luis Bay Fault at Diablo Canyon.

At SONGS, we need much more information particularly on the Oceanside thrust and the 30-mile bank thrust.

For all of them we need to better understand the risk of large, locally sourced tsunamis from submarine landslides.

Finally, just to wrap up, I'd like to say that I think we've heard quite a bit about fault segmentation models and I think that a primary lesson of the Tohoku earthquake that we can't be saying what about our fault segmentation models? We need to evaluate the possibility of large earthquakes that rupture multiple fault segments.

Thank you and I'd be happy to answer any questions.

COMMISSIONER BOYD: I'd just say thank you for being here.

CHAIRMAN WEISENMILLER: In terms of the Coastal Commission's regulatory challenges in the seismic area, are these two plants your most complicated seismic issues?

MR. JOHNSSON: We have -- I would say that they have a -- we have much concerns about them. But, no,

there's seismic complexities throughout the State.

CHAIRMAN WEISENMILLER: All right.

MR. JOHNSSON: The level of study that we feel is warranted here presents some interpretation challenges, but no more so than other comparable levels of study elsewhere.

CHAIRMAN WEISENMILLER: And in terms of the research we've heard about this morning, particularly the 3D imaging, what tools or what research would be most useful to the Coastal Commission as it deals with its decisions on these two plants?

MR. JOHNSSON: Well, in my advisory role, I have most concerns -- well, I won't say most concerns. A very great area of concern for me is the thrust fault mechanisms at both plants.

Coincidentally, both plants the thrust faults are the largest area of concern. The 2D seismic imaging on land that PG&E is proposing may go a long way to answering the questions of thrust faulting directly beneath the Diablo Canyon.

And the studies by Southern California Edison are less -- less described, less underway. But the kind of seismic reflection studies that they are proposing there will, hopefully, answer the same types of questions for Oceanside and the 30-mile bank thrust.

And, remember, that many earthquakes occur on faults that we don't know about, so finding new faults by these studies is of great concern, too.

CHAIRMAN WEISENMILLER: Thank you.

COMMISSIONER BOYD: Mr. Chairman, I'm reminded by your question that while today we are heavily emphasizing Diablo Canyon and San Onofre, the hearing notice and this agency also worries about the shutdown plant on the coast up at Humboldt.

And as I imagine the Coastal Commission does, as well, and ultimately other agencies in California.

But we still have a shutdown nuclear plant with a fair amount of on-site spent fuel stored there that we tend to worry about, and that's an interesting seismically active area of the State. And they recently experienced some of the tsunami wave all the way from Japan up there.

So, just for the audience's information, we do put that on our agenda of things to concern ourselves about as well.

CHAIRMAN WEISENMILLER: Exactly. I would assume that that's probably our -- Humboldt is probably our greatest concern in terms of tsunamis of these three units.

MR. FLORIO: Just a question in terms of the

relative roles of agencies here. Does the Coastal Commission have any direct regulatory jurisdiction or are you preempted by the Nuclear Regulatory Commission when it comes to these facilities?

MR. JOHNSSON: No, we most definitely do have regulatory authority. The Coastal Act requires that we assure geologic stability, regardless of whether it's a nuclear power plant or a single-family home.

MR. FLORIO: Okay.

CHAIRMAN WEISENMILLER: And for the record would you also just clarify your role in the 3D imaging studies?

MR. JOHNSSON: I sit on the Independent Peer Review Panel that was required by the PUC to continually peer review the studies proposed by both utilities, and to help interpret the results.

CHAIRMAN WEISENMILLER: That's great. And my recollection was that State Lands is sort of the lead agency on the CEQA analysis and you're participating in that CEQA document as a responsible agency?

MR. JOHNSSON: You're correct, State Lands is responsible for the CEQA, largely on the 3D imaging, but also the ocean bottom seismometers and the 2D on-land imaging.

We are working closely with our sister agency

and certainly commenting on -- we've just sent out a comment letter on the notice of preparation.

MR. FLORIO: And based on what you've seen so far are you satisfied with the scope of the studies that are being undertaken?

MR. JOHNSSON: Well, there is always room for -- I'm a scientist, I'm always looking for more data. I think that -- I think we need to wait for the CEQA document before I can really make a comment on that.

MS. SANDOVAL: Thank you very much for your work on these issues.

I was wondering if you could just amplify a little bit on your assessment of the implications of the Cascadia Fault for tsunamis affecting particularly both the Humboldt area and Diablo Canyon?

MR. JOHNSSON: Well, when we, the Coastal Commission, approved the independent spent fuel storage installation at Humboldt, that's where now I believe all of the radioactive -- highly radioactive material, I think they've got low-level material outside of there.

We did need to make an analysis of all of the geologic hazards and the stability of that site.

We -- the staff report is referenced in the report that I think you have on the Tohoku earthquake and for tsunami hazard we did find that -- the

Commission did find that the tsunami hazard was not adequately mitigated for and, actually, was in contradiction to those parts of the Coastal Act dealing with geologic stability.

However, the situation with the spent fuel in the spent fuel ponds was considered worse. So, under the Coastal Act, and we're getting out of my area of expertise and more into the policy areas, under the Coastal Act there is conflict resolution procedures whereby if something is inconsistent with parts of the Coastal Act, but it would be better for the public good to approve it, you can balance those issues.

COMMISSIONER BOYD: Mr. Chairman, this might be an appropriate time to mention an interesting little factoid relative to the Coastal Commission's responsibility, heavy responsibility in this area.

When the Nuclear Regulatory Commission recently agreed to not release a license for -- a relicensing license for Diablo Canyon in the face of all the requests of executive and legislative representations here, in California, they predicated their decision on the Coastal Zone Management aspects of what needs to be done, not as much on what any of our two agencies have raised, repeatedly.

But because the Coastal Commission needs to look

at these seismic issues in doing its job, they chose to use that as the reason for a “delay” in relicensing.

So, they are a key partner and, obviously, a key member of the Independent Review Panel as well.

CHAIRMAN WEISENMILLER: Thank you for that history.

Thanks again.

MR. JOHNSSON: Thank you Mr. Chairman, Commissioners.

MS. BYRON: Thank you. With Mark Johnsson’s presentation, he’s the last speaker on Panel 1. I’d like to thank all of you for coming and being with us today and your participation.

And could we ask Panel 2 members to come to the table?

We’ve got, as our first speaker, will be Loren Sharp. He’s with the -- with PG&E. He’s been with PG&E since 2007 and is currently the Senior Director of Technical Services at Diablo Canyon.

His responsibilities at Diablo Canyon include geosciences, license renewal and the Licensing Basis Verification Project.

Before coming to Diablo Canyon, Loren was plant manager at Humboldt Bay Power Plant. And while there he completed the ISFACE (phonetic) campaigns for Humboldt

Bay and prepared strategy for Humboldt decommissioning.

Loren received a BS and MS in nuclear engineering from Idaho State University and he holds a mechanical engineering degree from Washington State, and Senior Reactor Operator Certification.

MR. SHARP: First of all I would like to take the opportunity to address the panel and thank you for the option to come, as well as some of the questions that came up in the last session, on Humboldt. If you still have some of those questions at the end of my presentation, I can address some of those Humboldt issues, as well.

So, from an agenda stand point I'd like to talk a little bit about the -- in presentation the recommendation status of AB 1632 report, as well as the initial lessons learned from Fukushima that we've got to this point.

In the next slide we have, essentially the top six show the items that have been completed thus far and the items on the 1632 Report recommendations.

The items on the bottom portion, the additional seismic surveys and spent fuel storage facility, I'll discuss those in a little bit more detail later on in the presentation.

From a seismic hazard stand point we intend to

do three specific tiers of seismic research. We're working on getting all the necessary pieces in place to make that happen. The high-energy 3D offshore imagery is one that is looking to get the permits in place such that we get to the point by fall of 2012 we could complete that survey.

The 2D onshore work also is moving forward well and I'll talk a little bit more about that in the details on the next couple of slides.

The 2D/3D low-energy offshore work is actually kind of ongoing at this point. The first process in the northern portion was done over the fall of 2010 and in the spring of 2011 and we'll complete the southern portion in the fall of 2011.

For the 3D offshore high energy, I should also mention that we submitted the initial draft for a permit to the State Lands Commission on April 29th.

We also have submitted for the offshore portions for an exemption for the marine protection area to the California Fish and Game. That was submitted on April 29th of this year.

For the onshore 2D work we met with the San Luis Obispo County and that was determined not to trigger a use permit condition, so we have gone down to the next permitting areas, which are encroachment permits on the

associated jurisdiction of roads, parks, or county roads and those encroachment permits were filed to the respective agencies on July 15th.

For the ocean bottom seismometer effects the monitors that we're looking to install, we have initiated a number of permits. The surface lease permit was submitted to the State Lands Commission on May 6th.

The outline of the mitigated negative declaration was submitted to the State Lands Commission on May 20th.

And then the initial study for the mitigated negative dec was submitted on June 17th of this year.

So, things are moving forward in many areas.

This is an overall anticipated schedule of what we view to be all of those associated activities. And you can see in general many of those will be completed by the end of 2011, with a lot of the long permitting activities or environmental reports to support the permit for the high-energy 3D offshore not anticipated until the summer of next year, such that we could do that survey in the fall of 2012.

Switching gears a little bit to the spent fuel storage facilities, there are a number of discussions that have occurred. The NRC Task Force is looking at the Fukushima Daiichi accident and looking at

recommendations and issues associated with the spent fuel pool from that event.

There also was an earlier compemensory actions that looked at sources of water for the spent fuel pool, and I'll show you a slide of that in a second.

And then there was a report by the National Academy of Sciences, making a comment that in some cases it's a better nuclear safety perspective to end up with a mix of fuel in the older, as well as the recently discharged fuel assemblies in the spent fuel pool, rather than just recently discharged fuel assemblies.

The dry cask storage at the Diablo Canyon, we have completed two campaigns. We have 1,068 spent fuel assemblies in Unit 1 spent fuel pool and 1,096 in Unit 2 spent fuel pool. We have 512 used fuel assemblies in the dry cask storage at Diablo Canyon. We have new casks that arrived on-site in June.

We are planning a next campaign in January to load seven of those and we'll proceed forward to get more delivery of casks so that we'll be prepared for the next set, as well, once we get past the third campaign.

I'll talk a little bit about Fukushima Daiichi, the lessons learned. I'd like to talk a little bit about the differences. If you'd note a little bit on the right side, the Fukushima Daiichi site is located

roughly 20 feet above sea level.

Whereas in Diablo Canyon most major structures are 85 feet above sea level.

Our salt water snorkels are the lowest piece that we have at the Diablo site, it’s 45 feet above sea level.

And I will also mention, if you noted in some of the discussions we had in the last several presentations, they talked about that the major things that drive tsunamis are subduction zones faults, the proximity to those subduction zone faults, as well as the topography underwater or the -- if you have a zone where you have shallow water for a long period of time fronting your coastline, those tend to be a much more impactful tsunami configuration.

So, the recent bathymetry work that was done in Diablo Canyon helped confirm that assumption that we don’t have some of those same features in our area.

This is another picture of the same types of things. You’ll notice on the foreground here, this is the OX saltwater snorkels at 45 feet. Most of the power block structure, diesel generators are located at the 85-foot power block on the bluffs above the water.

The dry cask storage we mentioned earlier, as well as a fresh water reservoir of 5 million gallons,

two ponds of two and a half million each, are at the 310-foot elevation. And, again, the spent fuel pools are located at roughly 140-foot.

So, from an emergency power stand point we have a number of ways to provide design basis capabilities. In the case of a station blackout event we have six air-cooled diesel generators, three per unit, with a crossties from generator -- from one unit to the second unit.

We also have two underground diesel fuel oil tanks that have a seven-day supply of diesel fuel oil. And then, again, we have most of our electrical switch gear and batteries at grade levels 85 feet or above.

And I'll show you some of those sources for emergency cooling for both the spent fuel pool and the others.

This is a supplemental spent fuel pool sources, not only do we have the firewater tanks that are on the upper left, and these two tanks, we also have the capability to tie in with fire trucks or fire system to either of these huge, 5 million gallons of water to provide either with piping or hoses and fill into the spent fuel pool in a beyond-design-basis event.

We do have a fairly unique feature at Diablo Canyon, I'm not aware of anyone else that has such a

large water source above us at the 310-foot elevation for a use like this.

For emergency cooling capacity, I'll talk a little bit about all these features to remove heat from the steam generators or from the spent fuel pool.

In this particular picture you'll note the steam generator on the left, we have the ability through the condensate storage tank, the firewater storage tank, as well as the condensate storage tank for the second unit to have the ability to replace water in from those sources.

We also have, again I mentioned, the 5 million gallons from the route water reservoirs. And we have the main condenser hot wells. And then, again, as a last resort the Pacific Ocean.

So, we have a number of sources to be utilized for removing decay heat and providing makeup to those secondary systems.

So, from initial lessons learned, obviously, we need to look at the Fukushima from multiple unit design capabilities and making sure that we consider the impacts from multiple units. That's one of the things that we're looking at, as well as robust capacities to recover from a station blackout and to mitigate any challenge in their spent fuel heat-up during upset

conditions.

So, we did a number of things. First of all, the NRC had follow-up actions that asked us to look at beyond-design-basis phenomena. We considered that, as well as we went out and looked at a number of our in-place features.

So, the first one we looked at is what we call B5 Bravo. That's actually an acronym for 9/11. So, these are many of the mitigating features that we put in place after 9/11. So, we looked at these to say, number one, validate that the equipment is in place, that the equipment is available and it's functional.

And then we identified if we had any deficiencies, we put them in a correction action program and worked to fix all those that we had identified.

We also did a similar thing association with Station Blackout. We looked at all of the things that we are crediting for Station Blackout to make sure that the equipment is functional, it's in place, it's staged and that the training is in place for both the previous on, on 9/11, strategy as well as Station Blackout.

So, the design team, we're taking all that insight and we look at this Beyond-Design-Basis Response Team we have a Diablo to say what are the things that we can do, from a modification stand point, to strengthen

our ability to withstand this type of an event on a beyond-design basis, our emergency preparedness enhancements, or any training or qualifications that we would add as we look at these challenges.

So, we're continuing to work within industry, as well as with the NRC to look at those pieces. And so far to date I will tell you that these are the things that have come to the surface.

Our backup aux saltwater cooling water system was a lease that we had for an off-site agency to bring water capability for pumping on-site over existing roads.

We terminated that lease, procured that equipment and put that equipment on site, so it's on site as of today.

The low lease design reactor coolant pump seals was something that was just recently -- a new product that came on the market within the last year or so. We are looking and have approved to put those seals in as a design modification to minimize leakage from a reactor coolant system in this beyond-design-basis event. So, that's going on as we speak to do the design work for those changes.

The capacity for the diesel generators to restart in a beyond-design-basis event requires some

compressed air, so we are looking at the capability of bringing in a diesel-powered air compressor that will allow us to have the multiple restart capability in an extended period of -- an extended station blackout.

We're also looking at the potential for some diesel generator power charging pumps, in addition to the previous one.

So, from a conclusion stand point, we've looked at all of the design features and training lessons for vulnerability of Diablo Canyon for design-basis events. We've looked at the actions that have been taken in response to the initial lessons learned and we continue to move forward as we learn information from Fukushima, as well as reviewing any insights that come from the NRC Task Force to see what changes or impacts we might have in our design.

CHAIRMAN WEISENMILLER: Thank you.

COMMISSIONER BOYD: Questions, if I might?

CHAIRMAN WEISENMILLER: Yeah.

COMMISSIONER BOYD: Mr. Sharp, I've got about three questions, if you don't mind.

The NRC recommendation an evacuation zone of 50 miles from the Fukushima Daiichi plant and the Diablo County Emergency Planning Zone is 18 miles north and 22 miles south.

What are the implications of the U.S recommendations for a larger evacuation zone in Japan than we have for Diablo Canyon?

MR. SHARP: So, first of all, Diablo Canyon has the largest zone, emergency zone of all the 104 plants that I'm aware of in the U.S. We had a fairly large one that we agreed to in our initial licensing.

So, we have looked at the things that we have done in our evacuation and we just recently completed an evacuation study that looked at our infrastructure for roads and bridges.

I would tell you that the study results that we just completed showed that our results are better than they were the last time around. We looked at this because they've done some seismic retrofits of the bridges in our area, so that has improved.

But I would say in general we are going to do another revision of that evacuation study when the 2010 Census -- when the recently completed Census is done in 2011, we'll start that study with that new data.

So, I don't envision that growing at this point.

COMMISSIONER BOYD: Well, building on what you just said, the NRC's post-Fukushima inspection of Diablo did note that the emergency plan relies on the highways and access roads that may well be inaccessible, since

they're so limited in this area after an earthquake.

Are you addressing this dilemma in this additional work you just referenced?

MR. SHARP: So, the work we just completed looked at the liquefaction that would occur in the roads and bridges around our sites, as well as our limited access roads, and looked at the ability to evacuate those people and accommodate the time frame it would take to make, I'll say temporary repairs, as appropriate to get people in and out. And in no case did we exceed the time frame that we thought was an unacceptable evacuation time.

COMMISSIONER BOYD: And, lastly, could you give us your description of the current status of your relicensing effort?

MR. SHARP: So, we have submitted a letter to the NRC requesting a delay of any decision on license renewal until we complete these 3D seismic studies we mentioned earlier in the slides.

The NRC had just recently completed an approval of the Safety Evaluation Report and had not yet started on the Environmental Report to be issued.

So, that is in a hold status until we provide feedback to them from the results of the seismic reports from these 3D work. And then at that point in time my

belief is that they would restart on the environmental review, as well as any ASLB hearings that might come as a result of that restart as well.

COMMISSIONER BOYD: Okay, and I might note for the audience where, normally, you'd expect a lot more questions out of us, or me, we've had two -- the Chairman, myself, and Barbara Byron have had two separate briefings with PG&E in the last two weeks as we pursue our internal issues in these issues, so got a quite a bit of background information.

There's still a lot of questioning going back and forth on re-racking the pools. As we recently discussed, there is a concern whether, you know, surrounding young fuel with older fuel, versus just getting older fuel out of the spent fuel pools and into the dry cask storage, you know, which is a better approach and we'll continue to have those discussions. But there are obviously differing points of view on that subject.

So, I have no more questions, thank you.

CHAIRMAN WEISENMILLER: Well, I had a couple on your slide on spent fuel storage facilities, if you want to pull that back up for a second?

MR. SHARP: This one or the one before?

CHAIRMAN WEISENMILLER: Actually, the one

before, sorry.

CHAIRMAN WEISENMILLER: Keep going.

MR. SHARP: That's too far.

CHAIRMAN WEISENMILLER: Keep going a couple more back. Yeah, I think one more. Actually, two more. Okay, got it.

Okay, so you mentioned the NRC's Near Term Task Force recommended enhancing spent fuel pool makeup capability and implementation. What's the likely timeline on those enhancements for implementation at Diablo?

MR. SHARP: Well, right now we are waiting to see. We've looked at some of the options to see what we have and what we are currently are learning from the Fukushima Daiichi.

We did learn that, indeed, they did not suffer any damage of their spent fuel pools due to the earthquake event. They apparently did maintain water over all the spent fuel pools.

So, we're continuing to learn from what they went through and looking at any recommendations coming from the NRC.

My suspicion is there will be some kind of an instrumentation upgrade, but it's just speculation at this point to see where that might go at this point.

CHAIRMAN WEISENMILLER: Okay. Now, down at the bottom you reference the National Academy of Science Report. In one of our earlier IEPR's we looked pretty extensively at that, so I was going to ask the staff to docket, in this case, the testimony.

I think Gordon Thompson was one of the participants in the panel and certainly testified here relatively extensively on this topic on what the Academy found or didn't find.

And also as part of that, certainly, there's a transcript of the discussion there. So, I think to get a fuller record, my recollection is that Dr. Thompson was very concerned about the dense packing and its particular implications of trying to move to a less-dense packing there.

Now, obviously, as you point out there's some benefits of moderating. But, again, there was -- and I think, also, unfortunately the Academy was really limited generally in terms of access to information by the NRC for concern that, obviously, there are potential implications for terrorists on getting access to some of the information.

Now, obviously, most people don't consider National Academy of Scientists as terrorists, but somehow they managed to limit their access to the data

in these cases.

But again I think no use digging into that much more today, as much as saying we have a record from the prior IEPR, we'll pull it in.

Certainly, PG&E, I think commented at that time and we should pull those comments in, too.

MR. SHARP: Well, I do think it's important to note that, you know, part of the discussion, there's going to be an optimum of this because, obviously, we use regionalized storage when we have the fuel either in the spent fuel pool or in the dry cask storage. You have the fresh ones surrounded by the more older fuel assemblies.

And in all cases I don't think there's an extreme one way or the other that is the optimum solution. I think there's going to be some dialogue on that before we come up with a recommendation from an industry on where that ends up.

MS. SANDOVAL: Yes, thank you. If you can say, publicly, how long can you operate without connection to the grid, if you have a power blackout?

MR. SHARP: So, that's a difficult question to answer from a number of different situations. I would tell you that we have seven days of diesel fuel capacity on site within our tanks.

We have a contract to bring in diesel fuel on a barge so that we have an ability to continue to run for an extended period of time beyond that seven days.

And so what you're looking at is the ability to continue to proceed to provide shutdown cooling capability in the event that you had an extended station blackout.

So, that's -- station blackout is really the loss of all onsite and offsite and what we're doing is trying to provide the defense and depth so that we do not lose our diesel generators.

MS. SANDOVAL: And do you believe that the barge will be able to reach the plant?

MR. SHARP: We believe that either the barge would, we even have a backup to that backup, that we could use, for the National Guard to come overland with their large vehicles to get us diesel fuel. So, we believe we have multiple capabilities to get diesel fuel on site.

MS. SANDOVAL: And your slides seem to be making a distinction about restart versus other backup. Is there some significance to the word "restart" is it sort of an automatic in the event of blackout?

MR. SHARP: Oh, I see what you're talking about. Our diesel generators, I made the point on restart for

diesel generators, there's a limited capacity of air in the air receivers and so if you continue to start the diesel generators until you exhaust that air capacity, then I could no longer restart the diesel generators without getting some kind of air receivers on site to provide that capability to restart the diesel generators. So, that's a vulnerability.

I'll say, in the Beyond-Design-Basis Center we've recognized and are looking at the solution to try and resolve that.

MS. SANDOVAL: And how long is that capacity, if you can say, that air capacity?

MR. SHARP: I would have to get back to you. Off the top of my head I can't give that answer, but I'll let you know.

MS. SANDOVAL: Yeah, we would be interested in following up on that, thank you.

MR. SHARP: You bet.

CHAIRMAN WEISENMILLER: Thanks.

MS. BYRON: Okay, our last speaker on this panel is from Southern California Edison and it's Mark Nelson. And the SCE slides didn't arrive in time for us to post, but we will be posting them on our website after the workshop.

I think all of the Commissioners have copies of

the slides and there are some that were left out on the table out front.

And Mark Nelson is currently the Director of Generation Planning and Strategy for Southern California Edison.

He has broad responsibility for policy, expansion, and strategic planning of power generation, including new and existing fossil, nuclear and renewable sources.

Mark.

MR. NELSON: We're in the installation phase here.

Okay, good afternoon, I recognize I'm between everyone and lunch so I'll try and work through it here.

Welcome, Commissioners. As I said, I'm Mark Nelson, from Southern California Edison.

I have with me Carolyn McAndrews. Carolyn is a Director at San Onofre. She's from the site. We split how we work with San Onofre. I'm actually from the Central Office, so I'm from Rosemead. So, it's oftentimes helpful to have someone from the site who's more technical, in case we get into questions that are more site-oriented, so Carolyn might be answering some things.

