Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: 2.206 Petition Review Board
RE Diablo Canyon Power Plant Unit 1

Docket Number: (n/a)

Location: teleconference

Date: Monday, April 29, 2024

Work Order No.: NRC-2805 Pages 1-39

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1716 14th Street, N.W.
Washington, D.C. 20009
(202) 234-4433

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

MEETING BETWEEN THE U.S. NUCLEAR REGULATORY COMMISSION PETITION REVIEW BOARD AND THE SAN LUIS OBISPO MOTHERS FOR PEACE AND FRIENDS OF THE EARTH REGARDING A 2.206 PETITION SUBMITTED ON SEPTEMBER 14, 2023

+ + + + +

MONDAY, APRIL 29, 2024

+ + + + +

The meeting was convened via Video-Teleconference, at 3:00 p.m. EST, Lynn Ronewicz, Facilitator, presiding.

PRESENT:

LYNN RONEWICZ, NSIR/DSO/ISB, Facilitator

NATREON JORDAN, NRR/DORL/LPL2-2

JAMIE PELTON, NRR/DORL

ON YEE, NRR/DNRL/NVIB

JOHN TSAO, NRR/DNRL/NVIB

JOHN WISE, NRR/DNRL

JAMES KIM, NRR/DORL/LPL1

DANIEL KING, NRR/DORL/LLPB

PERRY BUCKBERG, NRR/DORL/LPL2-2

ROBERT CARPENTER, OGC/LHE/SE

ALSO PRESENT:

DIANE CURRAN, Counsel to San Luis Obispo Mothers for Peace

HALLIE TEMPLETON, Counsel to Friends of the Earth

DIGBY MACDONALD, Professor in Residence, Departments of Nuclear Engineering and Materials Science and Engineering, University of California at Berkeley

C-O-N-T-E-N-T-S

P-R-O-C-E-E-D-I-N-G-S

3:00 p.m.

MS. RONEWICZ: Good afternoon. Welcome to this virtual public meeting and thank you for attending. My name is Lynn Ronewicz. I am an NRC employee and I will be assisting with meeting facilitation.

The purpose of this meeting is to provide the Petitioners Diane Curran and Dr. Digby Macdonald an opportunity to address the Petition Review Board, or PRB, and clarify or supplement the September 14th, 2023 petition regarding reactor pressure vessel embrittlement at Diablo Canyon Power Plant Unit 1 based on the results of the PRB's initial assessment of the petition. The PRB will then consider information obtained today in its final assessment of the petition's acceptability for further review.

The Petitioners may present information to the PRB, but this meeting will not include a discussion regarding the PRB's evaluation of the subject petition as this would be outside the scope of this meeting. I will provide a gentle reminder if we get outside the scope of the meeting. After the presentation members of the public and others may ask questions about the 2.206 process which will be

answered by the NRC staff.

As a general note please keep yourself muted unless you have been called on to speak or have the speaking role and please do not turn your camera on unless you are speaking, and then remember to turn your camera off. This will save bandwidth and allow the focus of the meeting to be on the specific individual who is presenting or speaking.

After introductions are made a presentation will follow after which time the opportunity for questions and comments within the scope of this meeting will occur.

Please keep yourself muted in Teams and if you dialed in on the bridge line, use the mute icon or dial star-6. Please only un-mute if you are in a speaking role. For phone --

(Simultaneous speaking.)

MS. RONEWICZ: -- unmute using star-5. Yes, hello. Everyone please mute your phones if you are not speaking.

Attendees will be called in order of hands raised at the appropriate time. At that time, speaking clearly and loudly, please state your name. And if you are affiliated with an entity, please state the entity.

A court reporter is transcribing this meeting. All questions, comments are to be made verbally for the court reporter to transcribe, and thus the Teams chat has been disabled. The transcript will become a supplement to the petition. The transcript will also be made publicly available.

Is the court reporter present and able to record the meeting?

COURT REPORTER: Yes, I am.

MS. RONEWICZ: Great. Thank you. I will now turn the meeting over to Nate Jordan, but again I just want to remind everybody please keep your cameras off if you are not in a speaking role and your phones muted. Thank you.

MR. JORDAN: Thank you, facilitator.

I'd like to thank everybody for attending today's meeting. My name is Natreon "Nate" Jordan, and I'm a project manager in the U.S. Nuclear Regulatory Commission, and also a member of the NRC's 2.206 Petition Core Team.

