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NUCLEAR REGULATORY COMMISSION

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PUBLIC MEETING ON FILTERED CONTAINMENT VENTING ISSUES

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THURSDAY

SEPTEMBER 13, 2012

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ROCKVILLE, MARYLAND

The Public Meeting convened at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 9:00 a.m., Robert Fretz, Facilitator, presiding.

NRC STAFF PRESENT:

ROBERT FRETZ, Moderator
SUD BASU
TIM COLLINS
BOB DENNIG
DON DUBE
ED FULLER
KATHY GIBSON
RICHARD LEE
JOHN MONNINGER
ALLEN NOTAFRANCESCO

ALSO PRESENT:

JEFF GABOR
PAUL GUNTER
STEVE KRAFT
MARY LAMPERT *
MARK LEYSE *
DAVID LOCHBAUM
ED LYMAN
JIM RICCIO
RAY SHADIS *
MATT SOLMOS
RANDY SUMMERS
RAJGOPAL VIJAYKUMAR
RICK WACHOWIAK

*Present via telephone

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

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

P R O C E E D I N G S

(9:03 a.m.)

MR. FRETZ: I guess we are going to get started.

Good morning.

I would first like to thank all of you for your interest in today's public meeting. My name is Bob Fretz, and I am the NRC Project Manager for the staff's review of the issue of filtration of BWR Mark I and MARK II containment vents.

Today's meeting is intended to achieve two objectives. First, this meeting is essentially a followup to the meeting we held with the Electric Power Research Institute on August 8. At today's meeting, the staff will provide information about some of the analysis it has been performing regarding filtered venting. Specifically, the staff will discuss the MELCOR analysis of selected severe accident sequences for BWR Mark I containments and how the results will inform the staff's regulatory analysis of filtered venting.

But, secondly, during the August 8th meeting, EPRI provided an overview of work that was initiated and performed independently by the industry for the purpose of proposing alternatives to installing filters on MARK I and MARK II hardened vents to the

Commission.

While we await EPRI's more detailed report, which is expected shortly, the staff believes that the August 8th meeting was beneficial in beginning to understand the industry's position. That said, the NRC staff also wanted to hear from our other stakeholders. Today's meeting is intended to give members of the public an opportunity to provide technical insights on the issue of filtered venting.

Next slide.

First, a few administrative items I would like to go through first, as we always do at the beginning of most public meetings. But this is a Category 2 public meeting. Now members of the public are invited to participate in this meeting by asking questions of the NRC staff at the points identified in the agenda. In fact, at this meeting a good portion of our meeting is intended to dialog with our public stakeholders, as we will discuss the agenda.

But, again, for those who are participating on the bridge line, there will be designated points where they will be invited to ask questions of the NRC staff.

Also, for those of you who are attending in person today, please sign on the sign-in sheet before you leave the room today. It is located right around the pillar at the podium. A list of attendees and participants will become a part of meeting record.

And again, copies of the presentations can also be found in the back of the room. Now, in addition to the presentations that are there in the back of the room, there was a number of documents that were submitted to the NRC by members of the public that we have not made copies for. One of my last slides will show you some of the ML numbers that you can find those documents. There is one more document to be added into the record, and we hope to have that ML number before the end of today's meeting. It was essentially the slides for research in the afternoon. In fact, the last slide in your packet for today for my presentation will have those ML numbers.

Again, there are a number of documents that have been submitted to us regarding this subject. Again, we appreciate that input.

Okay. Next slide. We will go over the agenda.

Again, as essentially is shown in the agenda, the morning session will involve, again, some opening remarks by myself. But, essentially, the whole purpose of the morning agenda is to give an opportunity for members of the public, as represented by non-governmental organizations, and as well as members of the public on the phone or here in the audience, a chance to provide comments and ask comments of the NRC staff regarding the issue of filtered venting.

And then, following the morning session, we will take a lunch break. Right now, it is scheduled between 12:00 and 1:00. And then, we will reconvene at one o'clock to allow the Office of Nuclear Regulatory Research the chance to present some information regarding the analysis. It is performed in support of our regulatory analysis.