What I'd like to do is split the discussion in

two, again, the 1632 update and, also, Fukushima.

We spent about 18 months providing the analysis of the AB 1632 questions that were posed to us by the CEC. As you'll recall, that was generally focused on plant reliability. That activity, as Barbara had noted, grew out of Assemblyman Blakeslee's bill.

We provided a fairly dense report. This is the executive summary of it. The report, itself, was probably two inches thick, it covered the seismic and tsunami evaluations, our safety culture, economic impacts, low-level red waste, used fuel management, a number of items.

We had one open item and that was regarding our discharge conduit. That work has now been completed and we anticipate that we'll be providing the results of the reliability impacts of our discharge conduit in the next week or two.

The big hanging item, as Barbara also noted, was that we have filed an application with the California Public Utilities Commission for approximately $64 million in funding to complete 3D seismic, and other related research on the seismic front, and I'll talk about that a little bit more in a subsequent slide.

So, that was basically the completion of our 1632 work.

To discuss a little bit about SONGS' seismic and tsunami design, first off the NRC has a substantial body of work that's required that requires us to design the plant according to the natural phenomenon that would be appropriate for the plant. In our case largely earthquakes and tsunamis, obviously, that's different in different jurisdictions.

In our case we looked, prior to construction of the plant, at the earthquakes, at tsunami. The plant is designed conservatively to a peak ground acceleration of .67 G.

The plants aren't designed to a magnitude earthquake, that's all taken into the models and then it results in a ground acceleration. So, the magnitude of the earthquake is just one factor.

The safety-related structures have to remain functional so that the plant can be shut down in the event that there is some sort of disruption.

In the case of tsunamis we have done the analysis and conservatively built the sea wall to 30 feet.

The subsequent analysis, which was discussed a couple of presentations ago, came up with a 23-foot tsunami inundation, so our 27-foot, at the time the plant was designed, shows the conservatism of the

plant's original design.

We also have an ongoing seismic program that provides for periodic evaluations of new information as it comes into the plant. We utilize new information that comes in from various sources.

And the NRC, through its generic letter process, is currently performing a review of the adequacy of seismic margins of all plants.

What you've probably heard of right now is GI199, which would be associated with the East Coast plants. And an earlier speaker talked about the 200-year return on the east of the fault in the Midwest.

so, again, we'll be participating in that with the NRC, so that will be a significant effort as well.

Taking a look at the work that's been done, in the early life of the plant there were extensive geotechnical studies that were completed. Those were 2D studies, there were borings, gravity and magnetic studies. The site was back cut into the hill, so at the time that was cut that provided an ability to do a substantial amount of analysis on the site.

There was an earthquake history that was generated then, as well.

In 1995 the NRC had all licensees do additional probabilistic seismic hazard analysis.

In 2001 we did some additional work and that was directly related to the Oceanside Thrust which was discussed, again, a few speakers ago.

And then we did additional follow-up work as part of the recent AB 1632.

And I list here future work and that's the work that we have now pending at the CPUC in our application for funding. And that would be putting additional GPS and seismic monitors out, doing 2D and 3D reflective mapping, both shallow and deep.

That will require permitting. We can't permit the deep until after we've done the shallow. The shallow will help us understand what the range of the deep would be, so that would be definitely helpful because that will allow us to economize on how much deep we do based on what we see in the shallow.

We'll reprocess the data and reanalyze so that we can take a look at what all of the existing body of knowledge is.

We'll also do more work at the existing site, do some borings and better understand the site, itself. And we'll implement all this in the framework of the generic letter, which the NRC is working with.

And so that should all come together in a time frame that makes sense, so that we'll have NRC guidance

on how to interpret all this information.

And now to talk a bit about the Fukushima event. The NRC Task Force Report, the 90-day report is out. I suspect that everyone has seen it, it's about 80 pages.

We could have spent a substantial amount of time really just summarizing the report. There's also a Power Point on it that was given to the Commissioners. And if you haven't seen it, there's a transcript as well.

They're all relatively quick reads and I think that I would recommend that everybody spend some time with them.

Basically, the NRC conclusions were that a sequence of events like Fukushima is unlikely in the United States, that continued operation and continued licensing activities don't pose an imminent risk to public health and safety.

That improvements could be made in the NRC framework and that the next steps would be the engagement of the stakeholders.

Additional areas that the Task Force has under review would be, again, improvements in the regulatory framework, a periodic review of the seismic and flood design basis of plants, enhancements to -- I'm sorry, enhancements to prevention or mitigation of seismically

induced floods and fires, extended station blackout mitigation capabilities. Hydrogen control and mitigation after we saw the explosions in Japan, used fuel pool instrumentation or cooling water enhancements. Integrating on-site emergency response capabilities, emergency plans for station blackout in events involving multiple reactor issues, and strengthening regulatory oversight of plant safety performance.

So, this is what the Task Force has brought back. The Commissioners have had robust discussion and they're in the process, now, of trying to determine how they're going to move forward with these recommendations, what the process will be and how they're going to get public input, and how the -- how the plants will take this information and move ahead with it.

In looking at SONGS and how we look at safe operation, and how we're learning from it, as we just heard from PG&E, B5B mitigation strategies have been in place since 9/11 and those strategies are strategies that can be used in many events. And so they address plant damage following explosions or fires and the cause is generally irrelevant.

And the same thing is true with severe accident management guidelines. And, again, they're actions to

address malfunctions, they're beyond-design-basis issues. So, if those occur, you can use these guidelines and these practices.

So, these were created before Fukushima, but they are practices that can be used in the event of a Fukushima-like event.

SCE has also established a Fukushima Event Response Steering Committee. It's led by our Chief Nuclear Officer. Our Senior Management Team supports it.

And the objectives are to bring the information in and find improvements in our safety and operational margins. We also want to insure that our Workforce is focused on its day-to-day safety and excellence so that it can be responsive to the work associated with Fukushima.

And we also want to work with the regulators to make sure that we can implement any lessons that come through, as they come through from our different regulators and the groups that we participate in.

And I'm also available to answer any questions that you may have.

COMMISSIONER BOYD: Thank you. Mr. Chairman, some questions.

Good to see you, Mark. The word we had

yesterday was you had a back injury and might not be with us today. As one who suffers from that, myself, on occasion, I'm glad to see you hear and empathy and sympathy.

Now, the questions. You talk about having, in one of your slides, an ongoing seismic program and, yet, AB 1632 report recommended that you develop a long-term seismic program similar to PG&E's for Diablo Canyon.

I don't have any indication that you've mimicked the PG&E program.

Do you have any comments or do you want to disabuse me of my understanding?

MR. NELSON: Well, in our request for funding at the PUC, we've requested funding specifically for a more active program for ongoing seismic.

The ongoing seismic program that we have currently at San Onofre is to look at the different efforts that have been ongoing. For instance, if there's work in academia that shows that -- and I think the Oceanside Thrust is a good example. If there's data on that and we need to bring it in and process it in our models, and take a look at how it impacts the margin, we do that and that's part of our ongoing effort.

PG&E has a different license, they're the only licensee that has an LTSP, a Long-Term Seismic Program,

so theirs is unique to the industry.

So, no, we don't have that. But what we have is ongoing seismic that takes in information, as its available, that's coming in from the -- you know, from the seismic industry.

What we've asked for is additional funding to enhance the program and do additional work and that's consistent with the request in 1632.

COMMISSIONER BOYD: Okay. You have to recognize that I suffer from several years of interacting with the NRC on the question of seismic activity and our access for any of the plants has been the relicensing route.

However, as you know, perhaps NRC consistently has refused to consider seismic activities in relicensing, had until Japan, on the basis that it's a real-time ongoing issue and it would affect current, ongoing operating licenses. Therefore, they don't need to take into any kind of relicensing.

And yet, as I testified to the U.S. Senate for two and a half years, we have suggested that there's all kinds of data regarding seismic concerns and the NRC seems to have turned a deaf ear to that, even though they said any time they get information they would pursue it.

So, I'm a little sensitive to people's comments

about how much seismic work they're doing. So, we'll continue to pursue that question with you, as an agency, as we have done with PG&E.

I want to ask you the same question I asked PG&E about the NRC recommendation for a 50-mile evacuation area in Japan; are there any implications to your facility for a larger emergency planning zone now, in light of the issues in Japan?

MR. NELSON: It's my understanding that the NRC is not currently -- that they've evaluated and they're not currently looking at changing the range of their emergency planning zone at this time.

So, we wouldn't -- we wouldn't at this time think that there's any change in our emergency planning zone.

COMMISSIONER BOYD: So, you're not thinking twice about it?

MR. NELSON: Well, at this point we don't believe that the NRC is looking at a change and we reevaluated in our 2010 period, and then we provided that information as part of our AB 1632 response.

COMMISSIONER BOYD: All right. Now, the AB 1632 response was my next question. That was submitted in February, before the event in Fukushima. Do you have any plans to update or revise the findings of that

report in light of those events in Japan?

MR. NELSON: We do update periodically. Carolyn, what's the periodicity of the updates on emergency planning?

MS. MC ANDREWS: Are you asking specifically about emergency planning or about the many recommendations that we responded to?

COMMISSIONER BOYD: Well, you did a report before there was a Fukushima. Are you considering updating your report in whatever areas it may necessitate updating as a result of lessons learned, and we've all been going through the lessons learned process.

MS. MC ANDREWS: Absolutely. So, I think the key is what framework would we use? And as we get the lessons learned from the various agencies, among one is the NRC, we will be evaluating those lessons learned and producing the changes to our processes, and our programs, and any other type of activities that would be needed to implement those insights.

We're not going to plan to go back and change, and revise that particular report, we're moving forward with insights that come out of subsequent reports.

COMMISSIONER BOYD: Okay, thank you, I don't have any other questions.

CHAIRMAN WEISENMILLER: Mark, a couple questions. The first one is easy, could you docket for us the NRC reports, the presentation for the Commissioners and a transcript? Not necessarily today, but I mean if you could submit it for our record, that would be great.

MR. NELSON: Sure, we can do that.

CHAIRMAN WEISENMILLER: Okay. The next question was on page 5 of your slides you talk about future work in the seismicity area and I thought it would probably be useful to talk about what you see as the likely timing and cost to those activities?

MR. NELSON: We have a pending application at the CPUC. The entire application is $64 million. We, I believe, have proposed a time frame that would give us a decision yet this year, so the work would start late this year, early next year.

And I believe that the time frame that we have laid out would be approximately three to four years total, so it would take approximately three to four years to get the work completed.

CHAIRMAN WEISENMILLER: Okay. Now, in terms of implementing the recommendations from the Blakeslee study, as you indicated, that incident has put in place an enhanced seismic group.

I was wondering if you want to just flag for us the major accomplishments of that group in the last couple of years, in terms of setting it up and the process?

MR. NELSON: I'm sorry, I'm just -- I'm not catching your question?

CHAIRMAN WEISENMILLER: I'm just trying -- I thought it would probably be good for the record here just to summarize Edison's major activities on seismic evaluations in the last couple of years.

MR. NELSON: The group that we have right now, we have -- what we have is a Technical Advisory Board that has -- I'm just counting here -- it has seven members of industry and academia that have been reviewing the ongoing work and the seismic environment.

We have put out a number of seismic sensors. We've been in the process of gathering information to reprocess data. We've been participating in the local seismic workshops in trying to get a better understanding of the seismic environment.

So, really trying to make sure that the -- that we participate. As you've seen, the USGS and other agencies have been finding -- have been participating in the offshore activity, so we've had participation in that as well.

And what we're trying to do with our application at the CPUC is reinforce that work and then put additional sensors out in the form of GPS's and other data collection devices that would bring additional information in, so that it could be added to the amount of information that the industry has in order to analyze.

And we also would like to go backwards in history and bring up the prior data, digitize it and reanalyze it as well.

CHAIRMAN WEISENMILLER: Okay. Now, obviously, one of the issues in the last couple of IEPR's has been Edison's struggles with workers safety or safety cultural issues that sort of reflected the NRC, certainly was reflected in your INPO reports.

And I thought it would probably be good to -- at this point if you could summarize where that issue lies and where you've gotten in terms of regaining your INPO ratings back from, say, the middle nineties?

MR. NELSON: Well, the INPO only reevaluates every two years, so there wouldn't be any INPO reevaluation for another -- at least another year or so.

But the NRC, it's my recollection that as recently as March the NRC has indicated that our nuclear safety culture is improving and that they're satisfied

that we're on an improved trajectory.

Our new -- our new Chief Nuclear Officer has been striving to improve -- to improve our nuclear safety culture.

Carolyn, if you wanted to add to that, since you're at the site?

MS. MC ANDREWS: I would agree with what Mark said, that the NRC recently reaffirmed that San Onofre continues to be operated safety and preserves the health and safety of the public, number one.

Number two, they have seen improvements in safety culture. And we have, in ourselves, in doing our own evaluations have seen this improvement, so we're expecting some good results as the year goes -- as the year follows through and we get more reports from the NRC. But we are monitoring that and we are making improvements.

CHAIRMAN WEISENMILLER: Well, what about -- and, again, not getting into the specifics of the INPO recommendations, but also in terms of what's Edison doing on trying to deal with the last INPO audit.

MS. MC ANDREWS: So, INPO is a industry group that strives for excellence, as you know.

And so we have continuous improvement processes that we apply and we have identified our gaps and are

closing those gaps by systematic performance improvement plans.

And so we monitor them, we have performance measures, we have accountability to achieving our actions and our results.

CHAIRMAN WEISENMILLER: Thank you.

MS. SANDOVAL: Yes, thank you, just a couple of quick questions. One thing that you mentioned on slide 7 is improvements can be made to the NRC regulatory framework. And I was wondering if you could be more specific about what types of improvements are needed and what the status is of those improvements?

MR. NELSON: What the task force noted was that in some cases the NRC would have a rule-making or an order and in other cases they would have a recommendation or just guidance.

And so the task force was looking for more uniformity or consistency in how the NRC dealt with issues, so that was really the point that the task force was trying to make.

MS. SANDOVAL: And then a similar question to what I had asked about PG&E, if you can say publicly, how long is your extended station blackout capability, if you lost connection to the electrical grid, how much backup power do you have?

MS. MC ANDREWS: So, again, like Loren said, that's a pretty complicated answer. We have done some preliminary analysis and we have identified actions that if we were to have a true station blackout, no diesels, no off-site power, that we could survive a long enough time in order for diesel generators to be brought in place, dropped in place and connected up.

At Fukushima they did have capabilities, in fact they brought emergency diesel generators, what I've been told, within 24 hours to the site. The challenge there was that the connections were down low and they were flooded. Our connections are up at the 50-foot and in protected buildings.

So, again, what we are looking at is, you know, can we cope with an extended period of station blackout and then could we import, bring in an emergency diesel generator.

And we have looked at that and we find that we are in pretty good shape. Those evaluations are preliminary and so I can't say any more than that.

MS. SANDOVAL: So, when you talk about bringing in emergency diesel generators are you bringing it in over land, are you assuming the road would be functional?

MS. MC ANDREWS: So, we're exploring the various

options that could occur. Again, in Fukushima the roads were not available and they still got an emergency diesel generator in. So, there are ways in which things can be brought in.

We're located right on the Marine Corps Base, so we've got resources that I think through mutual aids will be able to help us.

MS. SANDOVAL: Yeah. When I was driving to the event in San Diego I saw tanks right at that area, so there certainly are tanks nearby.

And then, obviously, we'd be interested in following up about the hydrogen control and mitigation measures. The hydrogen explosions at Fukushima were part of what started the catastrophe.

So, can you tell us a little bit about any actions to address the potential for that type of hydrogen explosion?

MS. MC ANDREWS: So, the information coming out of what caused that hydrogen explosion is still unclear and the location of those explosions is unclear.

Our containment structure is extremely large, so from a stand point of having a hydrogen buildup within our containment, we have a large, dry containment, that is not likely.

In fact, we've done extensive analysis, several

years ago, about hydrogen control and containment.

Now, outside of containment, that is what challenged Fukushima. We need to understand, really, what was going on.

So, when we speak about lessons learned from Fukushima there's -- it's going to be a while before we get the real true lessons learned of what technology changes we need to make.

MS. SANDOVAL: Thank you.

MR. NELSON: There are devices, there are hydrogen recombiners that can be added to containments to deal with hydrogen. So, it is really a matter of understanding what it is that occurred, so that you can decide what the appropriate counter measure is.

COMMISSIONER BOYD: Mr. Chairman, I have a couple more questions. Getting back to the diesel generators, did you mention how many generators you have on site?

MS. MC ANDREWS: We have four emergency diesel generators that are located in opposite sides of the plant, they can be cross-tied, there are two per unit.

COMMISSIONER BOYD: And what -- how many day backup supply do you --

MS. MC ANDREWS: Seven days.

COMMISSIONER BOYD: Seven days. What about the

water supply, backup water supply, emergency water supply?

MS. MC ANDREWS: We have several seismically-qualified tanks, I don't have the number off the top of my head in terms of the number of gallons, but more than sufficient to provide for the cooling that I talked about in the event of a station blackout.

COMMISSIONER BOYD: Is it right on site at the, say, 50-foot level or is it up the hill?

MS. MC ANDREWS: It's in several different locations and in seismically enclosed buildings, too. So, there are several locations.

In addition to that, we also have a seismic -- a diesel-driven seismically-qualified fire pump that can deliver 2,500 gallons per minute and we can take a suction from multiple sources.

So, we have the ability to get water where we need it.

COMMISSIONER BOYD: PG&E referenced the fact that they have air snorkels to provide air supply to their generators, I think at the 45-foot level, if I remember correctly.

Are you generators basically at a 50-foot level, therefore overtopping them you feel is highly unlikely?

MR. SHARP: It was not the diesel generators, it

was the pumps that pump water from the Pacific Ocean up for heat sink.

COMMISSIONER BOYD: Oh, okay, my mistake. Thank you. Well, enough said then. Thank you.

CHAIRMAN WEISENMILLER: Actually, I was going to ask PG&E one more question, which is in terms of the Diablo Canyon Independent Safety Committee, what is its role at this time in helping you look at the implications from Japan, if any?

MR. SHARP: Well, we need meet periodically with the Diablo Canyon Independent Safety Council. They have come on site to do independent audits, as well as to ask for specific presentations or reviews of specific topic areas.

Certainly, the last meeting that we were at, they had a number of insights that they provided from their work with the DOE on Fukushima. So, I would say in general it's an additional, independent look to make sure that we're looking at the right things as we're doing our reviews and assessments from the Fukushima Daiichi issues.

CHAIRMAN WEISENMILLER: Okay, thank you.

COMMISSIONER BOYD: Mr. Chairman, I keep coming up with questions. One last question for Edison.

What are your plans with regard for filing for

re-licensure? Do you intend to go through the entire AB 1632 seismic evaluations before making a decision or are you -- do you have any public comments as of yet on that?

MR. NELSON: We intend to come to the PUC with a cost-effectiveness and funding request, first, for license renewal.

COMMISSIONER BOYD: Before or after the seismic studies are completed?

MR. NELSON: They would probably be running contemporaneously.

CHAIRMAN WEISENMILLER: Okay, great, we're going to take our lunch break. We're going to be back at 2:00.

(Recess at 1:01 p.m.)

(Reconvene at 2:06 p.m.)

MS. BYRON: Yes, our third panel is -- the topic is Events at Fukushima and Their Implications for California's Nuclear Plants. Our first speaker is Dr. Mujid Kazimi, who is a professor of Nuclear and Mechanical Engineering at MIT. He's the Director of the Center for Advanced Nuclear Energy Systems; he served at the head of the Department of Nuclear Science and Engineering until 1997; has extensive experience in design and safety analysis of nuclear fission reactors;

and I believe -- is he on the line? He's participating remotely.

MR. KAZIMI: I am online.

MS. BYRON: Good afternoon.

MR. KAZIMI: Good afternoon everyone.

COMMISSIONER BOYD: Good afternoon, the floor is yours.

MR. KAZIMI: Okay, thank you very much. Uh -- am I supposed to be seeing the slides as well, because at the moment I don't see them.

Let me start by saying that -- I want to start a little bit before Fukushima, at the beginning of this year to review where we were, in terms of nuclear energy technology in the United States and its applications for electricity generation. As you know, the US depends for about 20% of its electricity on nuclear power, and that means we run roughly 104 reactors, and they have been improving their performance in terms of reliability and delivery of electricity continuously since almost 15 years ago. And, it used to be that the performance wasn't as good, if you go back to 1985 or 1990, we used to be able to make them work 70% of the time, as opposed to 90% of the time, which has been the case for the last decade or so. And with that good performance we also were able to increase the power allowed from some of

them and that allowed us to generate almost five percent more electricity than some decade ago, or so. So the performance in the United States has been very good. With that confidence we allowed the reactors to apply for another 20 years of licensing time, so about 60% of them, in fact, did get their license for 60 years, instead of 40 years. And there was a very promising beginning of a new bunch of orders, which now has repeated for a couple of reasons; one of which is for sure the needs to absorb the lessons from Fukushima. Some parts of the world have decided that the lessons from Fukushima can be tolerated, and in fact, defenses against the reactors can be amplified. For example, China is marching ahead with its building program -- they have 26 reactors under construction. Other parts of the world have decided no, they want to retreat from their building programs, such as Germany, Italy and Switzerland. Some parts of the world are still in the decision mode. I think I would put the UK in this position. But the US, also is in this position, as well.

Next slide, please. What we can say about Fukushima is that the event subjected the plant to much higher loads than were -- than the plant was designed for. The first -- the earthquake was about four times as strong

as the design bases earthquake, and secondly the tsunami was more than three times as high as was expected in the design of the plant. In fact, the plants have survived the earthquake reasonably well and the emergency power worked for quite a while until it was disabled by the tsunami flooding the lower parts of the plants. This was progressed with events until it, you know without the power there wasn't enough means to get water in the core so a few had melted in three of the six plants there, and that has caused some radioactivity to be released. We know that the amount of radioactivity that has been measured thus far is a small fraction of the total content of the fuel of the three reactors. And of -- at some point in time people thought because there were hydrogen explosions in the upper parts of the plants that the spent fuel pools may have been the cause of this hydrogen. That means that the pools have heated up to allow the zirconium, which is the cladding of the fuel rod, to react and generate that hydrogen. But I think we now know that this wasn't the case, and in fact the cause of the hydrogen was the reactions that took place inside the much hotter fuel in the core within the vessels of the plants.

Next slide please. We have the following observations, then, that we need to upgrade the

frequency with which we check on the adequacy of bringing water into the plant in case of severe accidents. So -- severe accidents like the one in Fukushima are considered to be outside the design basis, you know, beyond the design basis. But nevertheless there are requirements for the plants to be able to cope with them, and the requirements are not checked on, you know -- the facilities that are very involved in mitigating the severe accidents are not subjected to the same frequency of checking as the normal design basis accidents. I think this will change. I also think that there will be a requirement for strong piping to connect the vessels, which might contain the consequences of reactions, so that they could release the gases from the vessels into the atmosphere without causing any leakage into the plant buildings, which might result in hydrogen explosions, such as those observed in Fukushima. So that will be checked on, as well.

In the United States, in fact, there was quite a bit of upgrading of capabilities to withstand severe accidents after the September 11 events, as a way to counteract terrorism, and some of that was not translated into actions in Japan. But, nevertheless, I think that a re-checking on the situation is desirable, and some of that has already taken place by the industry

and by NRC.