On September 14th, the Petitioners submitted a petition to the NRC seeking immediate closure of the Diablo Canyon Unit 1 due to concerns that the reactor pressure vessel could reach an unacceptable level of embrittlement well before

expected. This petition was referred to the Title 10 of the Code of Federal Regulations, 10 CFR Section 2.206 petition process.

The purpose of today's meeting is to provide the Petitioners an opportunity to address the Petition Review Board, or PRB as it's called, and clarify or supplement the petition based on the results of the PRB's initial assessment of the petition. The PRB will then consider any information obtained today in its final assessment of the petition's acceptability for further review.

Welcome, Ms. Diane Curran, Hallie Templeton, and Dr. Digby Macdonald.

PRB is a symbol for certain 2.206 petitions and typically consists of a petition manager, myself; a chair who is usually a senior executive service manager; and members of the NRC staff based on the content of the information given in the petition. The PRB chair for this petition is Jamie Pelton, Deputy Director of the NRC Division of Operating Reactor Licensing in the Office of Nuclear Reactor Regulation within the NRC. PRB members will introduce themselves shortly.

In addition I'd like to open this meeting with introductions. To better facilitate

introductions virtually I will read attendees' names.

Again, my name is Nate Jordan and I'm a petition manager for DORL. The list of the PRB members on the line: Jamie Pelton, On Yee, John Tsao, John Wise. Next NRC participants who are also involved may be James Kim, Daniel King, Dave Rudland, who is not on -- who wasn't able to make the call. Perry Buckberg as well, who is the primary 2.206 Petition Core Team member, as well as Robert Carpenter.

And so at this point I want to ask first of all are there any Licensee staff in attendance for this meeting?

(No audible response.)

MR. JORDAN: Okay. Hearing none, I also want to make known too that it is not required that members of the public introduce themselves as part of this meeting, however, if there are any members of the public attending this meeting and they would like to introduce themselves at this time, please feel free to do so.

(No audible response.)

MR. JORDAN: All right. Hearing none, at this time I will turn it over to the PRB chair, Jamie Pelton.

MS. PELTON: Hi. Good afternoon. As Nate said, my name is Jamie Pelton and I'm the Deputy Director of the Division of Operating Reactor Licensing in NRR.

Welcome to this meeting regarding the 2.206 petition submitted by Diane Curran and Hallie Templeton.

I'd first like to share some background on our process. Section 2.206 of Title 10 of the Code of Federal Regulations describes the petition process, the primary mechanism for the public to request an enforcement action by the NRC in a public process. This process permits anyone to petition the NRC to take enforcement-type actions related to NRC licensees or license activities. Depending on the results of its evaluation NRC could modify, suspend, or revoke an NRC-issued license or take any other appropriate enforcement action.

The NRC staff's guidance for the disposition of 2.206 petition requests is Management Directive 8.11, which is publicly available.

The purpose of today's meeting is to give the Petitioners an opportunity to provide any relevant additional explanation and support for the petition after having received the Petition Review Board's

initial assessment.

This meeting is not a hearing, nor is it an opportunity for the Petitioners or other members of the public to question or examine the PRB on the merits or the issues presented in the petition request.

During the question and answer phase the NRC staff may ask clarifying questions of the Petitioners and the Licensee. The Licensee may ask PRB questions related to the issues raised in the petition. And then the Petitioners and the Licensee may ask the PRB questions related to the 2.206 petition process in general. This is consistent with Management Directive 8.11, Section III.F.

No decisions regarding the merits of this petition will be made at this meeting.

Following this meeting the PRB will conduct its internal deliberations. The outcome of these internal meetings will be provided to the Petitioner in a letter.

I would like to summarize the scope of the petition under consideration and the NRC activities to date.

Diane Curran and Hallie Templeton submitted a petition to the NRC on September 14th,

2023, which was referred to the 2.206 petition process. The petition requested that the NRC immediately close Diablo Canyon Unit 1 and require the completion of tests and inspections of the pressure vessel, require the public disclosure of the results, require a public hearing and a determination by the Commission that Diablo Canyon Unit 1 can safely resume operation.

To provide some process background the PRB first evaluates petitions using MD 8.11, Section III.C.1., criteria for accepting petitions to assess whether or not further review is warranted. A petition must basically provide facts not previously reviewed and/or resolved by the NRC to warrant further review.

On March 8th, 2024, Nate, the petition manager, contacted Diane Curran and Hallie Templeton via email to inform you of the PRB's initial assessment that the petition did not meet the MD 8.11, Section III.C.1(b)(2) criteria for accepting petitions. The PRB's initial assessment was not to accept your petition for further review.