And then, following the presentation by Research as well as the discussions that might ensue regarding their work, then we will provide members of the public the opportunity to ask questions and provide comments.

And then, hopefully, before four o'clock, we will be able to wrap it up and work on that.

Okay. Next slide.

Now, as far as the morning agenda, we did receive some comments from Mark Leyse, who is a nuclear consultant. He prepared a paper on behalf of the Natural Resources Defense Council. That information was submitted to us.

Now, if Mark is on the phone, I will give him the opportunity to at least provide an overview of that information. Otherwise, I will try to paraphrase what he said on that.

In addition, we have on the schedule planned presentations from the Union of Concerned Scientists as well as Pilgrim Watch.

And then, following those presentations, I would like to take comments and questions and any input from any members of the public who are here in attendance today. And then, following that, we will go to the questions that we might get via the webinar feature, and then from the phone. So, hopefully, we can do that in that order, and then everything will operate pretty smoothly.

Next slide, please.

Okay. In December of last year, the Commission directed the staff to take certain actions regarding reliable hardened vents. They supported the recommendation that the staff had made to order licensees to include the reliable hardened vent in BWRs with MARK I and MARK II containment designs.

In addition, they supported a recommendation to form a more long-term analysis or evaluation on reliable hardened vents for other containment designs.

Next slide.

But, additionally, the Commission acted on a recommendation by the staff to take a look at the issue of filtration of containment vents. The Commission directed the staff to move that issue and merge it with the Tier 1 issue for the reliable hardened vents for the BWR MARK I and MARK II containment designs.

Next slide.

In February of this year, the staff did make some recommendations. They did provide a proposed order to the Commission for review. In addition, they noted that severe accident service and the issue of filtration would be treated as a separate Tier 1 issue. They also noted that they would be submitting a Commission paper, policy paper, regarding the issue of filtration. Essentially, we gave a due date of July of 2012 of this year. The current date for the Commission paper is November of this year.

On March 12th, as many of you know, the NRC issued an order requiring reliable hardened vents containments with the MARK I and MARK II containment designs.

Next slide.

Now, since the issuance of the order, the staff has been very busy taking a look at the issue of severe accident service and the issue of filtration for the BWR vents. The issue of containment venting and filtration is really not a new issue, and the staff has been reviewing almost 30 years of regulatory actions relating to this subject. While much remains to be learned about what happened at Fukushima, the staff has been incorporating many of the insights we have gained from the Fukushima event in our analysis.

In addition, the staff has attempted to engage our stakeholders with a number of public meetings, which we will show in a few minutes, as well as we have looked at what other countries have done regarding filtered venting.

And finally, the staff has been busy performing a number of technical analyses on this subject in order to help arrive at a recommendation.

Next slide.

Again, this slide 10 shows a number of the public meetings that we have held on the issue of filtered venting. In May, we had two public meetings that touched on this subject. Staff did provide an overview of the issue. During that time, we received a number of comments from the public as well as the industry.

In addition, the staff has conducted public meetings from various vendors who have performed extensive research and testing on various filtered venting designs. In July, we had representatives from AREVA who have been involved in research and development really since the eighties.

And earlier this month, on September 4th, the staff held a meeting with the Paul Scherrer Institute, where again they provided information regarding their filter designs.

In addition, as I touched up earlier, we did hold a meeting on August 8th with the Electric Power Research Institute where, again, we discussed the industry's strategies for mitigating radiological releases.

In addition to the various public meetings that we have held over the past few months, the staff has been engaging with the ACRS. We have met with them. We met with them in May. And again, we met with them earlier this month.

Next slide, please.

As I touched on earlier, the staff consulted a number of times with various foreign regulators and licensees regarding filtered containment venting. Again, you can see on there, on the slides, these are the number of the agencies as well as licensees that are overseas whom the staff visited, as well as the class that the staff visited. But the idea was to take a look at how the various foreign regulators as well as foreign licensees actually implemented the filtered venting in those countries.

Next slide.

MR. LOCHBAUM: Bob, could I ask a question right here?