Finally, it may be desirable, also, to make the rooms that have the equipment that's supposed to cope with those severe accidents water-tight. Such a requirement exists in Korea, but not in the United States. In some plants they are water-tight, they're made water-tight because the plant owners wanted to be able to guarantee the operability of the plants under severe accidents, but that probably will be changed.

Under spent fuel management, I think we have to consider the appropriate time by which some of the fuel in the storage pools can be moved to dry storage. At the moment it is left to the capacity of the pools. You know, if the capacity reaches a maximum value that no more fuel can go there then we move the fuel -- the oldest fuel -- into storage -- dry storage that is cooled by natural circulation of air. And there may be some agreements here that perhaps loosening the load, or lessening the load in the storage pools might help in some situations, therefore faster-moving might be desirable. And in fact, as was argued in the MIT Fuel Cycle Report of the last few months, some plants in order to be able to store spent fuel in dry storage on a regional or central basis would be desirable, especially for the plants that already have shut down and their

fuel remains on sight because there is no place to ship it. So, I think it's also important to consider that in looking for all these changes that might be need to strengthen the safety of nuclear power plants, that in fact they come with some advantages already for us, so in the future it's important for them to be a part of the mix of energy generation, both in the US and also in California.

Uh, I've listed in the next slide come of these advantages. Most important among them are the very little emissions to the atmosphere of either warming gases, or for that matter of nitrous oxide and other undesirable -- for health reasons -- emission, which has particulates. There is also the benefit of having a supply of fuel for thousands of years to come, either from uranium itself, or from uranium and thorium eventually. And it's important to realize, as you can see in the very last slide that alternatives come with some penalty. The emissions are much more detrimental to either the environment or to health from the fossil plants, and if we move in a bigger way to replace nuclear with renewable, it would be at the cost of having to dedicate much more land for that purpose than we can do with nuclear. So to gain some of the advantages, it's important that we keep developing the

technology of nuclear for future generations to make use of. Thank you.

COMMISSIONER BOYD: Thank you Dr. Kazimi, this is Commissioner Boyd, if I might ask a question or two -- uh,

you -- the MIT report didn't reference any recommendations on whether reactor owners should be required to accelerate the transfer of spent fuel older than five years old from pools to dry cask. That's an issue we talk about a lot out here. Do you have any comments on that subject?

MR. KAZIMI: Uh, we didn't, as a group, study this in detail because in fact our study was finished before the Fukushima events and -- but let me give you my opinion in terms of the considerations that might affect the decision to accelerate or not to accelerate. First of all, you know, when we move the fuel to dry cask usually it is the oldest spent fuel that is moved, which has the least heat content. Therefore, the impact on the overall rate of heating the water in the pool would be small. For technical reasons we don't move the spent fuel directly into the dry cask, we need a cooling period in the order of five years or typically much more, in fact, but people have analyzed the situation for five years and they find that may be acceptable.

The second reason is that, you know, more movement of fuel would imply that we will have to consider some, small perhaps, but added risk to any events that might occur during the movement. So, since we have to go to the pool ordinarily anyway, a second move, if done too quickly, will give us at least a calculated risk that is higher. On the other hand, yes there will be less fuel in the pool itself, so the ramifications of any situation that might lead to excessive temperatures would mobilize less -- or would be able to damage less fuel. And I think that it's not for sure that we should accelerate to the minimum time, but we might find that dependent on the capacity of the pool, the density of the fuel in the pool might be reflected, but no automatic movement of the fuel into dry casks.

COMMISSIONER BOYD: Thank you.

CHAIRPERSON WEISENMILLER: This is Chair Weisenmiller. A couple questions; the first one was one of the institutions that evolved here -- excuse me -- one of the realities, I think, for the nuclear power industry is that it is going -- it's viability is really going to be held hostage by its poorest performers. And that if we have this sort of accident happen again, obviously the industry's not going to survive. And so the question in part, particularly as you have more

dispersion of reactors around the world, what can be done to really make sure that people are trying for excellence in the operation of those, in terms of safety? Something like an INPO, more on an international level.

MR. KAZIMI: I am very supportive of this idea and I think it makes sense to me to make an international organization, perhaps one or perhaps another organization, more capable of assessing the conditions of operations of nuclear power plants at various parts of the world. INPO has made a big difference in making the operations of nuclear plants in the US much more safe and we find ourselves today with very fewer incidences of the type of events that may lead to severe accidents. That was the case prior to TMI, and prior to the establishment of INPO programs for sharing best practices, as well as insisting on appropriate training for the operators, and so forth. So such an approach I think will lead to strengthening the safety in other countries, as well.

CHAIRPERSON WEISENMILLER: What -- I think the other problem seems to be that this was certainly not, sort of a best case of how to handle the public perception, or understanding of the accident. And in part, has there been any effort by the industry to

determine a much better way to tell the public what's going on and what the consequences are than what's happened in Japan?

MR. KAZIMI: Well, uh, not to make excuses, but I think we haven't quite faced a similar situation like the one in Japan, where the entire area was devastated by the tsunami and the earthquake, so the ability to reach the plants with the right experts and the ability to communicate for some time was not even there, because neither the land lines nor the cellular lines were functioning for a while. So there is -- there was a confusion, particularly at the beginning that is probably due to the magnitude of the event, particularly knocking out communication means.

But, another factor here is the fact that we had six units on one side that needed a quick reaction and an assessment and frankly, I don't know what was the ability of the workers to arrive at the plants following the disruption of transportation means -- it must have been hard. And luckily at least one diesel generator remained functioning so two of the plants did not get into any trouble, and others had to go through this improvisation of getting water in from the sea, and how to get it in and so forth. But, the confusion, I think, is partly due to the magnitude of the event and the need

for improvisation of how to respond to it. And I do think that the way the words are used in Japan also give some difficulty because it's not as straightforward as we describe events in the US. I'm describing the conditions that might lead to a difficulty in -- but I think things like misquoting units of radiation, speaking about radiation without putting it in the context of perhaps correspondence to the normal radiation surrounding individual communities, and so forth, also does not help the community appreciate the level of risk that they are subjected to. So, yeah, there is room for improvement, but I think under the human condition is very operated, and initially it may have been a difficult human situation that they had to cope with.

CHAIRPERSON WEISENMILLER: It was certainly phenomenally difficult. I guess part of it was just they -- that company and industry seems to have lost a lot of trust in Japan, and the question is whether people have a serious plan to come up with a way to rebuild, or regain that confidence by the public there?

MR. KAZIMI: I have no knowledge of any particular plan. There seemed to be a case of let's face the realities of today and see if we can reach a cleaning stage for radioactivity in the plants that

would make it possible to relax, that any subsequent raises would be small enough so that people would be able to move back, because at the moment they have not been allowed to move back in the -- to the surrounding areas. Now, there -- the industry there has apologized for the event, and a group of utilities say they're going to propose some future actions that will indicate that they will be working to minimize any such large events in the future, but I haven't heard any detail about that, and the studies that the company itself is doing for the effective plans to analyze exactly what happened will still take some time to be released, at least a few months.

CHAIRPERSON WEISENMILLER: In your slides you say that radioactivity and molten fuel became mobile. I mean, do we know at this point in terms of the cores, how much of a meltdown occurred? Would you know?

MR. KAZIMI: Not for sure, but there has been significant fractions of the cores that melted because of the time that they had been without water, so without cooling. And, but no, nobody has been able to assess exactly how much of the cores have melted. It is a large fraction. You know at TMI, have roughly 20% of that molten -- this is a more severe situation. I won't be surprised if we're talking about 50% or so for the t

here reactors.

CHAIRPERSON WEISENMILLER: Has there been any public information of the nature of the isotopes released, in terms of -- obviously releases can give you some sense of how much breach has occurred, or radiation -- what -- the types of radiation can give you some sense of what's happening in the core.

MR. KAZIMI: The radio isotopes are measured continued by similar outfits, or similar institutions, I would say. Each prefecture, as they call it, or county has its own monitoring system and the report on it -- the Safety Authority has also monitors and does reports on it, and of course KEPCO also reports on it. As expected, most of the releases were the volatile -- that means the isotopes that put the vapor at the temperatures -- the hot temperatures that the fuel will reach, so there were releases of cesium and iodine. Of course there were releases also of gaseous materials, even a gaseous at normal temperatures, but those would be dispersed in the atmosphere without causing large doses to the public. Cesium and iodine, when they go out to the colder weather they condense and they can't precipitate, so these are the ones that usually are responsible for the larger dose. And yes, there are

continuous reporting and monitoring of such isotopes.

CHAIRPERSON WEISENMILLER: I was thinking more of the actinides or NOX, you know, basically -- obviously the volatiles would go, but whether with molten fuel more than any other fuel itself was picked up in the measurements.

MR. KAZIMI: Uh, the -- I haven't seen recent reports that indicate that things of the more solid particles that went out. So I would say there were some reports during the first week or so that perhaps some of the -- some of those did go out, but frankly, I think, you know, the measurement is dependent on the radiation emissions and I think they were confusing depending on the energy of that emission. They were confusing some isotopes together, so personally I haven't looked into it and I can't give you from my readings any assessment that I know about. Perhaps some of the other panelists can.

CHAIRPERSON WEISENMILLER: Okay. Also, you basically say spent fuel pools did not suffer as much damage as initially assumed. How much damage did they suffer, do we know?

MR. KAZIMI: Uh, the latest reports indicate at least units three and four did not have any damage, because there was always some water in the pools. I

won't be surprised if units one and two also would reach that conclusion, but they haven't announced that lately. And the contamination near them is such that it may be indeed the case that there are now isotopes that indicate that there is something coming from that region. So --

CHAIRPERSON WEISENMILLER: No, that's good. Do we have a sense of what the TIPCA's liability is for these -- for the cleanup at this stage in terms of dollar cost? Total liability?

MR. KAZIMI: Oh, I've read numbers that go somewhere between 25 and 40 billion dollars, and they were hoping to get part of that from the government, but the exact sharing was not clear.

CHAIRPERSON WEISENMILLER: I see. And the last question I had -- you talked about the land use for some of the renewable technology developed into nuclear -- do we know how much of the land in Japan is basically caught up in the evacuation areas, or contaminated at this stage -- the total surface area?

MR. KAZIMI: Uh, well they evacuated an area with a radius of 20 kilometers around Fukushima. I don't know how to translate that into percentage of land, but --

CHAIRPERSON WEISENMILLER: No, I was looking for

total land that you could compare to, say, a solar system. And I understand there's a question about whether it should have been 20 or 50.

MR. KAZIMI: uh, yeah, I would say that the 20, let's say relative to two -- that's about 10 if we take an area that's a hundred times as much, so that would be comparable to the solar system, about 100 times -- you need roughly 100 times as much in a reasonable solar area to generate that kind of electricity. You would need much more if it was wind or definitely biofuel.

CHAIRPERSON WEISENMILLER: Thanks. Mike, you had questions? Okay, thank you for your time.

MR. KAZIMI: You're welcome.

MS. BYRON: Okay, our next speaker is Alex Marion. He is the Vice President of Nuclear Operations in the Nuclear Generation Division of the Nuclear Energy Institute. For those of you who don't know, NEI is the organization responsible for establishing a unified nuclear industry policy on matters affecting the nuclear energy industry, including regulatory aspects of operational and technical issues. Mr. Marion --

MR. MARION: Good afternoon. I'd like to thank you for the opportunity to make a few comments this afternoon. Uh, I am deviating somewhat from the title of this panel session that suggests that we discuss

implications of Fukushima on Pacific Gas and Electric and Southern California Edison. I think in the earlier panel you got responses that dealt with that. What I'd like to do is clarify some issues that have been identified in the earlier presentations, and also give you a sense of what the industry is doing in addressing lessons learned from Fukushima going forward.

First on the clarifications -- one of the things that you need to be careful of is not to compare seismic events from one part of the country to another part of the country, and much less one part of the world to another part of the world, primarily because of the geological differences. You're really comparing apples and oranges, and you need to be careful in that regard. I think one of the fundamental questions that need to be asked and answered -- and I was hoping our friends from the US Geological Survey would have touched on this -- is are the methodologies in the US and Japan, in evaluating the historical experience of earthquakes and tsunamis consistent? Are the methodologies the same in that regard? And are the predictive techniques the same? I don't know the answer to that, that's a question that we're continually pursuing. We'll have an answer to that at some point in time, but I choose not to speculate.

One of the things that is important -- that's been a significant contributor to the success of the US power industry -- US nuclear power industry has been the evaluation of operating experiences -- a result of the Three Mile Island event in 1979. We realized that there were two similar events that occurred before 1979 -- that if that information had been thoroughly disseminated across the industry at the time, maybe we would have prevented the Three Mile Island event. But that suggested that we needed to have a more disciplined process in evaluating operating experience and integrating the results of that evaluation into the practices and systems and modifications at the plants. And that process has been in place for over 30 years, and we're in the mode now where, since the Chernobyl event in 1986 -- if I'm correct in that regard, if not I apologize -- in the mid-eighties -- uh, we realized that this operating experience is more important on an international, more global level. So now, with what happened in Japan, the US industry is looking at operating experience from that facility and evaluating it against our practices here in the US, and that's an extremely important point to keep in mind. The comments have been made about the Commission's statement, or the Chairman's statement -- NRC Chairman's statement about

the Emergency Planning Zone in Japan. The requirement in the US is 10 miles. The State and local authorities have the flexibility to expand that to 15, 20, 30, 40, 50 miles or more if the situation calls for it, but that responsibility rests solely with the State and local authorities based upon the unique characteristics of the event that occurs at the time. So that flexibility exists.

Uh, in terms of the Nuclear Regulatory Commission's Task Force Report -- there was a briefing of the Commission last week by the Task Force membership, and what you need to keep in mind is these are recommendations to the Commission, and the Commission is right now deliberating on these recommendations in terms of are they going to approve the recommendation as proposed, are they going to modify it somehow with some clarifying direction to the staff, or are they going to disapprove, and probably some combination of the three. As I understand it two of the Commissioners have already voted. The remainders are expected to vote within the next week or two. But, again, that vote will indicate what course of action will be taken by the NRC as an organization in following through with the recommendations. So, just because the recommendation suggests issue an order, there may not be an order

issued for quite some time.

Just an observation on the report, we expected to see a more thorough evaluation of what exactly happened in Japan, and how that translates to the operating practices for the systems and components in the US, and that evaluation wasn't conducted. We think that's extremely important, because you can't do an effective lessons learned, unless you do some kind of a gap analysis -- this is what they did, this is what worked, this is what didn't work, does that apply or translate directly to the way we would do the same thing in dealing with that kind of situation? That's extremely important. I'll give you an example, the recommendation calls for enhancements in the venting activities at the US plants. We don't know what that means because we don't know enough about what happened in Japan, in terms of the operators attempting to vent, when they did it in terms of time, what the conditions were at the primary containment, etcetera, etcetera. The information we received initially was that they vented at two times the design pressure, which is about 120 pounds, which is phenomenal because our procedures call us to vent at a much earlier pressure. But we don't -- we haven't validated that information, so we're reserving judgment on whether or not, you know, what they did, when they

did it and whether they were successful. So, to conclude that you need to do something in venting is premature at this particular point in time until more information is available. And the reason for that is we want to make sure we do the right thing that does have the result that we intend for it to have, which is successfully dealing with the situation of the plant in that kind of an event.

In terms of communicating with the public, I don't know if the Commission is aware of this, NEI established an Emergency Response Center on March 11, and manned that center for 24 hours a day, seven days a week for approximately six weeks. In assimilating information through our friends at the Institute of Nuclear Power Operation who had a connection with the World Association of Nuclear Operators - Tokyo Office, and we're trying to validate information, and once validated we made it available to our members and to the public. And what surprised me after about two weeks we became the go-to source for what was going on in Japan. As a matter of fact a lot of Japanese organizations were accessing our website for information. The information is out there, we're continually updating it on a weekly basis. I also recommend that any of you who are interested look at the Nuclear Regulatory Commission's

website. They've done a pretty good job in capturing some of the information.

In terms of a question that was raised a few minutes ago about the international efforts to strive for excellence, after the Chernobyl event, the international community recognized that there was value in having an INPO-like entity on an international scale. That's when the World Association of Nuclear Operators was formed. And, just a personal observation, I think that the Fukushima event is probably characterizes a wake-up call for that organization to get past some of the politics and get on with the realities of recognizing that nuclear power plants have to be treated differently in the way you operate. And if you want to maintain safe operations you have to make a commitment in that regard. Most important is getting back to sharing operating experience.

Uh, in terms of station black-out and loss of grid, a lot of questions about -- raised about how long can a plant operate without loss of offsite power? Just to give you a couple of reference points -- Hurricane Katrina, Waterford facility in Louisiana was off the grid for approximately four days. Back in the early nineties, I think it was '91 or so -- Hurricane Andrew hit the southern part of Florida. Saint Lucia was off

the grid for approximately two weeks. In both of these situations they were operating safely or -- I'm sorry, not operating -- but maintaining a safe condition, relying on their emergency diesel generators. So they demonstrated that capability, and those of you who recall the spade of hurricanes that hit the southeast in this spring, Browns Ferry station was out for a couple of days. They had an unusual events -- they had 20 some-odd hurricanes hit the -- I'm sorry tornados -- I apologize, tornadoes -- hit that site, and basically destroyed their switchboard and much of their transmission system. And they have a very diverse arrangement of electrical connections coming into the site. They had seven different rights of way, and the sense was at the time the plant was licensed, there's nothing that would possibly happen that could affect all seven. Well, it affected all six, so changes need to be made looking forward in that regard.

In terms of station black-out, if you sit back and look at what happened at Fukushima, it's really fundamental. They had the earthquake and, in Japan, you have an earthquake you're going to get a tsunami, they're prepared to deal with that. They have an effective warning system that was helpful, but the magnitude of the tsunami was much greater than what they

anticipated. But fundamentally what created the damage was the flood associated with the tsunami. Now, as an electrical engineer I look at, okay, well, why did the flood affect all their electrical equipment, including their diesel generators? They have the equipment located in the basement of the building. Why? You know, did they have sufficient redundancy or whatever, I don't know the answer to that question But we've got to get back to some of those basics if we really want to understand what exactly happened and translate that to the way we operate and the way we design our plants here in the US.

Now, in terms of what industry is doing, we've established an integrated effort that involves the Nuclear Energy Institute, but also the Electric Power Research Institute, which is the Electric Utility industry's research and development organization, and the Institute of Nuclear Power Operations, to basically integrate and coordinate all of our activities from the standpoint of evaluating operating experience coming from Japan, then comparing that against our programs and practices here in the US, to dealing with the regulatory agencies, not only the Nuclear Regulatory Commission, but also the Environmental Protection Agency, the Federal Energy Management Agency, as well as the

Department of Homeland Security, in dealing with some of the emergency preparedness issues as we go forward. Uh, the executive leadership of the US industry is involved in this. There have been a number of conference calls and meetings going forward. There is a document that is publically available, and I'll make it available to this Committee. It's referred to as the Path Forward, it provides a high level overview of the process that's been put in place to effectively, as an industry, deal with lessons learned from -- coming in from Japan, as well as dealing with the Agencies.

The bottom line in all of this is what's going to come out of it is enhancements in our ability to prevent, mitigate, and effectively respond to these kind of unusual events that have been experienced. And we will continue to do so as time goes forward. The real question is how long is this process going to take? Uh, the Japanese society and culture is different than it is in the US. We're more open and transparent. We're -- within the US nuclear industry failure is not a negative thing. If something goes wrong you understand it, you try to prevent it from happening again. Uh, and in Japan it's a different scenario, and I'll leave it at that. But I -- we need to have a better understanding

of what exactly happened, what challenges the operations personnel had at the plant, what worked, when it didn't work what alternative actions they took, etcetera for us to do a comprehensive evaluation. In my personal opinion it will probably be several years before we have sufficient information from Japan so we can complete our evaluations. That's not to say we're not doing anything now. We're looking at our ability to withstand floods and earthquakes, our ability to withstand large explosions and fires -- you heard the reference to B5B -- a lot of that equipment is stationed at the sites, and we can use that capability to mitigate some of these severe events as they occur. But there's going to be a continuum of activity over the next several years on an unprecedented scale. That basically completes what I wanted to say. I'll be more than happy to answer any questions you may have.

COMMISSIONER BOYD: Yes, thank you. Question -- uh, I'd be interested in your views on the need to accelerate the transfer spent fuel from spent fuel pools into dry cask storage to supposedly reduce inventory of radioactive material and heat load in the pools. And also, your thoughts on what the cost implications would be of doing that.

MR. MARION: Well, I think the cost implications

are plant-specific. About the only thing that I can give you generically, I think it's about a million dollars for one of these dry casks, or somewhere in that general area. Uh, the only comment I want to make in response to the question is that both conditions are safe. Dry storage is safe; storage in the spent fuel pool is safe. In terms of evaluating what happened in Japan we need more information. We heard negative things about -- well, not negative things -- we heard about potential damage to the pools early on in the event. There have been some samples that were taken of the water in the pools recently indicating that there's no evidence in a couple of the pools that there was any fuel damage. So we're trying to put the pieces together. There is an executive level effort within the industry that's looking at that management process, but they haven't made a determination of which direction they want to go, but it's something under active consideration.

COMMISSIONER BOYD: Thank you.

CHAIRPERSON WEISENMILLER: A couple questions. I was going to start with the observation in Science Magazine sort of viewed -- they had an article on Japan -- but viewed as a wake-up call in the sense that most people would think that they're, as a nation, they're

ability to deal with seismic issues, you know in general, is far beyond the US. Now, obviously they got hit with something well beyond what they were anticipating, but that certainly let one wondering with how would we deal? So, as you're cross-comparing, part of the issue, I think, is they have had to deal with seismic events much more frequently, and tsunamis, than we have over time, and it certainly -- generally I would have to say in probably a better position. That's part of the scary part in my mind --

MR. MARION: Well, I've seen some of the Discovery Channel shows that indicate some of the seismic design considerations they put into some of their commercial buildings, where they have computer-controlled systems. It's phenomenal, but I -- if I were a member of the seismic or tsunami community, assuming they're two different communities -- I'm not sure -- I'd be up in arms trying to understand what the difference were. I think -- the Japanese, as I understand it, are pursuing that question, to see how conservative they are in some areas, and maybe possibly not conservative in other areas. Btu that's something that will be answered as part of this process, but we don't have the answer right now. I wish we did, but we don't. And that's what -- as an engineer that's one of the frustrating

things, because you have a lot of questions along these lines but you don't get an answer to the question, but we're continually asking them.

CHAIRPERSON WEISENMILLER: The other surprising aspect was that -- again this may be mythology -- but the presumption was the Japanese were much further along in robotics than we were, but having said that I guess they really didn't develop robotics to deal with incidents at nuclear reactors.

MR. MARION: Uh --

CHAIRPERSON WEISENMILLER: They're had to scramble them over here, I guess.

MR. MARION: Well --

CHAIRPERSON WEISENMILLER: Well, what is the situation on that issue?

MR. MARION: -- I -- I don't know. I did an interview on robotics and quickly came to the limit of my knowledge when they were pursuing marketing related issues. But, what you need to keep in mind is if you consider the impact of the tsunami, and I'm sure you've seen some of the films -- I mean it was devastating. A lot of their radiation monitoring equipment was located outside -- a lot of their equipment located at the site was destroyed and taken out, okay? That creates a completely different scenario, because you relay on some

of that equipment to tell you what's going on from an environmental perspective. And when you think about the impact of the flood inside the plant, you had those -- the plant staff or what it was -- and we don't have the numbers of everybody on-site at each of the units here -- they were literally in the dark, with flashlights. They were removing batteries from their automobiles so they could power instrumentation. I mean, that's a completely different scenario than anybody ever experienced, and I think you need to keep that in perspective as you get more information and put the pieces together, so you understand what really happened and what challenges occurred. And I would not pass any form of judgment on the operations personnel at that facility in any way shape or form. They were stationed at the plant, their family -- their lives were completely destroyed by that tsunami. They don't know what they have, but they focused on what they needed to do, which is try to get the plant in a safe condition, and they did the best -- and they're continuing to do the best that they possibly can. But we just don't have all that information yet in any detail to give a coherent response, sorry.