The concerns that were stated, or that were evaluated from your petition -- there were four primary. One, that the license amendment issued by

NRC staff to Pacific Gas and Electric, PG&E, by letter dated July 20th, 2023, extending the schedule for conducting surveillance of the Diablo Canyon 1 pressure vessel until 2025 poses an unreasonable risk to public health and safety.

The second concern was that the Licensee committed violations by not properly monitoring the condition of the Diablo Canyon Unit 1 RPV, reactor pressure vessel.

Three, that PG&E has repeatedly postponed additional surveillance and testing of the pressure vessel.

And four, that the Licensee should implement Dr. Macdonald's independent analysis-based recommendations regarding reactor pressure vessel integrity.

In the email the petition manager informed you that these concerns have previously been the subject of facility-specific or generic NRC staff review and that the petition does not provide significant new information that the staff did not consider in prior reviews.

The March 8th response also included that Diablo Canyon Unit 1 reactor pressure vessel will not reach the pressurized thermal shock screening criteria

in 10 CFR 50.61 until approximately the year 2032.

Also that the Licensee's current pressure temperature limits documented in Revision 16(a) of its pressure temperature limit report, or PTLR, are applicable beyond the current 40-year operating license period.

Three, that the final capsule required for the current operating license period, Capsule V, was withdrawn and tested which provided surveillance data representative of the reactor vessel beyond the end of its current 40-year operating license period.

And finally, while the PRB recognizes the efforts by Dr. Macdonald highlighted in the petition, the merits of the recommendations do not justify a change to the NRC's already conservative approach to assessing the integrity of the reactor pressure vessel.

The petition manager offered you an opportunity to address the PRB to clarify or supplement your petition in response to this assessment and you requested to address the PRB in this forum.

As a reminder for all participants, please identify yourself if you make any remarks as this will help us in the preparation of the meeting transcript

that will be made publicly available. Thank you.

Diane Curran and Hallie Templeton, I will now turn it over to you to provide any information you believe the PRB should consider as part of this petition. You have 50 minutes for your presentation. Thank you.

MS. CURRAN: Thank you, Ms. Pelton. I am Diane Curran. I represent San Luis Obispo Mothers for Peace. And on the phone with us today is Hallie Templeton, but I will be the attorney speaking for the Petitioners. With me today also is Dr. Digby Macdonald, who is our expert.

As you know, we are very concerned that the pressure vessel for Diablo Canyon Unit 1 does not meet NRC requirements for integrity and therefore we asked the Commissioners to order the shutdown of the facility pending testing of Capsule B. And that petition was referred to the staff for consideration. We still hold that view and we primarily wanted to give Dr. Macdonald a chance to address you on our technical concerns because of his great level of expertise on these issues.

At the bottom we have legal concerns here. As you know, we're in the Ninth Circuit challenging the NRC's failure to treat the 2006 license amendment

as having effect in the -- on PG&E, that we believe that license amendment which allowed PG&E to operate Diablo Canyon for an extra three years to recapture, quote/unquote, the term of low-power testing included in it a requirement to remove Capsule B within the current license term and included a finding by the NRC that the data that has been collected so far, including Capsule V, was credible and showed that the reactor would approach the reference temperature limits at or before the end of its operating license.

We've got that issue in the Ninth Circuit. I don't think -- I don't see a point in discussing the legal issues here, but there are six points that Dr. Macdonald is going to discuss with you today. I know we have 50 minutes. We would also like to leave time for you to ask questions of Dr. Macdonald, so we're going to try to keep it to a half an hour.

In brief, his six points are -- they relate to: (A) the creditability of the data that has already been -- from the capsules that have already been removed; (2) the inappropriateness of relying on the so-called sister data from Palisades; (3) that the extension of the ultrasound testing deadline was in fact significant and has an adverse effect on the NRC's ability to assess the condition of the pressure

vessel with respect to embrittlement; (4) that we disagree with the PRB about the relevance of the experience of the Belgian reactors; (5) the possibility that hydrogen-caused embrittlement is a factor affecting the integrity of the Diablo Canyon pressure vessels; and then that Dr. Macdonald's own calculations show that NRC and PG&E have not done an adequate job of assessing embrittlement of the Unit 1 pressure vessel.

Therefore, we continue to advocate for the immediate shutdown of the reactors and testing of the samples from Capsule B.

With that, I will turn the discussion over to Dr. Macdonald.

DR. MACDONALD: Good afternoon. My name is Digby Macdonald. I was born and bred in New Zealand, no nuclear reactors, and I came to the United States after having worked at the Atomic Energy of Canada Limited developing CANDU reactors. That was in 1977. I've held a variety of university positions at Ohio State University, Penn State University, and University of California at Berkeley from which I just retired at the age of 80.

My involvement in nuclear energy has been extensive for more than 50 years and it included the

development of the CANDU nuclear reactor and the issues related to activity transport and mass transport of those reactors. And then when I came to the United States I concentrated a lot on describing the electrochemistry of the coolant in the boiling water reactor and in pressurized water reactors.

And I just want to make sure that everybody understands that in a pressurized reactor you have a pressure vessel of a ferritic steel that is clad with a very thin layer, seven millimeters approximately of stainless steel. And that's in contact with an aqueous solution which contains a lot of hydrogen, 35 CCs per kilogram added to the pressurizer. And not only that, that hydrogen is radialized by both the gamma radiation and the neutron radiation, and in the case of PWR the alpha radiation from the boron reaction with neutrons. And those processes result in very high concentration of atomic hydrogen.

Now hydrogen can enter the steel only in the atomic form. And so under normal corrosion conditions if you have a cathodic reaction that produces what is called nascent hydrogen, that's atomic hydrogen on the surface on the steel, part of that hydrogen enters the surface of the steel and will

cause hydrogen-induced cracking and hydrogen embrittlement. And this has been a major concern and still is a major concern in the oil and gas industry, for example. In that industry they call that sulfide stress corrosion cracking, but it's all the same phenomenon of hydrogen-induced cracking.

I've worked on the theory of hydrogen-induced cracking and the data derived models that are quite capable of accurately calculating crack growth rate under subcritical conditions. That is when the stress intensity is lower than the fracture toughness of the steel.

In the normal nuclear energy field, which is dominated by mechanical engineers that tend to concentrate a lot on the fracture toughness of the material, but cracks grow at sub-fracture subcritical conditions with a stress intensity factor of about 11 K_{1c}. And that should always be taken into account because those cracks eventually become long cracks and if they have sufficient loading, K_1 will exceed K_{1c} and you'll get sudden failure.

But what I've done really is to introduce electrochemistry into nuclear reactor materials concerns, and for that I was nominated this year for the Fermi Award. I haven't heard whether I won it or

not. I was nominated in 2011 for the Nobel Prize for my development of the theory of passivity which explains why we can use metals in contact with an oxidizing environment. So I've taken a different tack to describing phenomena that occur in nuclear reactors and it seems to work very well.

I was retained by Mothers for Peace, San Luis Obispo Mothers for Peace via Diane Curran to provide some expert background on what was happening in Diablo Canyon. And the literature is voluminous of course and I must congratulate people such as Dr. Kirk for the magnificent job that they've done in describing fracture in these reactors.

I'd just like to add some additional comments that I think should be considered. So let me just pull up my -- so the first one relates to -- the danger from Capsules S, Y and V were determined credible by the NRC in 2006 license amendment decisions and show that Unit 1 would approach or reach an unsafe level of embrittlement at the end of the current operating license term. And in fact that can be found in Reg Guide 1.99, Revision 2. There's an addendum to that revision written by Dr. Kirk which lists the various reactors in the PWR fleet in the United States and gives the values for the RTNDT, the

so-called reference temperature, in relationship to the critical value of the RTPTS. And Diablo Canyon, after the end of the 40-year operating period, is at 269 or so degrees, whereas the critical condition is 270 degrees.

Now let me say a word about these critical conditions in the RTNDT. As shown by Easton, Mitchell, and Odette in CF 6551, these quantities are distributed quantities. In other words, if you had somebody make measurement -- 100 measurements of each at the same time, you'd get 100 different answers. And if you were to plot those data, they would be described by a normal distribution. Well, that is what they claim. They don't actually demonstrate that it's a normal distribution.

Anyhow, normal distribution is characterized by a mean value, which is the average, which is the value that's quoted in the literature and in reports, and a standard deviation. And what is missing from and puzzling me -- so what is missing from all of this analysis is recognition that it's a probability problem that is described by a standard deviation in the mean. In fact two standard deviations in two means, one for RTNDT and the other for RTPTS. And so you can have RTNDT less than RTPTS,

but the wings of the normal distribution will overlap. And where they overlap that determines the probability of failure. Or the probability of an unacceptable condition, let me put it that way. But it will.