CHAIRPERSON WEISENMILLER: But is -- given your institution, the various global institutions, how do we

actually get a coherent story of what happened there, that's sort of independent enough that's going to be generally believable?

MR. MARION: There is an effort being coordinated by the International Atomic Energy Agency and the World Association of Nuclear Operators is involved, our Institute of Nuclear Power Operations is involved in putting together a sequence of events. The Japanese government submitted a report to the International Atomic Energy Agency in early mid-June that captured the sequence of events as they understood them through the end of May, and I read that report. It's nearly 500 pages; the Executive Summary is nearly 50. But, there's a lot of gaps in it, you know, so you follow some course of action, all of a sudden there's no follow up or no alternative if this thing didn't work that the operator tried to do. The Japanese government is committed to the international community through IAEA and WANO to put together that kind of sequence event to the best of their ability. They recognize the fact that the operators who typically fill a log of their actions or whatever, were not doing that at the time, they were just reacting to the event. So they have to pull all those pieces together by talking to individuals, and it's going to take some time. And I know there's an

effort underway to pull it all together, whether it'll be successful we'll just have to wait and see what happens over the next couple of months. Some of the preliminary information I've received is we should have a sequence of events probably sometime this, well, summer -- this is July -- probably by August/September timeframe.

CHAIRPERSON WEISENMILLER: I understand that the Japanese government has basically set up an independent expert panel. Do you have an understanding of when that's going to come out with a report?

MR. MARION: Independent expert --

CHAIRPERSON WEISENMILLER: I think again, sort of how do you really rebuild confidence there, and I basically --

MR. MARION: I --

CHAIRPERSON WEISENMILLER: Obviously Mr. Florio has his experiences with the PG&E Gas system on trying to have an independent expert panel help.

MR. MARION: Well, they have a different regulatory and political structure than we have here in the US. The local province leadership -- I guess the analogy would be Governor -- has the authority to either approve or disapprove the startup of a site. And, the regulatory agency is not an independent regulatory

agency as the Nuclear Regulatory Commission is over here. They're coupled in with the government, and the government supports nuclear energy. And if you look at that report, which is available I think on the IAEA website that I mentioned earlier, you'll get a sense that there were a lot of agencies and entities involved in doing stuff, but no one was really coordinating all of it to make sure we got the right information in a timely fashion. For example, one of the provinces -- someone mentioned that there are local provinces that have agencies that monitor radioactivity. They were collecting data from time zero, but the regulatory agency nor the government was aware of that until several days, nearly a week or so into the event. And there was all this data that was being collected by someone out in the farmlands somewhere, it was not being brought into some central point. So there wasn't an integrated coordinated response to what was going on. And I think what's going to happen is you're going to see some organizational changes within the government's structure and the regulatory structure going forward. Because they realized that they need that disciplined level of authority, who's responsible, what actions they're responsible for, etcetera, etcetera. Something similar to what we have here.

CHAIRPERSON WEISENMILLER: How many plants in the US are twins to these plants?

MR. MARION: Uh, there are 23 boiling water reactors here in the US. Of the Mark One design, I think there are seven or so, maybe a little bit more.

CHAIRPERSON WEISENMILLER: I mean is your organization focusing on what we should be trying to do there

in retrofit?

MR. MARION: Absolutely. One of the things that we need to keep in mind -- the Nuclear Regulatory Commission did a lot of research on the Mark One design back in the late Seventies and Eighties, and they did a risk assessment that looked at the probability of core damage as a result of having a station black-out, or whatever the case may be, and they decided that one of the susceptibilities was the station black-out event. One they concluded that in research, the NRC promulgated a rule-making that called for all the utilities, whether it was a boiler or not, to address a station black-out event. And that’s what we have done in this country. We don’t know the extent to which the Japanese did something similar. What was really surprising when this issue -- when this event first came to the surface -- we were surprised, and I think a lot of people were

surprised that the Nuclear Regulatory Commission didn't have a comparison, if you will, between the regulatory structure we have in this country as compared to the regulatory structure in Japan. What regulations have they implemented that we have also? The Executive Director of Operations committed to the Commission to develop such a document, but I haven't seen one yet. There were a number of other improvements that were done in the US to that Mark One design. I don't know the extent to which all those improvements were also implemented by the Japanese, I just don't know.

CHAIRPERSON WEISENMILLER: I guess my last question, which probably just more struggling on some level, is that as we've tried to figure out what happened there, I've been assuming that the US has assets monitoring air space in, you know, say near Korea, trying to determine what sort of isotopes are being released and what that says either about weapons testing or fuel production or whatever, and so I'm trying to figure out what sort of information we may have gotten from that that can be used in this context.

MR. MARION: Well, the Navy collected a lot of data, as I understand it, and not much of that data is being made available. We're trying to obtain it through some of the contacts that we have, but we haven't gotten

access to it yet.

CHAIRPERSON WEISENMILLER: Thank you. Mike?

COMMISSIONER BOYD: May -- a comment maybe. I probably shouldn't make this comment because it's so easy to pull a Monday morning quarterback situation like this, but knowing -- this discussion just reminded me again -- knowing how much the Japanese know about seismic things and seismicity, etcetera, and the great pains they've taken in their society to deal with it -- knowing what kind of earthquake fault was offshore there, people like me wonder why in the name of heaven did they even put this plant there? But I don't know -- I mean they designed it for a tsunami of a certain estimated height, and the missed it by an incredible amount, and it does make one wonder about how much they knew, and they know more than we know about what happens when you have a -- this kind of fault really let loose. Now, the good news for us here in California is we don't seem to have this kind of fault, but the bad news is, as you heard from all this morning, we don't know enough about what we've got out there to make some of us comfortable. But the Japanese, you assume so much ahead of us on that, and yet why there?

MR. MARION: I think we have a reasonably good understanding of what could happen in terms of

earthquakes and floods and whatnot here in the States. I think the real question with the Japanese situation, and if you go back to 2007 a nuclear site on the west side of Japan, Kashiwazaki-Kariwa had an earthquake that was approximately three times harder than was designed. Thankfully the reactor part of the building structures, if you will, withstood the earthquake. Most of the damage was to the secondary side of the plant. But following that there was an exhaustive study, a special review committee was established, and there was a requirement to upgrade their seismic design capability. But I don't know the extent to which that the Tokyo Electric Power Company implemented that requirement at the Fukushima Daiichi. We've heard conflicting information, that's one of the internal questions that the government regulatory agency in Japan has to come to grips with. But you raise a good point. Thank you.

CHAIRPERSON WEISENMILLER: I was going to say that unfortunately there was a Science Article Magazine that indicated that the thousand year tsunami stuff was something that in the literature just sort of emerged in the past year, but obviously didn't catch up with the utility or the government. But it became fairly clear -- and it's happened before -- and again that this type of thing could have been foreseeable, but also there's

some indication as you track down that, sort of, there may be similar problems looking toward Tokyo, again looking more at the geology there.

COMMISSIONER BOYD: And there's been a total chit chat about societal economics dictating where you put things, too, on occasion.

MS. BYRON: Thank you. Uh, I did want to mention that Alex said that as a follow up -- there weren't any slides, but that he was going to send a few just to clarify some of the points he made in his presentation, and we'll be posting those on our website. And our next speaker is Dr. Peter Lam, he was an Administrative Judge Emeritus, he's the Chair of the Diablo Canyon Independent Safety Committee, which conducts safety reviews of the Diablo Canyon plant. He was appointed to the Committee by the Energy Commission in 2009, he served as and Administrative Judge at the Nuclear Regulatory Commission for 18 years. Dr. Lam?

MR. LAM: Thank you, Ms. Byron. Good afternoon, Honorable Mr. Chairman, Honorable Vice Chairman, and Honorable Commissioners. I am delighted to be here to share with you my view about nuclear reactor safety before and after Fukushima. If I may add, I am indeed honored to serve as the Energy Commission's appointee on the Diablo Canyon Independent Safety Committee. My view

expressed here today does not reflect any consensus opinion on the Diablo Canyon Independent Safety Committee, they are strictly my own. If I may add, my service on the Independent Safety Committee has truly been an interesting and humbling experience. And that said, for those of us in the nuclear safety business, we constantly ask ourselves what is keeping us awake at night about the most feared nuclear safety events. One the slide you see the top five, and the black swan. The top five, the number one needs no prescription or description after Fukushima. You lose off-site power, you lose emergency on-site power, you lose D/C battery power, then you have a big problem.

The second event is called Anticipate Transient without Scram. Anticipate Transient used to occur about ten times a year on a per-site basis, nowadays they happen, perhaps, once a year. At that time if the reactor does not scram, then you have about thirty seconds to act.

The third event is called Reactor Vessel Rupture. It has something to do with aging reactive vessels that have experienced significant neutron damage, and perhaps may or may not have high copper contents at its bell line. And also this event is perhaps coupled with a -- what we call a pressurized thermal shock event. The Energy Commission, a couple years ago has directed the

Diablo Canyon Independent Safety Committee to look into if there were any coupling between the Reactor Vessel Rupture possibility and any seismic events. And there was a report that came out about a year ago to the Energy Commission.

The number four event is what we call Interfacing Loss of Coolant Accident. It primarily deals with the rupture of a check valve, and the motor operated injection valve between the reactor vessel and the ECCS systems. This single event would bypass containment, disable all the ECCS systems, and precipitate a major nuclear core melt.

The number five event is the Spent Fuel Pool Loss of Cooling, and also loss of inventory. Again, this one needs no description of any sort, after Fukushima. Now, the black swan has been truly a black swan by the definition of -- for those of us in the industry has always been saying multiple unit accident does not happen. These are the likely estimated before and after Fukushima. In station black-out we consider it -- used to consider it extremely, extremely unlikely because, why? Because we used to say you had multiple incoming off-site power, you used -- everybody had four to six emergency diesel generators, you always -- almost always set the cross time capabilities, and some of the diesel

generators had manual cranks. If they fail to start you can go down there and crank it. So before Fukushima, it's extremely unlikely. After Fukushima, well it happened.

For Anticipate Transient without Scram, we consider it extremely unlikely before Fukushima, and after Fukushima you see a question mark here. Why am I putting a question mark here? Let me share with you one of the rationales for extremely unlikely before Fukushima. It has something to do with the Scram reliability systems. The way we designed Scram systems, you've got multiple logics, you have a system usually driven by gravity. For example, for the Westinghouse Scram breakers, you have a huge breakers is being held together by energizing a magnet, and if you cut the current to the magnet, or you demagnetize the magnet, gravity will come in and drop that breaker, so that breaker switches position when you cut power to it. And on first principle, this is an extremely reliable system. Westinghouse used to say the system reliability or the system failure probability is ten to the minus 16 or ten to the minus 18, because you have multiple breakers, you have independent logics, and you had an extremely liberal success criteria. It's probably one-in-four, one-in-six. But now, I put a question mark here, it's

based on my earlier experience when I was beginning at the Nuclear Regulatory Commission. I was responsible with a group of specialists looking at operating experience, and one of the events that caught my attention had to do with a report filed with the Commission way back before my tenure. It has something to do with a failure of the Westinghouse Scram breakers. Now, at that time, the breakers, since they are big metallic instruments, they needed lubrication. Somewhere along the line when they serviced their breakers, somebody applied the wrong lubricant. And instead of lubricating the breaker it became a glue after a significant period of heating. So at the time of testing, none of the breakers opened upon testing. Now that caught my attention. The story here is what -- we can plan for a lot of things, but it's something that you do not anticipate perhaps can get us into trouble.

Now, on the Reactive Vessel Rupture here, some of your reactor vessels had high copper contents in the bell line. And couple that with high neutron influences, they become brittle. Now, I'm sure all of you in this room are aware, the NRC used to have an old rule on pressurized thermal shock. After a good ten years or 15 years of intensive research, the NRC now have promulgated and implemented a new rule. The old

rule -- under the old rule there are, I think, seven plants in this country that would not be eligible for license extension because they do not meet the NRC -- the old rule on pressurized thermal shock. But under the new rule now, all of them would be eligible. Now of course the NRC promulgated this new rule by saying nobody is obligated to adapt the new rule. Now, the Energy Commission has directed the Diablo Canyon Independent Safety Committee to look into the coupling between seismic activity and the reactor vessel thermal shock issue. The Committee spent about a good long year of effort under the major leadership of Dr. Paul Budnitz, and report back to the Commission saying first the Committee no, I mean no opinion as to what the NRC new rule -- what the merits are. However, the Committee found the coupling between the pressurized thermal shock issue and seismic issues are weak.

Now on Interfacing LOCA, the extremely unlikely estimations is based on two things. There's always a check valve, and a normally closed motor operating valve on all the major ECCS systems as a barrier against this type of scenario. Now, the extremely unlikely estimation is based primarily -- if I may switch to the next slide, and then I may come back -- the probability estimate is ten to the minus 8 to ten to the minus nine

per year because, as dictated by the check valve and the MOE rupture data. We have extensive data -- component data -- on these instruments that indicate that they don't rupture on you because these are valuable bust valves. And that estimation -- now I'm talking about history here, this is a good about 25 to 30 years ago -- is well within the safety goal expectations -- so everybody and wide acceptance within the industry and the government. Now, I happen to be involved in examining this scenario here, so part of disclosure here I may not be entirely impartial here. This is a schematic between Brown's Ferry, the crawl space system -- you see a testable check valve and a normal -- guess what. The testable check valve has a solenoid valve to open the disk, and also has indicators on top. This is the solenoid here --

THE REPORTER: Can you come back to the microphone, I can't pick you up if you --

MR. LAM: All right. No problem, next time I'll wear a portable one.

Now -- oh okay -- you see these position indicator here? You see the robust disk and you see a solenoid. Guess what -- operating experienced indicated there are at least half a dozen events where these check valves were either blocked open, or was opened intentionally.

How was it opened intentionally? There was a service man who serviced this check valve because either of disc wear, or some other issues, and after the servicing he misconnected the polarity here. So the wiring connecting to the check valve to the indicator was reversed. So when the check valve was actually closed, the indicators say it's open. So the next electrical guy came in and looked at say -- looked at the situation and say aha, this is open, let me close it. So he cranks open the check valve, the check valve was cranked open so that the indicator would indicate closed. So, the valve was open. And the MOE -- ah, way back 25 years ago, the licensee - not only Brown's Ferry, all the boiler licensees -- has a process of testing the valve while the operator -- while the reactor was at full pressure. So for more than like five years period we see this check valve was inadvertently open, either left open or intentionally cranked open inadvertently, and this valve was opened manually. And bingo, you have a thousand power pressure pressurizing you down through ECCS system. Now, of course, the Agency -- showing us the issue we came into focus -- the Agency issued generic communications and the problem was fixed immediately, and it's no longer a threat to our boiling water reactors.

Now you want me to go back to our original slide here -- the spent fuel pool accident was considered extremely unlikely for many fundamental reasons. One, you have a large body of water, the time to boil is exceptionally long, and also over the past thirty years, at the NRC and other industry the numerous draining accidents have been discovered and fixed. Now, practically everybody had a hydraulic dam installed on the spent fuel pool, so that even if you drain it, or inadvertently open up a line here and there it would not drop below a critical level. Based on these two considerations, this extremely unlikely probability was assigned. And also there's a joke in the industry, because of the long time it takes to boil, we could send up a group of men to go up and do what they usually do out there after they drink a lot of beer, would save the day.

(Laughter)

MR. LAM: Now, well, it occurred in -- at Fukushima. And then the black swan. We assigned a probability of absolutely unlikely to multiple unit reactors, because of the -- because of all the robust oversight -- the robust enforcement in the past three decades. We would consider a major reactor accident at a single nuclear reactor extremely unlikely, not to mention multiple events occurring in multiple units.

Well, here we are. Among all the events that are described here, we have three that occur and three that are assigned a question mark to it.

Now, beyond design basis event after Fukushima, as we have heard from everybody in this workshop here, there is intense and comprehensive scrutiny from everybody under the sun. Your NRC, your DOE, your IAEA, INPO, EPI, NEI, the Energy Commission, the California Coastal Commission, all the licensees, all the major universities and all the interested citizens. You see significant effort with tight schedules, and then you see many, many actionable measures. Therefore, one would expect genuine improvement in nuclear reactor safety.

As a few examples, we now see reactor pumps -- reactor coolant pump seal replacements. Reactor coolant pump seal is the major component that will fail on you -- the first thing when you have the station flag our units. And that will precipitate a LOCA, and when you need electric power the most, and then you don't have it. But now we are seeing, at Diablo Canyon, they are replacing the reactor coolant pump seal so that there will be no seal leakage when you lose power -- when you lose all the power. And then you see a portable equipment being talked about, and then you see DC

battery life being extended, and then you see water-tight rooms are being set up, and then of course you see the industry initiative in talking about Regional Response Center. So, one may expect genuine improvements in nuclear reactor safety.

Let me offer another view. There is always -- the cup is either half full or half empty. With all this intensive effort and activity, could it be a possible acknowledgement that our current design basis may not be adequate. For example, go back to Kashiwazaki -- we're here -- aha! -- why have the reacted -- these -- I mean earthquake -- nearby reactor is three to four times existing my design basis, and it survived. That's the good news. The bad news is who had made that design basis about two to three times below the actual event that occurred? Therefore, there's a debate for the need of additional fellow and State oversight. Now there are real policy and technical considerations, as Honorable Vice Chair James Boyd has said, he had experience with dealing with the NRC. The real policy issue perhaps would be, how do you make the NRC do something that you want it to do? -- well, you know, Commissioner and Vice Chair could shed more light on that -- and then there are technical considerations that which I will get to in the next couple slides. Now the issue -- as some

example for the California Energy Commission's consideration -- one is, in 2008 the Commission had made a recommendation to disband fuel pool at Diablo Canyon, and also at San Onofre. And then the second one is the life extension licensing issue, and then, talk about the seismic issue combining the Hosgri and the Shoreline faults, and then perhaps -- perhaps on the reactor vessel aging issue, as well.

Now, if I may elaborate on the 2008 Energy Commission recommendation. There are real -- again, policy and technical issues. Another point of disclosure -- I sat on the licensing board that approved the independent spent fuel storage facility for Diablo Canyon. At that time, none of these issues was litigate -- none of these issues were highlighted. If I remember correctly, the only issue that was litigated back then, was the financial capability of the licensee, PG&E, which happened to be in bankruptcy proceedings. And also, another point of contention which was admitted as one of the contentions, was what about malicious acts? For your information, I -- in the licensing position -- I wrote a dissenting opinion against the majority opinion -- against the majority opinion on the malicious act contention. At that time the NRC has a rule saying if any event that's unforeseeable would be precluded from

any contentious considerations. And before 9/11 that rationale was always used to dismiss any contention against malicious acts. So, at the time of the ruling, 9/11 has already happened, therefore I wrote a dissenting opinion saying that the unforeseeable standard should not be applied without commenting on the merits of the contention itself. So I object to the application of the unforeseeable event as the basis for denying a contention. And then, of course you know, this issue has gone all the way to the Ninth Circuit, and the Ninth Circuit happened to agree with me, that indeed the unforeseeable standard should not be sustained.

Now, on the real policy and technical issues, there is an absence of Federal waste central storage facility. This is nobody's fault but Washington. You don't have the sense to raise storage facility, what do you want the utility to do? Tow, the dry cask storage at licensing limits, as to how many they can build and how fast they can build. And then the dry cask has a thermal limit. This is something new to me. When I was conducting a site visit on behalf of the Diablo Canyon Independent Safety Committee, I was informed by the licensee that the cask -- you could not put 100%, five-year old fuel in the cask. That would exceed its

thermal limits, so they need to mix and match and wait and wait and wait until an older fuel comes into -- to be available.

Now, beyond what we call the Emergency Planning Zone, one of the major controversy that happened during Fukushima was the NRC's recommendation that for United States citizens near Fukushima, evacuate by a 50 mile evacuation zone. Immediately it raised a couple contentious issues.

One, are American citizens' lives more precious in Japan than they are here, in the States -- in the United States of America?

Two, is Fukushima -- the events that happened at Fukushima inherently a lot more dangerous than any that we could possibly foresee domestically? Three, remember Indian Point is only thirty-three miles from Manhattan. If you impose a fifty mile evacuation zone, you're dealing with ten million people evacuation. Can you do it?

Now, again, the Vice Chair Boyd -- Mr. Vice Chair was talking about -- Diablo has 18 miles north and 22 miles south Emergency Planning Zone. And as our previous speaker has said, the Federal rule is only ten miles. Therefore, if any consideration of expanding the Emergency Planning Zone would involve local

participation.

Now, there are other considerations for everybody to think about. If you impose a 50 miles, or 30 miles or 40 miles, one needs to weight and balance the benefit or protecting public safety, against the potential increase in traffic fatality, and the potential increase in burdening the State and the local authorities with an emergency evacuation exercise. That may or may not be necessary.

Finally, this is my personal view and observations here. Now, the first two are obvious. I believe the current extensive further oversight will likely be expended. I further believe there will be increased industry vigilance.

Now, however, there are some inherent difficulties. The first one is the sheer size and complexity of the technology. We are dealing with a 10 billion dollar facility for a single nuclear power plant, there are more systems than you can count, and there are more procedures than you can remember.

One example, at the very early dawn of the nuclear power age, a technical specification which is part of the nuclear license has about 500 LCO, which stands for Limiting Conditions of Operation. These are triggers to bind the licensee to take safety measures so

that the plan would not deviate from its safety boundaries. Again, in the earliest stage, a tech spec at about 500 LCO. Today, a typical tech spec of about 10,000. How could you expect anybody to be completely familiar with 10,000 LCOs? Each LCO triggers and binds the reactor operator into something her must do within certain parameters.

The second inherent difficulty is that either safety system with largely quiet capacities and rapid response. We are running against the laws of physics. We are dealing with safety systems that stand idle -- this is the nature of our current technology, they're just sitting there, you are not activating them. But when you need them, you need them in a hurry, and these are large systems.

Typically, you talk about pressure injection here of about 1000 per square inch. You are dealing with hundreds, if not thousands of gallons of water per minute. And there lies some of the -- I mean, some, if not all of the major nuclear operating experience that we have seen in the past thirty years.

And then you have human and system interaction. When you deal with human errors, we all know you not only have the error -- the potential for error of commission.

You also have the errors of omission. How do you catch somebody from not doing something? It's -- just think about it, it is difficult.

And then we have the unforeseeable events. Unforeseeable means Fukushima -- you don't foresee it. And I may add, perhaps we are talking about -- I'm not really sure if this is the right forum to talk about it -- perhaps we are talking about malice. But this is an area I don't think we should venture into, maybe in the Commissioner's private deliberation.

And then we are talking about unforgiving technology after a severe accident. Before a severe accident, if you go into a nuclear power plant, you would be impressed.

I was at General Electric, 14 years ago when Fukushima number one first into -- first went into operation. We are celebration, we are champagne popping. Fukushima was so clean you could go have lunch on the reactor building floor.