So I've just done the calculation. In fact, finished this morning in the wee hours. And what I find is that for a Diablo Canyon 1 look-alike, where I took as much of the data as I could from Diablo Canyon 1 -- but I had to guesstimate some data because some data were not available. At least I couldn't find it. If you use data up to 30 years, the measurement of RTNDT every 10 years, then you would project to come within -- you'd be less than RTPTS, but the wings of the distributions would go to that and you calculate that the so-called failure probability is 0.22.

And how this would be interpreted is as follows: If you have a weld that is 100 centimeters long in about 22 centimeters of that weld the RTNDT equals or exceeds the RTPTS. So even though the average value of RTNDT is less than the average value for RTPTS. So it's a question of probability. And that's not unusual. That phenomenon occurs all the time in natural systems and in corrosion and in

failure analysis and so forth. So I'm not introducing any new concepts here. It's well-described methodology in the literature. I just happened to apply it to this particular problem.

So that's first, but there's some other troubling things. When PG&E published the report on the Capsule V, they declared all their data to be not credible. And that allowed them to attempt to seek further licensing via 10 CFR 50.61, I believe it is. And so that's what they attempted to do. And what they sought to do was to use data from a so-called sister plant like Palisades.

But let me come back before I go onto the Palisades issue and just point out that they declared the data to be non-critical. Then in 2009, when they wanted to get a 37-month extension, as Diane Curran pointed out, the data became suddenly credible. Now NRC had declared the data to be -- or deemed the data to be credible in 2006, but I can find nothing that PG&E did would have caused them to change their mind. So this is somewhat troubling that an organization would declare a set of data non-critical and then later have it declared credible, want to use it argue for a life extension. So that to me is somewhat troubling personally.

But now let's go to the sister plant. They chose Palisades. Now if you look in the document by Dr. Kirk, the RG 1.99, Revision 2, table 4 -- or 3 -- table 3, I think it is -- where he lists all the reactors that have -- and gives the RTNDT and RTPTSs, the RTPTS of Diablo Canyon, as I said before, was 269 degrees, 1 degree less than the critical condition. But Diablo Canyon -- I'm sorry, Palisades had a value of 322 degrees Fahrenheit, well over 100 degrees over the -- well almost 100 degrees over the limit, the critical limit.

And so in terms of the existing embrittlement, in my opinion Palisades is much more embrittled than is Diablo Canyon. As you know, Palisades was shut down. Then it was bought by Holtec International and nobody seems to know what Holtec is going to do with it, whether they want to restart it, maybe get the pressure vessel a thermal anneal and then restart it. Nobody seems to know at this point.

So it was -- it's not a very good sister plant. For example, the plants are of completely different design. The Diablo Canyon plant is a Westinghouse PWR on a four loop design, which has four heat exchangers for the one reactor core, whereas Palisades has only two. So they operate quite

differently. And if you look at the operating histories, which we've done by digging up data from the International Atomic Energy Agency and International Energy Agency and various other sources, Diablo Canyon has been run more as the baseload-type plant, whereas Palisades' startup/shutdown history is chaotic, to say the least. And they had many, many shutdowns to zero power, whereas Diablo Canyon has -- tends to have shutdowns to zero power only during refueling. So they're quite different in their operating histories. In their energy availability they're quite different. So I've put together a lot of data to show that.

I had in fact intended to have some slides, but I just didn't have the time from when I stopped working on doing the calculations on the probability of failure until this morning.

So we would argue that Palisades is in no way a sister plant, but there's also something other -- something else which is a bit troubling. The way I read the regulations PG&E was supposed to first of all deal with the outliers according to letter GL 9201. And if there's a good excuse for excluding any of the outliers, they would -- they were to quantify what that excuse was. Well, this is a normal procedure in

science, by the way. And this was what the NRC was insisting that they do. But we find no evidence that they ever did that. Okay?

Now secondly, when they chose the sister plant, they were supposed to make the case to NRC as to why that plant was -- should be considered as a sister plant, but we can't find an analysis of where that was done. Now perhaps it was done and not published publicly, which I would argue would be improper, but it's certainly nothing that we can find. I stand to be corrected if somebody knows where that was published and done. I'd be more than happy to have a look at it. But as things stand at the moment, we're unable to find any case made by PG&E to NRC and NRC's approval that Palisades should be considered a sister plant of Diablo Canyon.

It's like the human race: I regard Palisades perhaps at best as a (audio interference) or a second cousin, but I don't consider it to be a twin. And even if it was a twin, just as human twins have the same genetic material, they grow up quite differently and they lead quite different lives.

My wife for example is a twin and she excelled and became a professor of nuclear physics in France and then a professor of engineering science and

mechanics at Penn State University when we were there, yet her sister did not excel in anything that she tried. And so the operating experience, both in human beings and in complex systems like nuclear reactors, say that you have to be very careful in choosing what you believe to be a sister plant, okay, because the operating history essentially determines the properties of the system. And the operating histories of those two plants are quite different and therefore they should not be regarded as being twins.

Now we believe that UT inspections, as they were scheduled over 10 years and not carried about by PG&E for 20 years, are very valuable inspections to have because what they detect is the formation of voids, fissures in the belt line region due to embrittlement. So the embrittling process itself involves knocking metal atoms out of their normal atomic positions, and those metal atoms are hot. That is, they have a lot of energy and they move through the lattice like a bull in a china shop.

And they knock other atoms out of position and so forth and you get a cascade of atoms produced and you also -- a cascade of vacancies. Now some of these vacancies are annihilated by the atoms jumping back into the vacancy to become an atom in a normal

atomic position from there being an institution. But many of the vacancies will diffuse quite rapidly through the lattice until they find a free surface. And the free surface may be at some metallic inclusion, for example, such as a manganese sulfide or maybe an intermetallic compound, a nickel/copper or a nickel/iron, or copper/iron, which by the way explains a lot, the debilitating effect of copper and nickel in welds.

Anyhow, they combine and they form voids. And if these voids are platelet shaped, as they usually are, they have a sharp edge at the periphery. Like a flying saucer they have a sharp edge around the periphery. And if they are then loaded with a thermal stress or a load due to a thermal stress resulting from a loss of coolant accident, for example with cold water suddenly being pumped into the reactor so that you get the pressurized thermal shock problem, because once you've got pressure being applied, then you can exceed $0K_{1sec}$, the stress intensity factor for slow crack growth.

And these cracks will grow slowly and their size, where the K_1 equals K_{1c} fracture toughness, then the crack will grow unstable. In fact, it may lead to failure and you get a characteristic bang, as

we all must have heard if you drop a glass on the floor. And that is caused by the shockwave of a fracture moving through the material. That is significant fraction at the speed of sound. So these events, these platelets form in a very embrittled material, that is a material that is approaching the RTPTS limit. And so it's very, very important that we in fact are able to detect these.

Now I bring up the Belgian experience, what Professor Walter Bogaerts at the University of Leuven in Belgian -- he's an old friend of mine. He asked me to team with him to look into the Doel 3 and Tihange 2 issue.

Now many of you may know that these reactors were built -- the pressure vessels were fabricated by a Dutch company, and I won't attempt to pronounce the name, that has since gone out of business. But the argument is that they forged the ingots into the rings for the reactor pressure vessel in a very humid environment. The moisture, HDO, reacted with iron to give you hydrogen plus iron oxide, and that hydrogen was retained by the steel. And it diffused to where the manganese sulfide inclusions had been smeared out by rolling the ingot from the vessel rings and this resulted in cracking

along with smeared manganese sulfide inclusions.

And that is a characteristic form of cracking, but it's also very characteristic of hydrogen embrittlement. But nobody in Belgium, in FANC, which is the equivalent of NRC -- they didn't want to hear any of this. Okay? And neither did Electrabel, the operator. They just didn't want to hear. Not interested. Didn't want to hear.

But we did get the ultrasound examinations and we found that not only the population of indications increase with time, but also the maximum size of the indications increase with time. To us that meant growing cracks.

Now, they immediately responded to us by saying, oh, no, no, no, no, no. Said the people are using better UT examination. Now all of a sudden they're finding more cracks. Well, maybe, but that -- they should be finding small cracks, not large or larger cracks. Okay? Not large cracks that are becoming even larger. They were characterized quite well by previous examination.

So we wrote all this up and made our case. They didn't even read it. Okay? They weren't interested. They just wanted to produce electricity.

Well, they hired SCK CEN to carry out some

experiments for them and that's the Belgian National Laboratory, if you like. And the Belgian National Laboratory people contacted the reactor operator and said, you know, there's something really funny about this steel. And it seems that they found evidence that what we had concluded was probably quite true. But nobody published it. It was never put into a report, certainly not the report that they ended up with the NRC and was disseminated to reactor operators in the United States.