Ah, but once you have a severe accident, this technology is unforgivable, if I may use the word. Why? You are dealing with a combined meeting of two things. One is the decay removal. All we need to do is look at the decay heat curve and couple that with the power Generation -- the sheer size of a nuclear facility. At

the very beginning of decay curve, you are taking about several thousand pounds of steam production per hour. Even as now, you are talking about putting up several hundred pounds of steam production per hour. That's the need number one, you need to manage that.

Two, you need to combine the management of radioactivity. Everybody is familiar with LD50, which means the Lethal Dose to 50 percent of the population. The LD50 is well known -- it's about 500 RAM. The contact dose of an operating reactor fuel bundle -- the contact dose -- is about one million RAM per second, give or take all the value too, or so. And during a major severe accident, you not -- you need to manage the decay heat production coupled with radioactivity, either releases the threat to the environment, or releases the threat in the plant worker, who would be doing the major -- whatever activity he was assigned.

And if I may remind our audience here, in Chernobyl they sent firemen on top of the roof to put water into that reactor. And every single one of the firemen perished. Therefore, the unforgiving technology nature needs to be seriously considered in accident management.

Now, again, I have no personal view into either being a proponent of this technology or being an opponent to

this technology. All I am saying is these are considerations for our political leader, like Honorable Commissioner here, to consider when they debate the merits of any mitigation of remedial action that's necessary in their opinion.

Now the State agencies are all here, I'm only listing a partial list. One is license extension. The Energy Commission and the California Public Utility Commission has had success in asking and obtaining in advance of the license extension. Now, of course an abeyance of the licensing extension by the licensee PG&E. But I believe the Energy Commission and the PUC has been instrumental in, I would say, achieving that outcome.

Now the spent fuel pool issues, I think that the Energy Commission has the foresight -- before Fukushima, the Commissioner asked for the re-racking. Now, at least I do not know the merits of re-racking, other than on first principle it would provide some inherent safety markers.

However, there may be -- there may or may not be other means to achieve the same goal. So I am sympathetic to some of the measures the licensees have proposed and they actually implement. Absence -- I mean absent we are arranging this spent fuel pool

configuration. As I indicated earlier, they are facing genuine policy and technical issues. They may want to do it, but they cannot do it as of now.

And then of course the seismic issue, again the California State agency has had success in forcing the seismic issue into the forefront of this re-licensing debate. And then of course, you know, the ones through our coping, has -- I do not believe it has something to do with Fukushima. It has something to do with one of the State agencies in California, thinking about the damage to the environment.

And then the Emergency Planning Zone issue -- discuss what need to be further examined. This concludes my remarks. And thank you for your attention.

CHAIRPERSON WEISENMILLER: Thank you. Jim, any questions?

COMMISSIONER BOYD: Uh, real quick. Thank you Dr. Lam, it's always a pleasure. Appreciate your service to the people of the State and to this Commission. Uh, this is really not a question, it's a comment.

One, you've reminded me of one of the things that is -- that hasn't been talked about today hardly at all, that is a concern to us, is the reactor aging, the metals -- materials degradation and embrittlement issue

is something we also worry about in reactors that are getting old.

And then, you've reminded me of perhaps my favorite expression I may -- or concern that I may use in speeches here and there, but not in my opening today, is, what's one of the problems with nuclear power? The problem is mixing the human species with this exotic, mechanical hardware, and you're certainly pointed out some of the difficulties we have there. So, I thank you for your presentation.

Uh, one quick question -- are you aware of any studies planned at the federal level in light of Fukushima to rethink this Emergency Planning Zone question in the United States?

MR. LAM: No, I am not aware of any. Now I do think our previous speaker had pointed out an important consideration. Even though the Federal rule is only ten miles, the State authority, the local authority has perhaps the incentive or the initiative to expand it.

COMMISSIONER BOYD: It's unfortunate it took Fukushima to make anybody think about anyone other than the Federal government having something there. But thank you for that answer, and thank you very much.

MR. LAM: Thank you.

CHAIRPERSON WEISENMILLER: Thank you. A couple

questions. Uh, my recollection is that one of the units at Diablo have the potential -- well cap weldments, which could lead to the embrittlement issue, is that correct?

MR. LAM: Uh, I -- my recollection is yes, because one of the unit of Diablo was not eligible for life extension under to old NRC PDS rule.

CHAIRPERSON WEISENMILLER: Right.

MR. LAM: However, if I may indicate again, the new rule that was promulgate up to a good 10-15 years extensive research by the NRC had indicated that if they adopt a new rule, everybody is eligible.

CHAIRPERSON WEISENMILLER: Right. Other question was -- I don't know if the Independent Safety Committee has looked at this issue, but obviously when these plants were originally licensed and the ten mile evacuations zones were established, there was different population densities. I think one of Commissioner Florio's headaches is that pipelines were laid in the ground at an era when the population densities were relatively low, and then obviously people moved on top of them.

And so part of the question is, within those ten mile zones now, what is the population relative to what it was when these were permeated?

MR. LAM: Oh that's an excellent question. I think -- in many of our public hearings the public had some in and highlighted their concerns about the increase in population. The real number I do not have, I think the ISNC do have that number because they have collaborated extensively with the County authorities.

CHAIRPERSON WEISENMILLER: Yeah, it'd be good, actually if PG&E and Edison could provide both the initial numbers at licensing and now in terms of occupations in those ten mile zones.

COMMISSIONER FLORIO: Dr. Lam, I was quite struck by your presentation. The -- did you have these concerns before Fukushima, or is it -- was that event the -- what brought these issues to your mind?

MR. LAM: Are you talking about the major severe nuclear accidents?

COMMISSIONER FLORIO: Yes.

MR. LAM: Oh, I've been in the nuclear safety business for 40 years, since 1971. These accidents has always been my concern from day one. Now, I also had the benefit, in my beginning of service with the NRC, I was responsible for a group of specialists who examine nuclear operating experience. At that time we called them the Licensee Event Reports. So, over a five year period, I and my staff have reviewed over 50 thousand

Licensee Event Reports.

Way back then, even early 1980, each plant -- each licensee has submitted about 100, if not more, Licensee Event Reports per year. So when you're at 104 operating reactors -- we saw over 10 thousand events per year, and I was responsible for that group for about five years.

So the 50 thousand events, I must confess I perhaps have seen more than I wanted to, and some of these operating experiences highlight one of the most difficult issues for those of us in the nuclear reactor safety business.

It's -- we are dealing with high consequence and low probability events. So, if I may add, now the emphasis has shifted to, well, given limited resources, why don't we just make plans for those with the most severe consequences, and never mind what that probabilities are. Because if we focus on that, what other thing that worries us the most, and if they are cost-effective measures, then let's implement them.

For example, Fukushima had a 300 year tsunami protection. At that time, I must admit, they follow our footsteps, our licensing criteria, 40 years ago talked about 100 years flat. They exceed what our usual requirements by 300 years. Little did they know, way

back in year 859, they had a monastery's record of a tsunami that indicated perhaps a 50 or 60 foot tsunami.

If they use a carbon 14 dating on some of the soil examples, so they could estimate how big was the wave. Little did they know, if they were to adopt that standard -- now to be fair, nobody adopted a thousand year flooding standard.

As of today, we don't adopt a thousand year flooding standard. But if a thousand year flood can be prevented with the minimal amount of money, then perhaps we should do it, right? It all boils down to, in my humble opinion, is well, how much money do you have and where do you want to spend it?

But if we plan for every conceivable scenario, then nothing should be build, and nothing will be built. Once we have it built then let us say -- let us say if a hundred feet tsunami is the thing we worry about, let's not dismiss it based on probability.

You see, in the old licensing framework and the old reactor oversight framework we went about things deterministically, so we fixed them. We fixed them with the fundamental principle application of diversity, redundancy and physical separation. So that's done. For things that are being considered true outliers, we say, well, let us do this, let us do a cost benefit

analysis, really it's a charitable description of let us dismiss it by probability.

Now, little do we know, probability dismissal is not an exact science. By it one can be very, very wrong. For example, you know, Fukushima was to retire six months ago, and they were extendable ten more years, right. Perhaps if you have the crystal ball, right, perhaps retirement would be the more honorable thing to do for them. But who knows?

Again, it goes to -- let us worry about -- this is when the rationale for me to put the top five and the black swan on the screen here. These are the nastiest of the nasty accidents. If it does not cost much to fix them, I think we would all be better off.

Now, the key is well, how much does it cost? Perhaps the cost will be the minimal. For example, the reactive vessel ruptures in the area. One of the difficult scenario for everybody is you may have a projectile under 2000 pound per square inch of forces when the bell line ruptures on you.

Do we have enough physical restraint of that -- restraint that top vessel part to become a projectile and penetrate containment for you. If somebody goes through the calibrations, say oh that's easy, let me add a concrete slab of five feet thick, let me add a couple,

you know, ten inches of steel rebar that will solve the problem. Then I would say fine, let us do it instead of demission it entirely based on probability, because as you know, probability estimates have large uncertainties.

And besides, a probability estimate is -- if somebody say is ten to the minus six, it does not mean it will -- you have to wait a million years. It only means -- assuming that estimate is correct -- if it happens today you have to wait a million years for it to happen again. Wow, that's a very different -- that's a very different proposition here.

So the answer to your question, you know, I put them down to say, well, let us not be complacent by only comparing what our current facilities are with Fukushima. We can always say, you know, well I'm not Fukushima, I sit two miles high, you know, and there's no way I'd be vulnerable to tsunami.

My response is yes indeed, you are not vulnerable to tsunami. But before Fukushima nobody was worried about tsunami. Should I now worry about something else? What would that something else be? That would be a meaningful exercise for those of us involved in reactor safety for some many years. Do I answer the question?

COMMISSIONER FLORIO: Yes, thank you.

CHAIRPERSON WEISENMILLER: I was going to say, thank you very much. I should note Commissioner Sandoval is back and actually Galen Lemei has been sitting in for Commissioner Douglas, and I guess we have, hopefully, two more speakers on the phone. So let me thank you and I think the last -- I think we had the privilege of Tom Cochran at the last of these IEPR sessions, and that was Tom's last day as an NRDC employee, and hopefully Tom's on the line now.

MR. COCHRAN: I'm on the line. Can you hear me?

CHAIRPERSON WEISENMILLER: Yes we can.

MR. COCHRAN: Good.

COMMISSIONER BOYD: Barbara, you want to do introduction?

MS. BYRON: Uh, Dr. Cochran is a consultant to the Natural Resource Defense Council, where he began working in 1973. Before retiring, he was the senior scientist and held the Wade Green Chair for Nuclear Policy at NRDC. He's served as consultant to numerous government and non-government agencies on energy, nuclear non- proliferation, nuclear reactor, nuclear waste matters. He received his PhD in physics from Vanderbilt University in '67, and was Assistant Professor of Physics at the Naval Post-Graduate School

in Monterey, CA until 1969. Dr. Cochran?

MR. COCHRAN: Thank you. How do I move the slides? Or how do you move the slides?

MS. KOROSEC: Just tell us when you want us to advance the slides, Tom.

MR. COCHRAN: Oh, okay. Well, I'm -- my colleague, Matthew McKinzie assisted me in some of this research, so he's also listed on the title. Next slide please.

What happened at Fukushima? I'm going to go through this fairly quickly, because I think most of you already know most of what happened. But there was a very good presentation by a Japanese professor at the National Academy's Radiation and Nuclear Safety Boards, and I recommend you look at the PowerPoint, you can get it from their website.

Next slide. I'm using some of his slides. These are the units before the accident.

Next slide. And we all know there was a major earthquake off shore.

Next slide. Those also show the aftershocks. It was in three instances the design basis ground acceleration was exceeded, but the reactors shut down safely.

Next slide. But they were followed by the

tsunami that was like 15, another 14 or 15 meters where they had designed from, like, 5.7 meters and -- next slide -- this I before the action and I call your attention to the lower right hand corner. You see two fuel tanks out near the water, right at the edge, and if you go to the next slide, you will see those have disappeared. Those were the emergency diesel generator fuel tanks. It was one of the design failures at this site.

Next slide. As I think you already know, the major problem was a station blackout. The earthquake took out the grid and the tsunami took out the emergency diesel generators and clean water pumps, and that led to a meltdown in three reactors.

Next slide. Well this -- this is just a chart of the occupant -- we'll move on.

Next slide -- uh, this is a photo that you can get off of the NNSA, DOE and NNSA's website, they assisted the Japanese government in doing off-site radiation measurements. And the -- one thing you should bear in mind when you look at this kind of data is the prevailing winds went to the east, and so you don't see any of the fallout plumes that would have gone over the ocean. And so you get a smaller impact on the land that you might otherwise if this had not been located on a

coast with prevailing winds to the east.

But one of the immediate problems following the accident was that they, I believe, set a standard for evacuation of children that was too high. And, frankly, it was the same that you would use for occupational workers and the frequency of expected cancers in ten year old children due to the exposure -- that was the annual exposure -- would be one excess cancer per 250 children.

That's using the risk estimated from the National Academy's PEER Seven report -- so the first thing that goes in an accident like this is the radiation protection standards that are put in place. Next slide. One of the immediate --

MS. KOROSEC: Tom -- excuse me -- can you speak a little bit closer to the phone, we're having a hard time hearing you.

MR. COCHRAN: Yes. Uh, one of the immediate responses in the United States was the Nuclear Regulatory Commission ordered walk-downs of the US reactors, and my immediate response -- and this was by the, you know, by the site inspectors and the regional inspectors -- and my immediate response was, well wait a minute, isn't that their day job?

And yet, we see here for Diablo Canyon's

innumerable discrepancies in safety systems. Many of these were for accident sequences beyond the design basis, and therefore they were not regulatory requirements, but recommended requirements, or volunteer requirements.

You might ask if you had Admiral Rickover had gotten back from one of his submarine Commanders how long that Commander would have retained his ship command, or submarine command.

Yet, in the civil nuclear sector we don't seem to have a very high level of reprimand for failures in safety systems.

Next slide please. I've just catalogued -- there are now a number of reports -- very good reports -- lessons learned, not only the Nuclear Regulatory Commission's Task Force Report, but the IAEA experts' report, there's a Japanese government report that was mentioned earlier to the IAEA, there's a good report by the Union of Concerned Scientists, and I think you're going to hear from Arjun Makhijani, also with the regular report.

But, I've, on the basis of some of the earlier reports, attempted to catalogue some of the lessons learned into these categories, and we'll go through some of these, but not all of them.

If I could have the next slide? Uh, the focus, of course on Fukushima has been on earthquakes and tsunamis, but if you will take our last speaker's remarks to heart -- Dr. Lam -- you would also focus on some of these other issues in red, because what we've seen historically, there've been a fairly wide range of fuel damage accident or events in reactors, and Fukushima involved -- the precursor was earthquakes and tsunamis, but all the other cases involved other precursors, and so I think if you focus too much on the earthquakes and tsunamis you've failed to take into heart the more -- maybe the more important lessons.

If I could have the next slide please? One of the things I've looked at is what this latest data means in terms of whether reactors are safe. And so I went back and tried to catalogue all of the fuel damage accidents to date.

And if you go to the next slide -- I believe it's the next slide -- I listed in some of the -- in one of my earlier reports these 12 events -- 12 reactors that have had fuel damage accidents beginning in the '50s through the Fukushima event. I have since added ten more events -- mostly events -- that took place in the '80s, many of them not as severe, of course -- none of them as severe as Fukushima, or

Three Mile Island, or the Chernobyl, of course. But when you take all of those events and compare them to the number of reactor years of operations and then compare the results you get -- if we could see the next slide -- you find that within -- this is sort of a baseline and there have been 582 nuclear power reactors that have operated in 1404 rector years, worldwide.

And there have been 137 nuclear power plants that have been shut down, and so you compare the accidents to these data and could we look at the next slide?

This was the data calculations I had before I added the additional ten events, but basically one in -- roughly one-in-ten shut down reactors had experienced some form of fuel damage and the frequency of core damage is about an order of magnitude higher than what the Nuclear Regulatory Commission would claim is their safety goal, of their frequency which constitutes safe operations.

And so, on a worldwide basis I think you could say from the historical data up through Fukushima that nuclear plants are not safe. I don’t think you can extrapolate that down to individual reactor or even the --

MS. KOROSEC: Tom, you need to get close to the

phone again.

MR. COCHRAN: -- countries in some cases. Uh, next slide please. Here's another set of lessons learned and, of course, the one that's of concern to California is the sixth one -- which sites have adequate on-site seismically robust systems for emergencies.

And -- but I think since you've had a lot of considerable testimony on that issue already, I'll move on to the next slide.

The, uh -- these are additional lessons learned relating to systems for coping or mitigating accidents. I won't go into those in any detail, but we'll continue on with this.

You've shown a considerable interest in the spent fuel pool issue. We've argued that the pools -- that the NRC should bite the bullet and order the licensees to move the spent fuel to dry cask storage as soon as it's cooled sufficiently to do so. There -- of course you've heard their arguments for not doing that, and that is that the older assemblies have the smallest heat load and therefore they don't contribute to the decay heat removal problem that the newer assemblies do.

But when you start filling up the pools with old assemblies you do force blockage of cooling of the hotter assemblies, which if you have older fuel packed

around it, and then if you have building debris, such as you had in Fukushima falling into the pools, you can more easily get into a problem with the newer fuel, because of the older fuel being packed around it.

So, I think it just makes sense to move the fuel out of the pools. We don't have a geologic repository, and we're not going to have one for decades, and we should just get on with moving the fuel into dry casks where it's safer.

I'd point out that while the assemblies are in the pool -- in the wet pools, it's the only time that the assemblies are not in a heavily thick steel container, initially being in the reactor, and finally in the cask. But while they're in the pools they are not in a similar container situation.

Next slide please. The -- a lot of attention has been given to hydrogen production and mitigation of hydrogen, particularly for the PWR reactors, this is not a problem in the California reactors, of course, which are PWRs, but there's another issue that is being neglected, and that is there's a rule-making petition before the NRC -- and it's been before the NRC since 2009 -- that says the computer codes that they use to calculate essentially the temperature at which you get runaway hydrogen production underestimate that

temperature time.

That if you had -- if these codes had been base lined against newer or more recent test data involving larger assemblies, rather than short pieces of fuel, that you would lower the temperature, and therefore that would argue that you would operate all of the reactors probably, including the PWRs, at a lower power. But instead, we -- the NRC has not concluded that rule-making, and in the meanwhile has repeatedly given power upgrades to reactors that have asked for it. So, it may be that we should be reducing the power to these reactors rather than increasing the power to the reactors.

Uh, next slide please. Uh, I'd simply point out that you can probably go on the web and find out what the weather is at your beach, but I bet you can't go on the web and find out what the radiation monitors are reading around the Diablo Canyon and San Onofre nuclear power plants.

I think in this day and age we have the instrumentation capabilities so that the public should have access to those reading on a real time basis. And that's something you could do in California. Next slide please.

Here, we've -- you heard earlier from one of the

presenters that the Nuclear Regulatory Commission -- and he was really referring to the newer term Task Force Review -- had looked at emergency planning and had not recommended any change from the ten year evacuation emergency planning zone.

I think that's the wrong issue, and I think that the problem that you need to confront is that the NRC's safety goals and safety analysis for reactors is based on an individual risk assessment, and no consideration -- or no explicit consideration -- is ever given to the potential environmental damage from a severe accident, or from the sever accident safety risk to large populations, as opposed to individuals, and to the socioeconomic costs of a severe accident.

And this raises a particular problem for San Onofre. If we can go to the next slide please -- because San Onofre -- here I've just superimposed the plume from Fukushima onto the San Onofre generating station so you can get an idea of the scale of the plume. Obviously if we had an accident in San Onofre releasing radioactive materials, the wind would not be going in the same direction.

And if we go to the next slide you see San Onofre is in a -- within thirty kilometers there are substantially more people than were around Fukushima

Daiichi plant, and I think the NRC regulations need to take into account the population density and the potential socioeconomic destruction, or damage due to large concentrations of population and industry, and they don't do that now. And, I think -- is there another slide -- well these are just more of the lessons learned taken from some of the earlier works, and I'll let you all go through that at your leisure, and I'll complete my --

CHAIRPERSON WEISENMILLER: Tom, thank you very much. Jim, do you have --

COMMISSIONER BOYD: Hi Tom, this is Jim Boyd -- good to hear you again. I guess the last time we were together was before a US Senate Committee a few months ago. I just want to -- one of your slides I found most interesting in reviewing them before the hearing today was the walk-down post-Fukushima inspection at Diablo Canyon.

I've got that one set aside, but I appreciate you pointing out that issue -- or that slide of issues -- that might not have otherwise come to our attention. And you've actually spoken to all of the issues I had listed to ask you about -- spent fuel pools, so on, and so forth. So I just want to thank you for your presentation. Good to hear from you.

MR. COCHRAN: Well I'm thankful for the invitation.

CHAIRPERSON WEISENMILLER: Yeah, again this is Chair Weisenmiller. Thank you very much for your presentation. Mr. Florio, question? Commissioner Sandoval?

COMMISSIONER SANDOVAL: Yes, thank you very much for your presentation. Just one real quick question. You talk about the need to assess the implications of predicted sea-level rise and increased storm surges due to climate change, so given the elevation and design for both Diablo and San Onofre, how do you think those factors would play out as potential concerns?

MR. COCHRAN: Well, I don't -- I don't have data or analysis of the individual reactors, so I'm going to leave that for those of you in California to assess. You know, when I look at the California situation, the issue that just jumps out at me is the population density around San Onofre, and of course you have a similar situation at a few other reactors.

We've also done that analysis on a world-wide basis, and the worst situation is actually in Taiwan, where if you go thirty kilometers from four PWR Mark Ones you're in downtown Taipei. And, you know, they're betting their country, which seems not to be a good

idea.

But, you know, until we get some regulations that restrict population density around reactors, we, you know, obviously run the risk of having situations that can be far worse than anything.

CHAIRPERSON WEISENMILLER: Again, thank you very much, Tom. Let's go onto the next speaker.

MS. BYRON: Okay, our next -- our last speaker for today is Dr. Arjun Makhijani. He's the President of the Institute for Energy and Environmental Research in Tacoma Park, Maryland. He earned his PhD from the Department of Electrical Engineering and Computer Sciences at UC Berkeley in 1972, specializing in nuclear fusion. Dr. Makhijami.

MR. MAKHIJAMI: Yeah, uh, are you going to give me control of the slides, or should I just go with what you --

MS. KOROSEC: You have control, Arjun.

MR. MAKHIJAMI: I have the control? Can you see my screen?

MS. KOROSEC: No, not yet. Arjun, we're having some technical difficulties, so we'll just go ahead and flip your slides from here, if you'll just let us know when to flip them.

MR. MAKHIJAMI: Oh, okay. I don't see them as

being up on my screen.

MS. KOROSEC: Give us just a second. My apologies.

MR. MAKHIJAMI: No problem.

Are they up on the screen over there? Should I just speak from my slides so long as you all can see them?

MS. KOROSEC: We're almost there. Our apologies. We had just got an upgrade --

MR. MAKHIJAMI: Oh no problem --

MS. KOROSEC: -- to our WebEX system and there's a few little bugs still. Do you see your slides now?

MR. MAKHIJAMI: Yeah.

MS. KOROSEC: Okay, go ahead.

MR. MAKHIJAMI: Alright, well, thank you Commissioners for asking. I have appreciated working with your staff and trying this out, and I'm glad we got it up there.

Uh, next slide. I just want to give you an overview. I think severe accidents are not as rare as assumed in theory. There was a functional failure on the vent system in all cases, maybe for different reasons.

One subject that hasn't been brought up today is that the zircaloy fuel rods -- the fuel tubes -- are a

poor material from a safety standpoint -- quite good from a lot of other standpoints, from a nuclear operational standpoint.

And if you look at the NRC assessments on spent fuel accident mechanisms, the Fukushima type of events are not there. Emergency management you've heard about quite a lot. Uh, I'll touch on de-commissioning issues after an accident, which hasn't come up.

You've heard about liability limits and I'm very disturbed by the NRC's reluctance to impose even reasonable costs to safety, and special reference to dry storage. And Federal government is not doing all it reasonably should, and I think in that view States ought to have a right to impose higher safety standards.

Before I actually go to my slides, I did a little calculation to a question that was asked of Dr. Kazimi -- what was the contaminated area at Fukushima and how did it compare to maybe renewable wind energy? Uh, contaminated area at Fukushima, defined by more than a hundred millirem dose in the first year DOE map, it's a lot more than 2000 square kilometers -- 200,000 hectares or more.

If you try to replace all the 104 nuclear power plants by wind energy and counted the actual footprint of, not the area of the wind farm, as a whole, but the

actual footprint of the wind facilities -- the footprint of the tower, the footprint of the buildings -- and the area per megawatt is about .6 hectares. It varies from facility to facility -- average -- and you could replace all the nuclear generation in the country for less than the land area that has been contaminated more than 100 millirem by wind energy, at 30 to 35 percent capacity factor. That's actual generation, not capacity.

Anyway, next slide. So this is before -- Tom already showed you this, so I'll quickly go through this next. So this is before Vermont Yankee, we want to keep it that way. This was re-licensed on March 21, 2011, without asking for dry storage. It has more spent fuel in that pool than all four Fukushima spent fuel pools combined.

Next -- this you know well. Next -- uh, you don't want this type of after picture. Next.

Okay, so what is the probability of accidents? Uh, we've had one partial core meltdown here, about three thousand reactor years. Chernobyl -- a ten day fire. Fukushima -- actually I re-measured it, I'll send corrected slides. It's actually more than half the area of Chernobyl that was the exclusion zone.

Fukushima contaminated the ocean and quite a lot of land, but the actual radio glide releases were less.

In the first 10-15 days, I think the cesium releases were estimated by the -- using the data by the Comprehensive Test Ban Treaty Organization, it was about 30-50, 60 percent of the Chernobyl cesium releases -- iodine releases were somewhat less.

These numbers will change because those were just in the first ten days, I think.

The Austrian Meteorological Organization did a pretty good job of estimating those releases in the early days.

So, now we have a record that one out of every hundred light water reactors have had a core meltdown before the first 40 years of operation are up, which is the license, initial license time here, as you know.

Three reactors have had serious releases and probably, possibly it should say, maybe, probably, possible Unit 4 spent fuel pool. We don't know very well, yet.

This is much more serious than in theory. One severe accident with substantial releases for every five to ten years of operation of a few hundred operating reactors, much more than the target that you -- target for U.S. safety and that you would want.

Okay, we don't know exactly what happened with these vents, but we do know that functionally every one

of them failed. We had four hydrogen explosions out of four possible cases. Were don't know where the hydrogen in Unit 4 came from, whether it came from the spent fuel pool, or not, or whether it came from another building, it's not clear, yet.

But I think the possibility that it came from spent fuel pool in Unit 4 should be kept open at this time.

The issue, one thing that hasn't come up is the problem that the valve required power and the problem of station blackout was raised at the time that the backfitting of these vents was discussed at the NRC. And, unfortunately, it was ignored.

Moreover, vent installation was voluntary. Three out of eight -- there are 23 Mark 1 reactors, the NEI information was a little bit off the mark. There are 23, so to speak. There are 23 Mark 1 reactors in the United States and there are eight Mark 2 reactors, very similar. Only three out of eight Mark 2 reactors did actually install the vents. All 23 Mark 1 have vents installed, but we don't know whether they will function or not and a station blackout might be hard.

Next slide. Okay, so this is a problem that -- zircaloy is a problem that is a common vulnerability to all light water reactors. That's where the hydrogen

comes from, it comes from the steam, zirconium reaction.

It also promotes the meltdown because the zirconium oxide that is formed in the reaction forms a eutectic with uranium dioxide and so that accelerates the process of the meltdown and you have an exothermic reaction.

Actually, this problem was raised in 1975, by Earl Gulbransen, who was at Westinghouse, and then at the University of Pittsburgh. He was an expert in materials and he noted that there was no alternative backup material. And there was quite a bit of controversy when he wrote to the Bulletin of Atomic Scientists about this, and I believe in 1975, and but no plan.

And after TMI it was no plan and, now, I have not seen any reference to it in the NRC materials after three or more meltdowns and four hydrogen explosions.

The next slide. Okay, spent fuel pool.

The next slide. Okay, I looked new reg 1353, which is where the scenarios for spent fuel pool accidents come from, and there’s no hydrogen explosion scenario in it.

In fact, no boiling scenario in it. In all scenarios there are fires, but the fires are caused by spent fuel rods being exposed to air and water loss is

assumed to be instantaneous. This means you have some kind of a very, very major hole in the spent fuel pool from some kind of an unspecified accident, and/or an earthquake in which you have complete failure of containment.

But, interestingly, the spent fuel rod structure holding the rods in place is assumed to be intact. So, the spacing of the rods is maintained. It's kind of a -- I find, a very strange scenario structure.

In any case the actual progression of the accidents and the hydrogen explosions that happened above the spent fuel pools, and in Unit 4 of course it was possibly from the spent fuel pool, not clear, yet.

Fukushima common pool did not, apparently, have releases, but only aged fuel was in it. Dry storage, also apparently zero releases.

U.S. average number of fuel assemblies is 3,000 and in Fukushima 2,724 in all. Of course, U.S. average assemblies, the weight of the assemblies in PWRs are different from BWRs, but rough numbers.

Dry storage cost is very modest, about 0.02 cents per kilowatt hour. I think I assumed about 45,000 megawatt days per metric ton.

And wasn't said earlier about the National Academy Study is they were actually prohibited from

their terms of reference for recommending dry storage, but they did conclude that dry storage was safer in the event of terrorist attack.

Next slide. I looked at the self-assessment, which is still allowed, even the Task Force Report, this Short-Term Task Force Report continued with the self-assessment idea and I'm very glad that the Commission and California concerns have been raised, and you have some independent review and process.

This shows you self-assessments of boiling water reactor containment failure, pressure at failure compared to design pressure. You can see in 9.1 the self-assessment is actually that failure would take place at substantially less than the design pressure, and nothing seems to have been done. Maybe the assessment was changed, but the reactor is still operating.

And you have some very strange assessments, like at Cooper.

Next slide. And the Sandia document that analyzed this containment failure issue discusses this strange result, but notes that there are some differences in design that cause different assessments, but also differences in definitions of failure. There's no standard definition of failure against which to

assess failure. NRC does not specify failure modes considered, calculation methods and methods of incorporating uncertainty so, naturally, you're going to get cumulative probability distributions that are widely different.

And this is a typical situation, I've shown you only one example. Probability risk assessment is a useful tool where you have lots of data from the real world for frequent events. And so you can have models that are based in the real world and can be tested.

But as a practical means to assess rare events which are, by definition, data poor, it is a pacifier. It is not a robust scientific tool.

I've thought a fair amount about this. I think to rely on probabilistic risk assessment for rare events is to console oneself that one knows what is going on, and there's a substantial self-delusion aspect to this. Strong word, but I think looking at Fukushima, if we don't use strong words maybe -- we don't want to be sorry. We should use strong words when warranted.

So, 50 miles? Is 50 miles going to be enough? Now, there are hot spots 85 miles away. Remember, hot spots, you know, from nuclear testing, we know they're caused by rain outs. And they've destroyed fisheries, they've destroyed farms. The releases are still going

on, much less than before. When will they stop, it's not clear?

One of the things that hasn't been discussed is the structure for handling spent fuel and, possibly, you know, all the stuff that is to be taken out of the reactor buildings, including the molten fuel.

Unit 1 apparently has melted through within hours of the start of the accident. That equipment has been destroyed. The rector building from which the crane was hung also have been destroyed in three out of four cases.

And we don't know in Unit 2 what the crane looks like, since we haven't looked inside, don't have any pictures.

It's very, very unclear how this site is going to be decommissioned because the handling equipment is not there and equipment have to be designed because radiation levels will continue to be extremely high and cannot be approached by unshielded personnel, and there's no equipment there to handle this stuff.

They cannot leave this on site in a seismic zone, on the shore of the ocean, as they did at Chernobyl. I don't believe this would be prudent at all.

It's very interesting that the NRC Task Force

didn't raise the question of children. I believe that the NRC is in continual violation of the Executive Order on children, which requires special consideration to children. It's been in effect since 1997, through three administrations.

And, basically, the NRC has been ignoring it. I don't know whether other government agencies are ignoring it. I know the EPA has been ignoring it, too. We've been in discussions with them, fruitlessly, for many years over this question.

But it's very important to pay attention to the question of children and their vulnerability. I'm very glad that Tom pointed out that their risks are considerably greater. As you go down in age from ten years to five years, and to infants, the risks go up very substantially. I really recommend the tables in the report to you about this.

The NRC Task Force recommendations about emergency management are grossly inadequate. I thought their seismic -- they did well by seismic and flooding issues, pointing out the patchwork. But I think to look at Fukushima and the maps from the DOE, that have been published with U.S. measurements and over-flight is to know that the emergency management is inadequate.

One of the things that is not taken into account

is that there's an assumption that accidents will be short and people will be able to go home. Neither of those assumptions is correct. In fact, we know that we cannot count on that at all.

Next slide. Okay, so the Brookhaven National Lab assessed the maximum possible damage from a worst case spent fuel pool accident. They assessed the range, actually, I've just quoted the maximum. In a very densely populated area, I think the density would have to be considerably greater than at San Onofre.

The worst case in today's dollars would be about $700 billion in damage and 140,000 excess cancer fatalities. This was done for the Nuclear Regulatory Commission, which proceeded to ignore the study in terms of its implications for dry storage.

I think you are very right in asking for dry storage. There is a classic moral hazard problem in the economic sense, the reliability over 12.6 billion has been passed on to the government, or the taxpayer. Will the government pay, given what is going on in Washington? I'll let you come to your own conclusion and not express an opinion unless you ask me.

The NRC allows self-assessment, still. I think there's a conflict of interest there. I think the Task Force was really remiss in not pointing that out,

especially as there's an Inspector General's report in the NRC that criticized health assessment and found it wanting.

We live in an atmosphere where Federal regulation and even the legitimacy of the Federal government is questioned in its regulatory aspect. And we can't expect vigorous NRC. And I think we're looking at an NRC that is not vigorous.

Even the Chairman's suggestion that there should be quick action on the 90-day review doesn't seem to have gone very far.

The next slide. Okay, State and Federal issues. I think 90-day Task Force has some useful recommendations, I'm glad that the license renewal of PG&E has been put off and the PG&E, itself, asked for that.

I'm glad that San Onofre hasn't applied, yet, for a license renewal and I hope that they won't do it. I think -- you know, until these issues are resolved and the costs.

I think it's arguable that actually license renewal applications at this stage, whether they can be considered in the spirit of NEPA. Because until it is clear what the costs are of compliance with the new regulations, you can't really compare it to the

alternatives, so you cannot really be in compliance with NEPA. Non-lawyer opinion, but engineering opinion. You need -- if there are substantial seismic back-fitting costs in the billions of dollars, then it will make a huge difference as to what the operating cost beyond the license renewal period will be, I think especially important for California.

Next slide. I think even 50 miles may not be enough, but 50 miles certainly needs -- the 50-miles radius needs to be revisited in terms of emergency management. It's not just an evacuation question, it's a question of having real-time measurements of radiation. It's a question of training emergency management personnel.

I'm glad, at least the NEI pointed out that this is a State responsibility and, you know, the -- so, you have that leeway to do that. Firemen and police, and other emergency personnel, health and emergency, hospital emergency personnel need training with radiation equipment and how to handle emergency patients. There's a whole thing that needs to be done.

And I think the rest at ten miles, or even 18 miles, and 22 miles in the case of Diablo Canyon would not be right. I think you need to revisit that. And I, personally, believe that Federal preemption needs to be

revisited in the sense that states -- there should be a floor that the Federal government sets, but states should be allowed to set tougher standards.

My own review you have, the URL for my own review. I'd be happy to answer your questions. Thank you.

CHAIRMAN WEISENMILLER: Thank you very much.

Commissioner Boyd?

COMMISSIONER BOYD: Thank you, Dr. Makhijami. This is Commissioner Boyd. You actually addressed a lot of the questions I had. I want to just thank you for your presentation but, in particular, I want to thank you for bringing up the issue of cost, it's been on my mind all day. We've flirted with it, but it's something we, in California, have raised several times, the need to take into consideration the ultimate cost of energy after the cost of building these plants, before any further consideration is given to them.

So, that was a good point you made and we certainly will be taking that into account as we prepare our report.

And, also, the emergency management aspects raises a lot of interesting questions that we need to pursue here.

And, finally, about states stepping out more,

that point came out earlier. From my nine plus years of working with NRC, my comments earlier that pre-Fukushima it would have been very hard for the State to step out, but I really do need -- I think we need to think about whether this State should consider some tougher safety standards and what have you, as we continue in our future.

So, I thank you for your presentation and I'll be looking for your task force report on the web.

MR. MAKHIJAMI: Yeah, if I might make a comment, Mr. Boyd? I was in Vermont on the 22nd of March, when the news came out that the Vermont Yankee had been relicensed, it was a long, scheduled trip, it just happened that way.

And I was talking to State Legislators that day and they were extremely disturbed that this had happened and Vermont, as you know, has said that they don't want this reactor to operate after 2012 and they thought that they had acquired the right to make that decision, which is now going to be in question, I understand.

And the fact that this was done without pausing and looking at the National Academy's Report, looking at the fact that the spent fuel pool scenarios were no longer valid, that the probabilities were no longer valid, that the relicensing or license extensions

proceeded as if Fukushima did not happen was extremely disturbing to me.

And I did not worry about spent fuel at all, honestly, before 9/11, but I have been worrying about it ever since and thinking we need hardened storage; not only dry storage, but hardened dry storage.

And now, with the cancellation of Yucca Mountain, we think, this is all the more important. So, yeah --

COMMISSIONER BOYD: Thank you for your comments.

MR. MAKHIJAMI: I think if the states get together, maybe they'll be able to get somewhere.

COMMISSIONER BOYD: And, again, thank you for your reference to the National Academy's ignoring the dry storage issue. We've talked about it all day here and I think you've heard some of that, and that's a big concern to us.

MR. MAKHIJAMI: Yeah, the National Academy's actually concluded it was safer, but they weren't able to make a recommendation that it should be done because Congress prohibited them from making the recommendation, by the terms of reference of the study.

CHAIRMAN WEISENMILLER: Okay. Thank you. This is Chair Weisenmiller, I just -- following up on that one note, I was going to ask Barbara if she would docket

the National Academy presentation that Tom Cochran mentioned.

CHAIRMAN WEISENMILLER: Catherine?

MS. SANDOVAL: Thank you very much for your presentation and analysis. I was wondering if you could expand a little bit on the zircaloy? This is an area that I'm not as familiar with, obviously, you would be more familiar with it, as the nuclear experts in the room.

So, these concerns about the zirconium reaction, is zircaloy commonly used in the United States and is it used in the reactors that are operational here in California? Is there a method to address this vulnerability that should be considered going forward?

MR. MAKHIJAMI: Yes, zircaloy, this is the material out of which the fuel tubes are made, you insert the pellets inside the tubes, and so it's the tubes, the zircaloy tubes more than 95 percent zirconium, with a little bit of tin, or niobium. That's what is in contact with the water and when you get a loss of coolant, the water becomes steam.

And zirconium was chosen because it has very good heat transfer properties and it doesn't absorb a lot of neutrons, so it's easier to maintain the chain reaction. And so there were a lot of good reasons to

choose zirconium, but it has this very unfortunate property of reacting with steam and producing hydrogen, and zirconium dioxide, which is really central to the process of meltdown.

It's used in all reactors in this country, including Diablo Canyon and San Onofre, all light water reactors.

And so this is a common vulnerability because if you choose a material that will not react with steam and produce hydrogen, or will not form a eutectic with uranium dioxide, you've greatly reduced the most severe accident mechanisms in light water reactors.

And it was a surprise to me to recently find out, after Fukushima, since I've been researching this, that this issue was raised in 1975, by one of the most prominent people in the business, and it wasn't reconsidered then and not reconsidered after TMI, and it's still not being reconsidered.

I think it should be a very urgent issue to redesign or at least consider redesign of these, of the fuel tube material.

MS. SANDOVAL: So, just to follow up there, again, I'm a lawyer, not a nuclear engineer. How difficult would it be to replace this tube? I understand that it has some good properties, but you've

also identified some serious consequences for it. We're not talking about replacing the material, but the tube.

MR. MAKHIJAMI: Yes.

MS. SANDOVAL: Are there existing alternatives? Is this an area where there needs to be more research? Is it a priority question?

MR. MAKHIJAMI: Well, you know, I haven't researched this to the degree to give you a precise answer to the question. If I could write you a letter about this, I know -- you know, other materials undoubtedly were considered when these fuel rods were designed, initially.

And Gulbransen, this man who raised the consideration in 1975, actually advocated, you know, that there should be backup materials.

I'm pretty sure that, you know, things like stainless steel might have been considered, but I don't want to speak out of turn without -- without -- I want to give you a properly informed answer.

So, if I might write you a letter about this, in a couple of weeks I'll send you some information.

CHAIRMAN WEISENMILLER: That would be good. Also, if you could provide to Barbara -- this is Chair Weisenmiller -- a copy of the Bulletin on Atomic Scientists article, so that it can go in the docket,

that will be great.

MR. MAKHIJAMI: I will do that. And, subsequently, there was some controversy. And, you know, I'll send you a couple of URLs, I'll send Barbara a couple of URLs.

CHAIRMAN WEISENMILLER: Okay.

(Reporter goes off the record at 4:45 p.m., but Workshop continues with audio only.)

CHAIRMAN WEISENMILLER: Okay, we'd like to thank the panel for their contribution and also thank the public who has been waiting to comment. And so, with that….

MS. KOROSEC: All right, we're going to go ahead and start with public comment. Now, just a reminder, we're just going to try to keep it to three minutes so we can get everybody out of here by 6:00ish. Our first commenter is Mr. Lloyd Levine, please if you would come up to the center mic?

MR. LEVINE: Thank you, Mr. Chair and Commissioners. My name is Lloyd Levine and, for those of you who don't know, I am the former Chair of the Assembly Committee on Utilities and Commerce. I also am the co-author with Senator Sam Blakeslee on Assembly Bill 1632 and worked very closely with him during its drafting and passage. I appear before you today as

someone who has a deep understanding of California's energy policy and a deep concern over the future of nuclear energy in California.

As you have heard today, the earthquake in Japan and the subsequent Tsunami caused unforeseen catastrophic damage to the Fukushima Nuclear Power Plant. For days after the double disaster, the world watched as safety systems failed, cooling tanks leaked, and explosions occurred. Radiation discharges were not a matter of "if," but how much and for how long. At the time, the news cycle kept us updated with the latest news and imagines nearly 24 hours a day for days on end, but predictably, the coverage began to wane and the news gradually pushed Fukushima to the proverbial back pages. However, as we know, the problems continued long past the initial news coverage.

It is entirely appropriate, although somewhat coincidental that the Commission holding this hearing today as, just yesterday, news reports out of Japan indicated the crisis is widening and worsening. News outlets reported that radiation fallout from the Fukushima Nuclear Power Plant is posing a growing threat to the Japanese food chain, extremely unsafe levels of cesium have been found in beef all ready for sale on supermarket shelves, and similarly high levels were

detected in vegetables and seafood.

It is now four months after the earthquake and Tsunami and local governments in Japan are still short of the equipment, staff, and funds necessary to deal with the myriad of effects. The Government is struggling to test all farm products and is considering whether it's even feasible to test cattle to prevent further shipments of tainted meats. There is no centralized system to check for radiation contamination of food in Japan. Local authorities and farmers are left to conduct their own voluntary tests. Products, including spinach, mushrooms, bamboo, tea, milk, plums, fish and others have been found contaminated with radioactive cesium and iodine, as far as 225 miles from the nuclear power plant. Now, let's Downtown San Francisco; it is 170 miles to Downtown Los Angeles; it's 225 miles in a straight line to the Nevada border, and only 119 miles to Fresno and 103 to Bakersfield, not to mention the short distances to Salinas and Monterey. That puts almost all of California's major agricultural products substantially at risk within a 225 mile radius of Diablo Canyon. And lest anyone forget the prevailing wind direction is off the Pacific, blowing west to east, meaning that, in the

event of a radiation leak at Diablo Canyon, the wind will push the radioactive material directly onto California's food supply.

It is with that in mind, the scope and continuing problems caused by the Fukushima disaster, and the potential catastrophic impacts that a similar event in California would cause, that I ask you to consider the issue of public safety with extreme rigor when deliberating the future of California's nuclear power and to take appropriate strong measures. Specifically, the Commission must 1) address the issues posed by ongoing storage and final disposition of high level radioactive waste being created and stored currently at facilities; 2) the Commission must update California's woefully inadequate liability limits; as you heard today, in case of a disaster similar to Fukushima or Chernobyl, California is left unprotected. California's currently liability limits are at $12.6 billion; in Japan, the estimates from the Fukushima disaster, the liability is expected to soar well past $100 billion; 3) require a plan as to how the 4,400 megawatts of power, which is approximately 14 percent of California's total energy supply, will be replaced in the event of a disaster that forces the immediate and unexpected shutdown at either or both facilities; and 4)

consider requiring 4,400 megawatts of the Governor's proposed 12,000 new renewable megawatts be earmarked to replace or provide for adequate generation in the event that either of the facilities faces a catastrophe which worsens in the immediate shutdown.

Finally, Commissioners, I recognize the significant problems currently facing California's energy generation, transmission and distribution systems. And I know that, in the face of problems like that, sometimes theoretical risks seem just that, theoretical, and therefore acceptable. Political and cultural inertia are powerful forces, they keep in place the status quo, but do so not through planning, nor with intent, but simply by default. However, with the catastrophic problems caused by the disaster at Fukushima still increasing and compounding weekly, it's my hope that the leaders of this state can overcome expediency and take the necessary steps to guard California against the same fates that have befallen the people of Japan and Chernobyl.

At the risk of being slightly trite, Benjamin Franklin said, "By failing to prepare, you're preparing to fail." We must know and acknowledge that at any second a massive earthquake could hit one of the many faults crisscrossing California and the Pacific Ocean,

and we must plan and act accordingly, because once that moment occurs, at that point it will be too late. Thank you, Commissioners.

CHAIRMAN WEISENMILLER: Thank you very much for being here.

MS. KOROSEC: All right, our next commenters are Michael Monasky.

MR. MONASKY: Hello, Committee for this important report. I'm a licensed respiratory care practitioner and I'm also a member of the Sacramento County Public Health Advisory Board, but I'm only speaking on my own behalf and not on behalf of the profession or the county. I only mention that because I think it's important to incur and speak about human health. Health in all Policies is the current trend that is being used in government circles now and the Commission mandate through the Public Resources Code Section 25301(A) says that the Commission shall use these assessments and forecasts, which is part of this report, to develop energy policies that protect public health and safety. I do not see that effort being made because there is not an integrated involvement with the California Department of Public Health and the County Departments of Public Health that surround these areas.