So that was my experience. I don't see anything that changed my experience with that, and conclusions. In fact, I was in contact with Walter Bogaerts just a few days ago just to make sure that nothing had changed as far as he was concerned. He said no, nothing has changed, but the experience that you and I had with the Belgian reactors showed different that there are active cracks growing.

And that's what you would expect when you have hydrogen that is under radiolysis conditions and separated from ferritic steel by a thin layer of stainless steel. Hydrogen atoms go through stainless steel. Okay? And so that needs to be done.

I've done a lot of work on modeling the radiolysis of the coolants of PWRs and BWRs. In fact,

I finished about three years ago a DOE basic energy sciences project where I calculated all the radiolitic conditions in pressurized water reactors and boiling water reactors. And so we know a lot about the chemistry of these reactors, and also the electrochemistry, which is the driver of cracks. And we've been able to predict cracking in the stainless steel -- in the sense of stainless steel components in BWRs very accurately.

We've modeled something like seven or eight operating nuclear reactors in great detail, predicted where cracking occurred. And we were very successful in predicting for example cracking in the core barrel, in the welds, the upper welds in the core barrel. (Audio interference.) And we also were very successful in calculating crack growth rate and the conditions for crack growth rate for alloy 600 and cold work stainless steel bolts, alloy 182, and these gave rise to -- the cracking of 182 gave rise to the Davis-Besse problem where there was leakage of coolant into the annulus between the reactor head and the control rod drive tube.

And as many of you know, that resulted in corrosion of the pressure vessel. In fact there was an 18-inch diameter hole where the coolant was being

held only by the stainless steel liner. Okay?

MS. RONEWICZ: Excuse me, Dr. Macdonald. I don't want to interrupt at all. This is the facilitator. I just want to give a gentle time reminder that we're at 3:46 and I think you roughly have about 10 minutes for questions. So I apologize for interrupting.

DR. MACDONALD: Thank you. Okay. I'll finish very quickly.

Okay. My calculations indicate that the NRC and PG&E, in my opinion, have not done an adequate job of addressing embrittlement. You can only monitor embrittlement by making the appropriate measurements, and that's the purpose of these surveillance programs. And that reactor head started off with being initially a five capsule program that got reduced to a four capsule program. Then it became a three capsule program and then it became a four capsule program with the addition of Capsule B.

But they say they couldn't remove Capsule B, which is held in by its own weight, or at least the plug was held in by its own weight. There's no corrosion occurring in this system that would result in a thick oxide that would jam the plug in place. So I'm at a loss as to why they couldn't take it out.

And I've asked people has this problem ever occurred elsewhere and nobody has been able to point it out where it has. So we'll leave that one at that.

And so I believe that it's not so much what has been done at Diablo Canyon that concerns me. It's what hasn't been done. They did not follow the regulations as they were written down. Now they would appeal to get relief for a regulation and the NRC would grant that appeal.

But people who run these reactors are there to make money and things like surveillance programs and regulations and so forth, they're often viewed as getting in the way of the primary purpose, which is to make money. But that is contrary to a good safety strategy. And so, Lord forbid, we don't need another accident in a nuclear reactor in the United States because if it happens, you can kiss much of the nuclear industry goodbye.

So I will end with that. And if you have any questions, I'd be more than happy to answer them.

MS. PELTON: Thank you, Dr. Macdonald.

So I'd like to thank you and Diane Curran for your presentations and for taking the time to raise your concerns.

Oh, go ahead, Diane.

MS. CURRAN: Yes, hi. Thanks.

MS. PELTON: Sure.

MS. CURRAN: And thanks, Dr. Macdonald.

I just wanted to conclude with two things: First of all, some -- just a couple of really minor clarifications of what Dr. Macdonald said.

I think he referred to PG&E asking in 2009 for a three-year extension. Just want to clarify it was 2006.

And also Dr. Macdonald referred to a table 3 in Reg Guide 1.99. And it's the regulatory analysis that accompanied that Reg Guide where you will find that table. I just wanted to clarify that.

And then one more thing, which is that Dr. Macdonald has been corresponding with the Diablo Canyon Independent Safety Committee about his concerns. That is an arm of the Public Utilities Commission. And in the next few days we are going to be sending them a report that will discuss some of the things that he's discussed here and we will share it with the PRB. Thank you.

MS. PELTON: Thank you very much.

So again, thank you, Diane, thank you, Dr. Macdonald for your presentations and comments and for taking the time to raise your concerns.