To wit, the Shoreline Fault, as close as 300

meters from the Diablo Canyon Nuclear Power Plant puts the surrounding populace and countryside at risk for exposures to ionizing radiation that, should there be a loss of cooling or energy power resources to keep the cooling going on. Further distribution of ionizing toxins throughout the air and water can make communities downwind of the plant vulnerable to disease. The Public Resources Code requires an assessment of risks to public health from the California Department of Public Health to be included in the report, and that's not being done. The questions disturbances to active fuel rods, and interruptions in cooling resources and loss of electric power to the plant, which I mentioned before. What are those? What are the effects of such scenarios upon humans, animal life, plant life, climate air quality, water quality, and food supplies?

I want to switch gears a little bit and go to a table that was put out front by the Women's Energy Matters.org group and it cites a ruling by an Administrative Law Judge from the CPUC and it shows energy demand and excess power. Right now, we're apparently producing as much as 50 percent more power than we actually need, and so I wonder why my energy bills aren't going down by 50 percent. I have a funny

feeling I know why, it's because electricity is elusive, it's created and then it's spent, and then it goes down the line and it's attenuated and reduced, and power. My question is this, and it's a feminization of the question: how can households generate energy? How can households pay for and build simple energy generators? How can households integrate and coordinate energy generation with other households? How can the government encourage households to get on the grid as energy producers? You notice there's a theme here on households? That's the feminization of it. How is energy generated locally, by wind? By solar? By energy recovery? And where is the energy inventory for households, for local neighborhoods?

In addition, how is energy conserved and energy use decreased by individual households and apartment units at the local level? And finally, energy cost: how can retailers, grocers, car dealers, other heavy users of energy, be convinced to conserve energy? You know the craziness of going to see a car dealership at 2:00 in the morning with all its lights on, or a grocery store with all of its freezers open, and you know, why is that the case? How can they afford to pay $5,000 a month? If I did that and had that many energy generators and use that much energy, I would go

bankrupt. Why are the tariffs and energy rates for residential use two to three times higher than those assessed against business? Anyway, that's my testimony, thanks again, and my questions.

CHAIRMAN WEISENMILLER: Thanks again for your testimony, your comments.

MS. KOROSEC: All right, next we have Rochelle Becker from the Alliance for Nuclear Responsibility.

MS. BECKER: Thank you so much for having me here today and, before I begin, I would like to thank Commissioner Boyd for all his work, all these years. We wouldn't be here today without you. And I can't tell you how much I appreciate everything you've done, and for your comments about the Nuclear Regulatory Commission, I thank you even more, as I've had 37 years of them now listening to me.

COMMISSIONER BOYD: You definitely beat – thank you for your comments.

MS. BECKER: You're welcome. We have five recommendations. The first recommendation -– can you put the slide up? How do we replace 4,000 megawatts of power? We don't replace it if we don't talk about it. We have 4,000 megawatts of [quote unquote] baseload generation, and whenever we talk about replacing these reactors, the utilities tell us, "Oh, it's virtually

impossible." We read all of their data responses. PG&E has at least looked for replacements, but said they're significantly too difficult to deal with. Edison hasn't even looked. But the proof is, if you earmark 4,400 of the Governor's proposed 20,000 megawatts for replacement of these nuclear plants, and you tell the utilities, "Unless you come up with your own idea, the State is going to replace your nuclear power plants. We are not going to be dependent on this aging reactor at a seismically active coast." So we need to direct the utilities to do replacement projects, to let us know how they would replace their current 2,200 here, 2,200 there, megawatts of baseload power. If we don't know the answer to that question, then we fear shutting them down. And I don't think we should fear shutting them down more than we should fear what happened in Fukushima. Next slide.

How much radioactive waste are we willing to store on our coast? We have all been paying for these somewhere else place to store this radioactive waste since these utilities began. We have been promised that it was going to go off to this somewhere else place, and that somehow it was going to get there. We don't know how it's going to get there, we don't know where it's going to go, and we don't know when it's going to leave.

How long are we going to wait for the Federal Government to come up with that answer? Three states have sued the Federal Government, "We're not going to pay you anymore," they said. "In fact, we'd like our money back," they said. California didn't join that suit. California should join that suit. This Commission should recommend that they do so. Next slide.

Estimates are up to $100 billion for liability. Price Anderson is $12.6 billion. If we have a Fukushima style accident, you can bet that it's going to be more than $100 billion. The Japanese are not a litigious society and there is no more litigious state than California. The minute that first rim leaves the site of San Onofre or Diablo Canyon, the first attorney will be standing there with his class action suit. We can't afford that; let's deal with it before we have to deal with every attorney in the world. Next slide.

Seismic studies still aren't done. There should be no license renewal. There should not be one penny for the license renewal process, PUC Commissioners, not one penny until they finish these seismic studies. We don't have a clue what we're investing in and we've done that over and over. The record at the PUC is very clear: when we didn't look at seismic studies before, it cost $4 billion in extra money to the ratepayers. I sat

there during those proceedings. I didn't have gray hair during those procedures, and neither did anybody else up there. So let's not wait until we're dead to answer this question, let's get in there and deal with these seismic studies now. Next.

Fifty-mile evaluation zone, 7.5 million people who live within 50 miles of San Onofre. Any Friday, any Monday morning, any vacation day, try to get through San Clemente just on a regular day, and then try to evacuate the area. The Mayor of San Clemente waived the evacuation plan -– this is three pages, I think hers was seven pages -– that's their evacuation plan to get out of San Clemente. They need help. They've asked for help from the NRC; what they don't realize is that's the last agency you ask for help. Next.

This is the only slide, the only picture that has made me cry. You asked about monitoring. There are 34,000 children wearing lysimeters. Next slide. Let's not make those children be ones in California. Thank you.

CHAIRMAN WEISENMILLER: Thanks, Rochelle.

MS. KOROSEC: Next, we have Harry Wang, please, from Physicians for Social Responsibility.

DR. WANG: Honorable Chair and Commissioners, thanks for the opportunity to speak today. My name is

Dr. Harry Wang, I'm the President of the Sacramento chapter of Physicians for Social Responsibility. I'm also representing our other California Chapters in San Francisco and Los Angeles, and also our National PSR Office. In 2005, my wife and I had a chance to visit Japan and we visited my wife's relatives in the Fukushima Prefecture, about 60 miles west of the Daiichi Nuclear Power Plant. Following the earthquake, tsunami, and the nuclear disaster, we were relieved to find out that our relatives and our friends were safe. The country, however, as you know, has been devastated by the triple-disaster. Having lost over 200,000 civilians from two atomic bombs, the country was especially re-traumatized by the nuclear plant meltdown and radioactive releases, which we know will take decades to cleanup. Japan now faces considerable uncertainty about their health, economics, and energy futures.

Following the disaster in Japan, California Chapters of Physicians for Social Responsibility received many telephone calls from individuals concerned about the safety of California's nuclear power plants. Could a similar disaster occur here? What would be the health effects of a nuclear accident or meltdown? These are support comments submitted by Alliance for Nuclear Responsibility that you just heard, and certainly I hope

that we all agree that there is an incredible need for updated seismic analysis. Disposal of radioactive waste remains an acute and long term public health issue. The wisdom and safety of nuclear power will remain in question because of this. Until other sources of energy are developed, PSR joins over 170 national and local organizations from all 50 states and are recommending that spent fuel be moved from pools to harden on-site storage and that spent fuel pools need to be physically protected.

Regarding the size of the emergency planning zone, in light of Fukushima, I read from a recent PSR Statement: "The effects of long term exposure on large populations are unknown and it may be many years before the incidents of cancer and other health effects emerge. Rigorous epidemiologic studies of workers at the site and populations, both in Fukushima and throughout Japan must be started now and continued for decades. The amount of radiation that has been released from Fukushima recently doubled from original estimates and the amount that will continue to be released is largely unknown." It is the consensus of the medical and scientific community summarized in the National Academy's report, that there is no "safe" level of radiation. Any exposure creates an increased risk of

cancer, as we've just been talking about, especially for children, they are much more vulnerable than adults to the effects of radiation, and fetuses are even more vulnerable. I thank you for the opportunity to speak today.

CHAIRMAN WEISENMILLER: Thank you for being here.

MS. KOROSEC: Next, we have Gary Headrick from San Clemente Green.

MR. HEADRICK: To tell you the truth, I don't know if I'm ready for this. That girl in Rochelle's last picture was my granddaughter and that's why I'm here tonight. You got me. I can't believe it. I'm founder of San Clemente Green and I represent about a thousand people in San Clemente, starting with my granddaughter, Isabella, and 8.5 million people that live within 50 miles of that San Onofre Nuclear Power Plant. And all of the things I've heard today are things I wanted to say, they're very practical, realistic, cost factors, but you've got to realize, this is not about money, this is about people and our lives and our livelihoods, and there's absolutely no reason we should continue talking about how to fix this industry. Put it away. Shut it down. Gosh! What are we thinking? That's it.

CHAIRMAN WEISENMILLER: Thank you, next comment.

MS. KOROSEC: Next, we have Dan Berman.

MR. BERMAN: Hello. My name is Dan Berman and I'm an interested citizen from Davis. I helped start a group called Coalition for Local Power, and we tried to edge Pacific Gas & Electric out of the power business in Davis and Yolo County, unsuccessfully, they spent $50 million beating us five or six years ago, and another $45 million last year to try to make it impossible to vote PG&E out of an area with just a majority vote, fortunately, they lost that.

But I – what's amazing to me is that the people in charge of nuclear power, or supposedly in charge, seem to be sleepwalking through a dream world. It's almost like a dinosaur devouring its own tail, you know it's going to kill itself sooner or later, you just don't know exactly when; maybe the same is true of the fossil fuel industry.

But, you know, after listening to Professor Monasky, Dr. Lamm, and Dr. Cochran, and Rochelle Becker, who is a hero of mine, I've only meet her once before, she is trying to say no to nuclear power. With the late John O'Connor, I wrote a book about 10 or 12 years ago called "Who Owns the Sun?" And we thought at that time that the people of this country had put the kibosh on

nuclear power. One thing that I would encourage people to do in Sacramento is look very carefully at a local example. You don't have to go to Germany, although, as we know, Germany just shut down seven nuclear plants, claims they're going to shut down the rest of them by 2025. Go to Sacramento's SMUD. SMUD did something stupid by permitting the ranch, Rancho Seco, in the first place. They couldn't get it to run right, but then they shut it down after a vote of the people. It's called Democracy.

And there's a very funny thing about SMUD, they charge 25 percent less than Pacific Gas & Electric for their electricity, and if you have a complaint, you can go and speak to the people who run SMUD, you just go to their monthly meetings. In any case, I think it's time to recognize that nuclear power is something that should simply be shut down and I realize the huge societal forces against it, not the least of them, the labor movement, you know, ILWU 1245 is always against any change in the status quo when it has to do with any nuclear power, public power, the same is true of the Utility Workers Union, but the main barrier is the power of the nuclear industry, the financial power, and I think it's time to really say no to nukes. Thank you very much for listening and I have some remarks that I

wrote up for the panel. Thank you.

CHAIRMAN WEISENMILLER: Thank you.

MS. KOROSEC: Next, we have John Burton.

MR. BURTON: Thanks to the joint panel for having this very educational hearing today. Just a little bit about my background, I actually -– my first job out of college was right here in the Solar Energy Office, and then I went on to start a passive solar energy and hot water company, it's been my successful career here in Sacramento, in Northern California. And I'm glad that Dan Berman just focused you on the advantages of local control, right here in Sacramento with SMUD, our wonderful public utility. And I'd like to point out that, to my knowledge, SMUD was the first utility after they shut down Rancho Seco to finally put their spent fuel into dry cast storage. I was over there running for the SMUD Board, I was almost elected about 20 years ago to that Board, and at that time they were able to put their spent fuel on site into dry cast storage because they couldn't send it to the Federal Government.

So, there's just two other things I want to talk about, which came up today, the spent fuel ponds and their hazards, and the fact that dry cast is at least the first step in making them safer. But I'm confused

because I heard earlier today, at the beginning someone said, one of the experts said, “Oh, there was no problem in Fukushima with the spent fuel pools,” as a statement, okay? Well, and what we’re trying to figure out is what kind of sleepwalking is going on here and what is the truth, and has it really been enough time to find out? We need to find out. Because, then, I also heard that – the next expert said, “Well, there was no damage to no. 3 and 4 ponds at Fukushima,” and his wishful thinking was that – and he said, “Well, but – anyway, 1 and 2, and then, I’m sorry I’m not stating this clearly, but then the last expert was saying there certainly was something wrong with no. 4, even though the previous expert said there was no problem with 4, so they’re getting their numbers mixed up, or they’re looking at different aspects of the spent fuel problem. I mean, we know at least the building falling into the spent fuel pools, and of course it did come out how over crowded these pools are now, both in this country and around the world. And so – and one last comment has to do with comparative studies of different power sources and, you know, my pitch is going to be for renewable energy, I started out advocating the solar tax credits, and that’s how I got my job here and started my work with solar energy, and you know, even though we’re not the leader

now, we were the leader then in promoting solar energy and renewable energy, and maybe we need to catch up to Europe and China, now.

So nuclear power plants are not just a site where you burn the fuel into plutonium, but it's also where you enrich uranium all across the west, and how do you separate that from the Defense Department and all the nuclear bombs? But I'm sure you could come up with a rational comparison. The Energy Commission is expert at that. And so I would just propose that you settle this insane people looking at different sides of the elephant and wishful thinking that their industry, that they're the most vested interest in, they can't possibly see how the other technology would do it much cheaper and must more environmentally preferred, and it's also hard for me to even stay calm because it's a very emotional issue and I thank you for getting up and showing that a lot of us have focused our careers on providing you the alternative -– let's get to it. When we mass produce solar, the price is going to go down, and you know it. So let's start being the leaders again. Shut down those plants.

CHAIRMAN WEISNMILLER: Thank you.

MS. KOROSEC: Next, we have Barbara George, Women's Energy Matters.

MS. GEORGE: Good afternoon, Commissioners. This is the chart that the other gentleman was speaking about, actually, and I don't even know him. And I've included three documents that my organization, Women's Energy Matters, has filed in the Long Term Procurement Proceeding as the other commission down there in San Francisco, the California Public Utilities Commission. My organization is called the Women's Energy Matters and I wanted to call your attention to some of the issues that we brought up in these documents. Eventually, this is a proposal that has made to -- I don't know who to give these to, so I give them up to you -- but I made a little packet of each one of them for everybody.

Our proposal, which we made May 4th, is to immediately quit using power from the nuclear power plants in California so that they can be shut down, and replace that power with energy efficiency, Demand Response, renewables, and other preferred resources, to the extent that we know how to use those now, which is much greater than we ever had before, and it's time, the Governor has proposed to have 12,000 megawatts of distributed generation, and Chairman Weisenmiller, I actually filed a comment in the June meeting on distributed generation, I was the person who asked the question of someone at the time about the fact that PG&E

doesn't know where their energy efficiency and solar photovoltaics are. And I said, "Well, wait a minute, you know you are the ones that hook those solar panels up to the grid, and you know where your energy efficiency is because you put it there." So I'm asking the Commission to order the utilities to actually track and report where the clean resources are on their distribution system, so that those will be counted along with what's on the transmission system. Though there are issues that certainly are coming up in the Long Term Procurement Proceeding, that's what they were supposed to be looking at is how to use preferred resources, and there are a number of parties that are offering a lot of great ideas, I think that this can be done, and I just have to say, I had a little déjà vu when I was reading PG&E's 750-page, you know, response to your data request, and trying to find all of those other reports that were referenced, but that they did not supply. I kept thinking, you know, this is reminding me of something, they're claiming that there can't possibly be a bad accident at the Diablo Canyon Plant, and it's like what does this remind me of, and then I realized, "Oh, I know, I'm from Marin, and they claimed that nobody could ever supply more renewable energy than PG&E at the same price," but we have managed to do that in the first year

of Marin Clean Energy being –- breaking off from PG&E's system. We have actually produced 26.5 percent renewable energy, PG&E only made it to 17 percent, and we have kept our rates stable, we actually dropped them this year, and so they were the same as PG&E's when we started, Marin Clean Energy started to produce power. So I was thinking that, you know, in the same way that PG&E said Marin Clean Energy can't possibly happen, they also say that a bad accident at Diablo can't happen. Unfortunately, I don't think that their claims about Diablo are any truer than they are in terms of Marin Clean Energy, it's sad to say.

In the rate case last year, I noticed the little piece, something that they wanted to replace, it's called the Westinghouse Hagan 7100 Process Control System, it's become antiquated and obsolete, this is 1970's analog technology, difficult to maintain, Westinghouse doesn't have parts anymore, okay, so what does this technology do? It's actually what allows you to monitor and control the reactor. So, it's not working very well. And they are going to be only the second utility in the country that is going to do this digital replacement, all of Japan's reactors actually were retrofitted with this digital, so it can be done, I'm not saying it can't be done, but this is what we are

running on today. I think that we really have to consider the risks that we're taking, all the information that we heard this morning really added up to "we don't know enough to know that we are safe." We do know enough to know that we are in very grave danger. And why are we doing this? I mean, we've got the other types of technology. We have people raring to go to develop a clean energy system. We can produce tremendous amounts of jobs and work locally, kind of really put California on the forefront of developing a new clean energy system, and isn't that what we really want to do? We are going to have to take care of the nukes for the next 100,000 to 200,000 years, humanity has only been around for 10,000 – I mean, we only have like 10,000 years of recorded history, and we are playing with a technology that has to be kept away from living things for 100,000 to 200,000 years, I mean, I think this is ridiculous. And we really have to face the fact that we don't know enough to play with this particular toy right now. I think what we need to do is treat our children a little bit better and consider the fact that we just don't know how to -– how to keep ourselves safe with these power plants running in this planet where we have earthquakes and people who make mistakes, and you know, with all the best will in the

world, or some people don't necessarily have the best will, maybe not, but we have such incredible ability to create and make something good, and that's really what I want to see us concentrate on.

CHAIRMAN WEISENMILLER: Thank you.

MS. KOROSEC: Next, we have Carol Brouillet. Carol, are you here? All right, I think we may have lost Carol. Ben Davis, Jr.?

MR. DAVIS: Thank you very much for the opportunity to address you. It's a privilege and a privilege to be amongst some of the cream of the crop of the nuclear resistance in this state. It's an emotional issue for all of us. I'm sorry? Closer to the mic? How's that? I'm the proponent of an initiative in California 110008, which would close the nuclear power plants if passed by the people, the voters of the State. As you may know, drafting such an initiative requires navigating through the Federal preemption issue that you've discussed very much today. I gained my knowledge of it from pursuing a court case against Sacramento for their adoption of their nuclear response plan in 1983, pursuant to Government Code 8610.5, to California Government Code, and it was California's response to the Nuclear Regulatory Commission's, really, lack of leadership in creating realistic nuclear response plans.

And, in fact, it doesn't seem to be common knowledge that when we first had this proposed, Government Code 8610.5 contemplated the 35-mile evacuation zone, but that was narrowed down partially because of a lobby by the nuclear industry, and also partially because of the PG&E vs. California case that established nuclear preemption.

I sent in, I provided the comment yesterday that evidently hasn't been posted yet, on my belief that a 50-mile zone is within the state's regulatory capacity if it's done for economic reasons. I'm not going to go into it more, but you're welcome to ask questions about it.

More, my reason to be here today is to ask for the Energy Commission's assistance in getting realistic answers to the economics of nuclear power in California at the moment. I asked for this assistance through your Public Advisor's Office several months ago when I first filed the initiative because, as you may know, when you file an initiative with the Attorney General, they provide it to the Legislative Analyst's Office to get a fiscal analysis of how this measure will affect California financially if passed. I had a brief discussion with the Legislative Analyst's Office and they asked me some question about replacement power. I

turned to the Energy Commission because, reading your mission statement and reading all those things about you that defines who you are, you seemed like the likely authority on this. In my mind, if you didn't know where the replacement power would be coming from, and whether or not California could realistically replace those plants, you should. As it was, I was told by the secretary that answered my call that it created quite a stir to get this question in the Energy Commission, eight people I counted once I did a Public Records Act request and got the emails they all sent each other, consulted on this issue, and then I got a response by phone. I was driving my car, even though I'd asked for an email, I got it on my cell phone, and I was told that basically California could shut the nuclear power plants down today and we had enough replacement to do it without blackouts of any kind. Some questions in my mind ran that I didn't even know to ask, like I didn't realize how much San Onofre, the Grid in Southern California was dependent on San Onofre. I said, "Well, is that a problem?" I want to emphasize that each one of these questions I asked, I looked for yes or no answer, and then an explanation. Clearly, after this conversation, what I found was the graph that you were given by one of the previous speakers, showing that we

had enough energy to close the nuclear power plants down without rolling blackouts, was the truth. I asked if I could get an email recanting this and I was told I could. I didn't believe it, but I was told I could. I waited a couple of days and when the email came, they recanted, they said, "We can't say any of this on the record."

I want you to understand my amazement that you don't already know and have this answer, given your mission statement and who you report to, including, as your mission statement says, the people of California. The fact that you didn't have an answer to this immediately in writing that I could give to the Legislative Analyst's Office is nearly beyond my belief. But the reason I'm here today is to ask you to provide that to me.

One more point I'd like to make on this. When I got the Legislative Analyst's Office analysis, I said, "This reads as if it were written by the Nuclear Industry." "Rolling Blackouts that are going to cost the State billions of dollars, at least," it says, "…annually if we close these nuclear power plants." When I got the answer to the questions that you asked of the utilities, I found that every fact was written by the nuclear industry. It reads exactly like San Onofre,

the Southern California Edison's answer. It says the exact same things, almost to the place where they put the commas. That's not what I deserve. I cannot go out with that kind of misinformation on a petition and have a realistic chance of bringing accurate information to the voters and get them to vote in an educated manner. I'm turning back to you and I'm pleading with you, tell your staff to deal with me, to answer this question not only for me, but for you because you can't make the recommendations you've been asked to make in these proceedings without this information. I need it and I need it quickly. I'm not making demands here, I'm really asking you if you can do that for me. I believe that the first conversation I had with your staff was real, they were educated people, they knew what they were talking about, and what I want is, if I get this question back before the Legislative Analyst's Office, your staff to have just as frank a conversation as they had with me, with them. Thank you very much.

CHAIRMAN WEISENMILLER: Thank you. I was going to note that I believe the Blakeslee Report that was done for this agency a couple years ago addresses that question, although certainly some of this question besides the transmission impact have not really been studied in Southern California since about – it was 2001

or so when it was reviewed as part of the steam generator replacement issues. So, thank you.

MR. DAVIS: I'll look into that. May I just respond that, if those things are the case, Legislative Analyst's Office was not able to dig them up. I'm hoping that, as I said, when they do another report, this office and comments like that, that I knew to make, will be provided to them. Thank you again.

CHAIRMAN WEISENMILLER: And it's sort of subject to check my memory on that report.

MS. KOROSEC: All right, next we have Robert Anderson.

MR. ANDERSON: Good afternoon, Commissioners. My name is Bob Anderson, I'm with the California Seismic Safety Commission. I'm here on my own behalf though, today, and not for the purpose of any commission. I used to work here at the CEC from 1999 through 2001, the spring. And one of my first projects here was working on a program called PIER as I was assigned from the Engineering Office to work on this earthquake problem. And it was called "Electric System Seismic Safety and Reliability Project," is a program with an entity at the University of California, Berkeley, called the Pacific Earthquake Engineering Research Center, it was sponsored by the Earthquake Engineering Research Facility, there

are three of them in the United States. And we had a partner on this, a contractual partner, which was Pacific Gas & Electric Company. There were two contracts issued. I inherited the last dregs of the first one, just by the sheer timing when I came to the Energy Commission, and then right after the Coachella Earthquake in 1999, in Turkey, that significantly damaged the transmission system in Turkey, Western Turkey, in particular, the Energy Commission had approved a second follow-on project, still with Transmission Distribution Systems for California. And again, that was a pass-through contract through PG&E, a user with experience, but also worked with Bonneville Power Administration, WAPA, Western Air and Power Administration, Southern California Edison, and San Diego Gas & Electric Company as advisors and stakeholders to this particular project. And we worked on vulnerability issues relative to transmission distribution systems, but not power generation.

One of the issues that we did not tackle on either project was tsunamis, at all. It was not on the table at that time, not on the radar. Now, we have power plants up and down the State of California, as we did back then, that have issues related to seismic safety and reliability, for not only transmission and

distribution, but power generation and physical safety of the plant in their communities.

One of the issues I'd like to invite you to reconsider is via PIER or whatever other mechanism that you may consider appropriate, is to reengaging what the electric power industry and earthquake industry and looking at appropriate issues to try to resolve vulnerability issues and risk management issues. And as you saw here today, there are significant holes and geological hazards issue to make a risk equation together with vulnerability issues. With this being the case, I'd like to re-invite you to come back to the group and either as a stakeholder, or as a co-funder, and help identify what your issues are that you have that aren't covered by Southern California Edison or Pacific Gas & Electric, and then have them addressed by an independently peer reviewed and fully vetted organization. Thank you.

CHAIRMAN WEISENMILLER: Thank you.

MS. KOROSEC: Next, we have Richard Cohen.

MR. COHEN: Good afternoon. Good afternoon, and I do mean, really, good afternoon. Thank you for your patience and your listening to all this. My name is Richard Cohen, as I guess I said, I was trained as a Nuclear Physicist. I spent, oh, 10, 15, 20 years

working around laboratories where there were reactors and accelerators, and all that stuff. I'm not afraid of nukes, any kind – for me. Thank you. I believe, I'll make a very simple statement – I believe that reactive power now generated, or proposed for the future, could be supplied easily by a combination of solar photovoltaics, solar thermal, wind, and improved energy storage technologies, and some reductions in energy use from energy efficiency programs. All of these techniques are now in large scale use in the United States, in China, in other countries, and are being rapidly reduced in costs and installed in larger quantities, in contrast to reactors which are always increasing in cost, regardless of what the initial promise is. Okay? So that's an answer to one of the people here who wanted to know what do we do to replace the power. Well, Barbara George's response is, well, you don't need to for quite a while, and the other answer is that, there are lots of technologies that are just being sold every day. I have some on my house. Okay, now, the next step is that, I have to say, since I'm a supporter –- I'm not afraid of nuclear stuff, but I have to say that reactive power –- my principal concerns about nuclear power come from what I think of as the Faustian Bargains. Everybody has heard of

Faustian Bargains. Faustian Bargains is when you sell your soul to the devil for something and you don't read the fine print, and it looks fine for a couple of years, and everything is happy, everybody is happy and you have lots of money and lots of fame, and then at one point the devil comes back and says, "Pay up." And you look at the fine print and, sure enough. Well, when I look at what is going on with nuclear reactors, it's the Faustian Bargain, only it's not one bargain, it's not one deal you would have reactors and, oh, I'll get – I'll get waste disposal; there are a dozen or more of those things. In fact, I learned a new one today. One of the Faustian Bargains is emergency planning zone, I didn't know that word before I came here today. And when I listen to all of the complaints that people had, most of them were about things that I would simply call another Faustian Bargain. And it's just amazing how many of these things there are and how enormously important they are when you actually get down to do it, and I will take the opportunity that other people have been using, of putting a little bit of personal stuff in here. When that thing started happening in Japan, I had a call from a long lost cousin who lives in Japan, is raising a family there, and she remembered that I had a nuclear physics background, and she emailed me and asked

me for some of the questions that were going on in Japan, where she was getting information in Japan, and she called me to get the straight -– I'm sorry -– she couldn't get the straight story, a story that she could believe. And what we're seeing now is that the whole trust relationship in Japan has been destroyed. There is a -– I'm sorry -– there's a three-page written document which will be in the record and it does contain specific references and specific stories, they are -- Science Magazine has done an extremely good job of describing all these problems and showing really how bad the situation is. So, take a look. Thank you.

CHAIRMAN WEISENMILLER: Thank you for your comments.

MS. KOROSEC: Next, we have Eugene Rule. Eugene? All right, Jackie Cabasso, oh, she had to leave, all right. David Gray.

MR. GRAY: Hello, my name is David Gray. I'd like to first of all thank the Commission for holding these hearings, they are incredibly valuable, incredibly informative, thank you. And I wonder why. My name is David Gray, I'm a volunteer on the Sierra Club California Energy and Climate Committee. I have a Bachelor's Degree in Physics from Oberlin College, and have been inside two nuclear plants over the course of

my life, the Sequoia Nuclear Plant in Soddy-Daisy, Tennessee, while it was under construction, and the Crystal River Nuclear Power Plant in Florida in the ‘90s, while that was operating. Sierra Club California Energy and Climate Committee has deep concerns about what we’re hearing about the relaxation of regulations by the NRC, and Mr. Boyd, I really appreciate your relaying your experiences over the past nine years with that organization. The AP, Associated Press, who has published an in-depth study on June 19th of 2011 which states in part, “If you found proof that aging reactors have been allowed to run less safely to prolong operations, that equipment has approached or violated safety limits, regulators and reactor operators have chosen to loosen or bend the rules. Last year, the NRC weakened the safety margin for acceptable radiation damage to reactor vessels for a second time. The standard is based on a measurement known as the ‘reactor vessels reference temperature’ which predicts when it will become dangerously brittle and vulnerable to failure. Over the years, many plants have violated or come close to violating the standard.” We just heard about one of the Diablo Canyon reactors fitting this profile. “As a result, the minimum standard was relaxed first by raising the reference temperature 50 percent,

and then 78 percent above the original, even though broken vessel could spill its radioactive contents into the environment." It continues quoting an engineer: "Many utilities are doing that sort of thing," said Engineer Richard T. Leahy, Jr., who used to design nuclear safety systems through General Electric Company, which makes boiling water reactors. To quote him again, "I think the vulnerability is on these older plants." Sierr Plant. The Diablo Canyon Nuclear Reactor Seismic Retrofit implementation would be exceeded by a magnitude 7.2 earthquake, a few hundred feet away from the reactor on the newly discovered Shoreline fault. Seismic retrofit design is supposed to withstand a 7.5 magnitude, 735.5 miles away on the Hosgri fault. The Shoreline fault was discovered in 2008 by Dr. Jeanne Hardebeck of the SGS, it connects to the Hosgri fault, and faults that connect can trigger and magnify if nested into each other, according to Dr. Hardebeck, who is an award winning geophysicist.

In contrast, we ask the CEC to inquire to NRC Region IV Administrator, Elmo E. Collins, Jr., regarding his being quoted in the San Francisco Chronicle on July 17th that the seismology around Diablo Canyon has been thoroughly studied. We'll send you written comments with supporting references for these facts. And thanks

so much for your time.

CHAIRMAN WEISENMILLER: Thank you for being here.

MS. KOROSEC: Next, we have Pedro Morillas.

MR. MORILLAS: Good afternoon. My name is Pedro Morillas, I'm the Legislative Director for the California Public Interest Research Group. This is an incredibly important discussion today. There have been a lot of lessons that we've learned from the Fukushima disaster, but perhaps the most important one is that you can't actually plan for every contingency, especially when it comes to nuclear power. Given the unique location of our plants here in California, on or near earthquake faults, the lack of a plan to move the waste that these plants produce off-site, and the increasing age of these plants, and then given the dangers posed by a nuclear accident to public health and safety, not to mention the potential cost to consumers and ratepayers of an unplanned shutdown of our two nuclear plants.

We urge the CEC to create a plan for the orderly retirement of California's nuclear power plants by the end of their licenses at the very latest, if not sooner. And then, we have also –- I forget the year of it now, but a couple years ago we released a report about the actual cost of nuclear power as compared to things like

wind, solar, energy efficiency, and I'd like to submit it for the record and for you all to take a look at that at your convenience.

CHAIRMAN WEISENMILLER: Thank you, yeah, please submit that for the record.

MS. KOROSEC: Next, we have David Weisman.

MR. WEISMAN: Good afternoon, Commissioners. My name is David Weisman and I'm with the Alliance for Nuclear Responsibility. Thank you all for hanging in there for what's turning into a really, really long day. You know, you're here long enough in the course of a day, and there's two people left, you begin to feel like home. I'd like to start by thanking Ms. Korosec, Ms. Byron, the support staff for this event, and for saying some of the most important things at this meeting, the things that she very much began with. I have a couple of housekeeping things I'd like to get out of the way, and what she said was, "You can call in on the phone, it's going to be recorded, it's going to be Webcast, and it's going to be transcribed." You don't know how important those few simple words are to those people in the advocacy community. By way of explaining, who is conspicuous by their absence today, but not by reference, that being the aforementioned Nuclear Regulatory Commission. Just to give you an example of

how important this is of service to the public, these very few simple housekeeping chores that were just dispensed with so causally at the beginning. Two weeks ago, the NRC held a conference call on a very important issue: Pacific Gas & Electric is attempting to change the design basis license for Diablo Canyon, an amendment request so unusual that one of the NRC's own resident inspectors said it was unprecedented, and they had no idea what was going on. The conference call was held at 7:00 in the morning Pacific Time, even though we asked them to hold it a little bit later. The call was not transcribed, the call was not recorded. And now, a month later, we've received a one and a half page summary of the entire two-hour technical conversation, the last page of which explains that Ms. Becker complained that the meeting wasn't recorded or transcribed. All of which is to say that we very much appreciate the ability of this Committee to turn around transcripts to provide and create a good substantial record for the people of the state to use. Not to belabor the point, how many NRC Commissioners does it take to screw in a light bulb? None, because the probabilistic assessment is the light isn't going out. And yes, there will be more, or stop me before it gets too late. But, no, seriously, folks, I've always wanted

to use that line at an official hearing, a phrase we heard used over and over again today was talked about, station blackouts that seemed to be a very big topic of concern, the station blackout. How much time can a nuclear power plant continue to exist safely without connection to the Grid? And what I'd like to propose, and I think bear merit, is let's just take that word and change it a little, "station Blackout," how long can a reactor exist without power to the grid? Why don't we take that word and make it "State Blackout?" I heard no mention today from the utilities or any of the presentations, how long could the State last without electricity coming back into our grid? You see, all the concern today was going in one direction, "if reactors get cut off, what happens to them?" What I say, in expanding the discussion further, and keeping in mind the economic arguments that Commissioner Boyd made, "How long does the rest of our State last without electricity coming back from these nuclear plants?" And that – the Japanese situation, you have to remember the economic damage and the claims we've heard may have to do with property damage. We also had the shuttering of factories, Toyota did not introduce their new line of Priuses they have planned because that factory was closed -– not because of contamination, not because of

nuclear fallout, but because they did not have the electricity to keep that factory open. And so, while we do express concern for safety and so forth on the effects of a station blackout, you as the energy planners for the State of California should look at the reverse scenario, what happens when we don't have the electricity coming back?

At the April 14th hearing held by Senator Padilla on the State of Nuclear power, the representatives, who are no longer here, Loren Sharp of PG&E and the representative from Edison, were asked by Mr. Padilla, "Let's say we had a Fukushima accident. How many days backup power do you guys have?" And there was a little hemming and hawing, and the Edison representative said, well, they think they had about two days before they'd have to turn to the spot market. Yeah, you knew it was coming, you all know what happens when you have to turn to the spot market in this state, we don't have to remember that, and the representative, Mr. Sharp from PG&E said he wasn't exactly sure, though they had planned for these things, and after all they always had some power from the Helms pumped hydro project. Now, I know there is probably some law of physics about water going downhill can only trickle so far before it has to be pumped back up. Again, so all I

can say is they had no plan, they told Senator Padilla they would get him answers, I checked with the Senator's office even a month ago and they had received no answers in return.

So that is my only request, is you look at the reverse scenario of how long our state could exist without the power coming back. And that plays, of course, into the request to examine a future without this baseload generation. Thank you very much for your time today.

CHAIRMAN WEISENMILLER: Thank you.

MS. KOROSEC: Next, we have Melody Barclay. Melody? All right, Mary Beth Brangan.

MS. BRANGAN: Hello. I'm Mary Beth Brangan from the Nuclear – I mean, we were the Nuclear Democracy Project, actually, that's what we started out as, and we've evolved it to the Ecological Options Network, EON. And I'm here today to thank you so much, I feel you really care. And I'm so gratified because I think our culture and our world will divide time from before Fukushima and after Fukushima because of the incredible implications, particularly with the concurrent push for a nuclear renaissance.

I just wanted to make a couple of points. First of all, I was puzzled by no mention -– maybe it was

mentioned and I missed it -– but that the water pipes had been broken to the Daiichi Plant reactors immediately after the earthquake, not the Tsunami, but the earthquake broke those water pipes, and that the meltdown began immediately, that’s what was reported in many places, anyway. And so I’m curious about that because, of course, the nuclear industry has contended that it was the Tsunami and not the earthquake that caused the major part of the problem.

On another fact that I really would appreciate everybody considering is the fact that we here along the West Coast have received a massive amount of the radionuclide’s from the fallout, from the rain that came precisely when that cloud passed over and it, of course, really impacted all along, from Vancouver, Seattle, and on down. And there’s no monitoring being done. We need -– we desperately need monitoring to know where those hot spots are. I don’t know whether that’s in your purview, but we must must must be responsible enough to locate where the areas are that should not longer be used for growing, we should be able to say these cows are producing milk that can be consumed by our children, you know what happened to the contaminated areas after Chernobyl and to the children who consumed the contaminated products from those areas. It’s hideous

that we are not being told. Please help us with the monitoring. I'd like to speak to you about suggestions that you might be able to make to me and to others who are very concerned about this and want to see what can be done through the government. We're at the stage now where the biomagnifications through the food chain is occurring and we need to know.

One more thing is I'd like to suggest that people can receive a very good report that's just recently been produced by the International Forum on Globalization on why nuclear power is not the answer to climate change, by Gareth Smyth. Thank you so much.

CHAIRMAN WEISENMILLER: Thank you.

MS. KOROSEC: All right, our last blue card is for a gentleman who was not able to attend in person, Frank Brandt, but who asked that his comments be read into the record.

MS. JENNINGS: Good evening. I'm Jennifer Jennings, Public Advisor at the Energy Commission, reading Mr. Frank Brandt's statement, he is from San Jose: "Today, the Energy policy of the state is unbelievably bad. It started years ago when the State shifted from regulating the State's electric utilities to managing them. The Legislature, egged on by special interests, decided that it knew how to do this. This

was a big mistake because the Legislature had no more talent for energy management than it did for managing taxpayers' money. A series of bad laws has been enacted, culminating in AB 32. For some obscure reason, the Legislature has asked the CEC to review the State Energy Policy. The CEC has consistently told the State that its energy policy is fine. Why? The State's principal electric energy problem is that it has insufficient in-state reliable 24/7 generation to meet the public and industry needs. This is caused by the State's mismanagement of new plant construction. As a result, the State has to import much of its electricity and California money is sent out of state to pay for it. When low Columbia River flow reduced hydro power, the state had to scramble to find energy from other out-of-state sources. This gave the energy gamers a chance to charge plenty, forcing PG&E to sell power below its cost, which led to bankruptcy. Now, with AB 32, the State, rather than facing the lack of reliable in-state power, is aggravating it by mandating the use of energy sources that cannot generate it. One of the worst errors of the Legislature bowing to special interests was to declare nuclear energy a danger to the public and ban further plant construction. Now, when they wish to reduce greenhouse gas production with AB 32, they are

not able to use nuclear energy, which is the only source capable of solving both the state's problems of reliable energy shortage, and reduced greenhouse gas production. The CEC can perform a great gift to the public and industry of the state by changing its policy, of promoting the state's anti-nuclear policy to promoting a pro-nuclear policy. The Governor and Legislature will object, but the CEC must find ways to educate them. This workshop should be devoted to the refuting of the tired old arguments of the anti-nuclear groups, which led to the ban on nuclear 50 years ago. The state already has two plants which have provided power with no problems and no greenhouse gas for years. France gets most of its electric power with no problem. Japan, despite the problems at Fukushima, which were caused by a Tsunami greater than what the plant was designed for, continues to rely on nuclear. China is building many nuclear plants. Watch: Germany will come to its senses sooner or later. Why is California, the ostensibly forward-looking state, the only holdout?" Thank you.

CHAIRMAN WEISENMILLER: Thank you. Do we have anyone on the line?

MS. KOROSEC: We have one potential on WebEx. Can you open June Cochran's line? June, are you there?

MS. COCHRAN: Yes, I am.

MS. KOROSEC: Could you go ahead and ask your question.

MS. COCHRAN: Thank you. Good evening, Commissioners. I want to thank all the panelists and I learned a great deal today. I am a member of San Luis Obispo Mothers for Peace, but today I'm speaking as an individual living within the evacuation zone of Diablo Canyon Nuclear Power Plant.

I continually read the Inspection Reports and see detailed information about ongoing and serious problems there. Dr. Lamm today brought up a major problem of human interaction with a huge complicated tower facility. And I just wanted to give you a few things that I've noticed, a lot of things like unlatched doors, several inspections in a row, a stuck rod that they couldn't figure out what to do with for 18 months, the fire protection system has not been green for years, there were 56 violations, huge fines by the state's own Department of Toxic Substance Control. And just these last four quarters, there were even 11 NRC cited violations, and one of the most disturbing ones to me is an adverse trend in problem identification and problem resolution. Let me repeat that – adverse trend in problem identification and problem resolution. That's really just asking for problems. This does not seem to

be going away any time soon, after hearing the words from different PG&E spokespersons at the last Diablo Canyon Independent Safety Committee meeting, they indicated that some of the problems -– and each one of these is a different problem that they found -– the procedure was flawed, there was guidance there on another one, and inappropriate analyzation [sic] of the system, an unresolved issue carrying over for a couple of years now, corrosion, long time degradation, a missed opportunity to see the vulnerability, and not installed in accordance with design requirements.

During a previous DCISC meeting, one of the committee members admonished PG&E by indicating there seems to be a lack of thoroughness, not going deep enough, a lack of senior leadership providing oversight. An inspection after the Fukushima disaster uncovered 20 problems at Diablo, alone, and an average of 200 issues are submitted to the Corrective Action Program every single week -– every single week -- 200 actions.

Okay, Committee Member Budnitz indicated that technology has increased 100-fold in the airplane industry and there would be many more accidents if the technology had stayed the same --

MS. KOROSEC: June, one more minute.

MS. COCHRAN: -- plant with aging parts that is

corroded and caused multiple problems. The planes with the old technology might have still been operable, but all of them had been taken out of service just as the aging nuclear power plants such as Diablo and San Onofre should be decommissioned. I urge you to do this for future generations. Thank you for your time.

CHAIRMAN WEISENMILLER: Thank you.

MS. KOROSEC: We have one more on WebEx, Patty Davis. Patti, your line is open.

MS. DAVIS: Yes, hello?

MS. KOROSEC: Yes, we can hear you.

MS. DAVIS: Hi, I just want to thank everyone for doing such a great job and being so thorough in all of their comments, like the last caller. I really learned a lot today, I really appreciate the hard work that people have been putting into this for years. I'm new to this process after Fukushima, I'm just a mom, and I'm very worried about my kids. I live in San Clemente and I very much appreciate how much people have been working at this for years. I'm probably like a lot of moms that -- they don't really know how bad this is until you examine it, we're kept in the dark. Now people are looking. And I really do hope that that changes the public view of how dangerous the nuclear power industry really is, from mining it out of the

ground, through what to do, and how to dispose of it. And I don't believe that there isn't alternatives, we live in the sunniest state just about in the nation, and I'm reading all the time about how Wall Street and other investors are investing in the solar energy, wind energy, and why not us? We could be -- we really need to have that as a serious option now, not just something that people are just talking about a bit here and there. I know it's a lot for people to think about, it is an emotional issue for a lot of us, especially those of us with children. And thank you again to everyone on the panel for your kind work, and all these years, and hopefully people like me who really haven't thought about nuclear power one way or the other in the past, will continue to wake up and notice, pay attention, and get involved, because that's what I'm planning on doing. Thank you, all.

CHAIRMAN WEISENMILLER: Thank you.

MS. KOROSEC: We have no other commenters.

CHAIRMAN WEISENMILLER: Commissioner Boyd, do you have any wrap-up comments?

COMMISSIONER BOYD: Well, just a brief comment thanking everyone for their participation, but in particular thanking the parties, the few who have stayed here until the end of the day, and in particular thanks

to the Commissioners and their Advisors for staying with us for the duration. This gives us a lot of food for thought and for discussion. It would be interesting to have more time to talk about some of the things that are going on that some of these people weren't aware of, but this is a hearing on nuclear power and not the other things, I mean, there is a law in the state that says were going to get 33 percent renewables and both agencies are working very hard to get there. The Governor has laid out some very strong goals for us and he even held a symposium yesterday on the subject. There is a lot of activity going on to try and address getting other forms of power in the state and I encourage folks to check the websites of the two agencies here for a lot of information about those things. But, in any event, I thank you all and we look forward to working together on this subject.

UNIDENTIFIED MALE SPEAKER: May I make one brief comment, very brief? We talked about the Renewable Portfolio Standard. Nuclear power does not come under the Renewable Portfolio Standard in California.

COMMISSIONER BOYD: Oh, I know that only too well. I was answering other people who said we need to do it with more renewables and just pointing out we have a pretty aggressive program in California for

renewables.

Commissioner Boyd: -- that's what I get for venturing away from the subject matter.

CHAIRMAN WEISENMILLER: Well, I was going to indicate that yesterday I was at the Governor's symposium, so in using Amory's metaphor, yesterday, and that was looking at Distributed Generation, that was sort of the soft bat, today we are looking at more the hard bat. The Governor certainly expressed his enthusiasm for renewables and also mentioned in passing, I just – one of the books on his shelf is Amory's book on nuclear power which, again, is what we're looking at today. But certainly, we appreciate everyone's contribution today, and patience, and I certainly want to thank my colleagues from the PUC for being here, and offer them the opportunity to wrap up, too. But, again, thanks.

COMMISSIONER FLORIO: I think this was a terrific day. It started out a little over my head, but it ended up with some comments that I'm going to take to heart going forward. Thank you very much for holding this hearing and for inviting me.

CHAIRMAN WEISENMILLER: Thank you for being here. Commissioner Sandoval?

COMMISSIONER SANDOVAL: Yes, and first and

foremost, thanks to our colleagues at the California Energy Commission, to my colleagues at the California Public Utilities Commission, Commissioner Florio, his Advisor, also Colette Kersten, who have been here all day, and special thanks to both the panelists and to the audience, both those here and those watching the webcast and listening. Yesterday, I was in San Diego, yesterday I drove by the San Onofre Nuclear Power Plants, so as you're talking about the evacuations, I drove on that evacuation zone yesterday, so we are very much thinking about these issues and their impact on people, as well as, you know, a lot of times we talk about power and the Grid, but the Grid is here ultimately to serve people. And we are here to serve people.

So, I thank you very much for you participation and really want to commend this committee, as well, for gathering this evidence and expertise that will allow us to engage an informed evidence-based decision making. So, thank you very much.

CHAIRMAN WEISENMILLER: Thank you. Actually, Suzanne, remind people when the written comments are due.

MS. KOROSEC: Written comments are due by August 2nd.

(Thereupon, the Workshop was adjourned)

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