The regulations in 10 CFR 2.206 provide an opportunity for the public to petition the NRC to take enforcement-related action, and the NRC understands that this process takes time and a lot of energy and resources by the Petitioners.

With that, I will turn it over to our facilitator for the question and comment portion of this meeting.

Lynn?

MS. RONEWICZ: Okay. We will now go to the question portion. First, we will ask if the PRB has any questions for the Petitioner, then the Licensee, if they are present, and then we will go to members of the public. I will call on you by name in order of hands raised. Please remember to speak loudly and clearly, stating your name first. And if you are affiliated with any entity, please state the entity.

I you dialed in by phone, please raise your hand by pressing star-5. And then once called on, press star-6 to un-mute yourself.

So at this time does the PRB have any questions for the Petitioner?

And we have a hand raised. Okay. Yes, Robert Budnitz, please go ahead.

MR. BUDNITZ: Hold on. Hello. Can you hear me?

MS. RONEWICZ: Yes, we can.

MR. BUDNITZ: My name is Robert Budnitz. I'm one of the three members of the Diablo Canyon Independent Safety Committee that was just mentioned three minutes ago and I want to make sure just to tell you that I'm one of the members. I have listened to this presentation. We have -- four of our consultants are also listening to this presentation, too, and we're trying to take it in so as to be sure we have as much technical information as we can get. As we interact, we -- as Digby Macdonald said, we intend to be interacting with them sometime fairly soon on the technical issues. Thank you.

MS. RONEWICZ: Okay. Do the PRB members have any questions for the Petitioner?

(No audible response.)

MS. RONEWICZ: Okay. If not, if the Licensee is present, does the Licensee have any questions for the PRB related to the issues raised in the petition?

(No audible response.)

MS. RONEWICZ: Okay. Does the Petitioner or Licensee have any questions about the 2.206

petition process?

(No audible response.)

MS. RONEWICZ: Okay. And lastly, before we conclude the meeting members of the public may provide feedback regarding the 2.206 petition process, however, as stated in the opening the purpose of this meeting is not to provide an opportunity for the Petitioner or the public to question or examine the PRB regarding the merits of the petition request.

Please raise your hand if you have any feedback or questions on the 2.206 process at this time.

Okay. Yes, Kevin Kamps, please go ahead.

MR. KAMPS: Hello. Can you hear me?

MS. RONEWICZ: Yes.

MR. KAMPS: Okay. This is Kevin Kamps with Beyond Nuclear and also Don't Waste Michigan, and I just wanted to express our full support for the efforts of Dr. Digby Macdonald and Diane Curran and San Luis Obispo Mothers for Peace.

We've been watchdogging the embrittlement of the reactor pressure vessel issue at Palisades in Michigan for many decades and we finally got the Nuclear Regulatory Commission to admit in writing in April of 2013 that Palisades was the worst embrittled

reactor in the country. Diablo Canyon Unit 1 was among the top five and now the top four because one of those, Indian Point Unit 3, has permanently closed thankfully.

And this is a tremendous safety risk and we fully support the efforts that went into this emergency enforcement petition. And I'd like to express my gratitude to all those who have worked so hard to bring it forward. Thank you.

MS. RONEWICZ: Thank you, Kevin.

DR. MACDONALD: Thank you.

MS. RONEWICZ: Are there any other questions?

(No audible response.)

MS. RONEWICZ: Okay. Well, we'll give it about 30 seconds just to see. And in the meantime -- so feel free to raise your hand if you have question on the 2.206 process.

I would like to ask though at this time does the court reporter need any additional information for the meeting transcript?

COURT REPORTER: No, thank you.

MS. RONEWICZ: Okay. And I'd also like to point out while we're waiting to see if there are any other questions or comments that we encourage the

participants outside the NRC to provide public meeting feedback to the NRC staff via the NRC public meeting web site. A link will be posted shortly after the conclusion of this meeting.

So again, we're at five minutes to 4:00. We do have a little time left. Are there any other questions or comments?

(No audible response.)

MS. RONEWICZ: Well, it appears there are not. So I believe we will go ahead and close out this meeting and we appreciate everybody who joined.

DR. MACDONALD: Well, thank you very much for giving me the opportunity.

MS. RONEWICZ: Thank you.

MS. PELTON: Thank you very much. Appreciate it.

MR. JORDAN: Thanks so much and great job, facilitator.

MS. RONEWICZ: Thank you.

MS. PELTON: Thank you.

(Whereupon, the above-entitled matter went off the record at 3:56 p.m.)