MR. FRETZ: Sure, go ahead.

MR. LOCHBAUM: Toward the bottom, you listed a number of site visits that the NRC staff made.

MR. FRETZ: Yes.

MR. LOCHBAUM: Are there publicly-available trip reports or summaries of what the NRC looked at and what they found for those?

MR. FRETZ: Well, we did prepare a trip report, but it is normal, I believe it is normal policy that the international trips and the international meeting summaries are not normally publicly-available.

MR. RICCIO: That is just not the case.

MR. MONNINGER: One thing within our paper that is due in the end of November, we will summarize our observations, experiences, the technical or policy basis for the foreign countries' decisions. So, I am not sure if that helps, but --

MR. LOCHBAUM: FOIA helps.

MR. RICCIO: So, we have to FOIA them?

MR. MONNINGER: We can check on the current policy.

MR. FRETZ: Yes, we can check on the current policy and see. There is really nothing in there that --

MR. RICCIO: I can tell you I have gotten trip reports out ADAMS before. I just saw trip reports in ADAMS yesterday.

MR. GUNTER: Yes, there were trip reports --

MR. RICCIO: International trip reports.

MR. GUNTER: Yes, there were trip reports to a conference in Paris in -- what was it? -- 1989 that the NRC participated in that looked directly at the hardened vent issue on filtration. I think we have provided that to the ACRS. So, we are aware of trip reports on foreign visits that have been part of the public document.

MR. MONNINGER: Maybe during the lunch break, we should be able to get back to you and say what the position is on the foreign trip reports.

MR. FRETZ: We will look into that.

MR. LOCHBAUM: Thank you.

MR. FRETZ: Again, much of the information during the May public meetings that we did hold, I know we presented a lot of the information and some of the insights that we gained during those visits. Essentially, by that time, Sweden and Switzerland had occurred. We had not yet gone to Canada.

MR. LOCHBAUM: Yes, I saw some of the things on the slides.

MR. FRETZ: Okay.

MR. LOCHBAUM: So, I have seen some of it before. So, thank you.

MR. FRETZ: Okay. Go ahead, next slide.

The current orders for reliable hardened events do not provide requirements for severe accident service. Therefore, the staff has undertaken a comprehensive review of containment venting as part of the strategies related to severe accident management. Again, the staff has looked at how venting plays a role in the current plant emergency operating procedures. Also, protecting containment goes beyond simply venting, and the staff has been looking at various strategies that may be employed by plant operators during a number of possible severe accident scenarios.

The NRC has also been considering various strategies that may have a benefit for reducing radiological releases. These strategies include the possibility of installing filter containment venting.

These insights were then used to perform a detailed analysis of representative severe accident scenarios or cases using the NRC's primary severe accident analysis computer code, otherwise known as MELCOR.

Because each case uses various assumptions about the sequence and timing of various plant safety systems, including the use of sprays, flooding, and containment venting, they serve to characterize one possible, but a representative outcome of certain severe accident scenarios.

The staff's MELCOR analysis focuses on the MARK I containment designs. And again, they were informed by Fukushima. But we will learn more about the details of that this afternoon during the afternoon session.

MR. LYMAN: Sorry. So, as part of that, did you model FLEX equipment use or not?

MR. FRETZ: I guess we can really address that. I believe FLEX was considered in some of the analyses, but we can answer that question this afternoon in more detail when the Research staff is here for their presentation.

Next slide.

Again, the purpose of the MELCOR analysis was to support the regulatory analysis on filtered venting. And again, the analysis will draw upon the results of MACCS calculations that will be based on the representative MELCOR cases. Again, the regulatory analysis will consider PRA risk insights as well as qualitative benefits. Again, more insights will be given this afternoon on that.

Next slide.

Again, the staff is still not done with its work. We have two additional planned public meetings on our agenda. Really, as a followon to this meeting, the Office of Research does intend to provide more insights regarding some of the results from the MACCS cases. That is one of the analyses that we are going to describe today in the month of October as a follow-on.

In addition, Westinghouse has asked us to allow them the opportunity to present information regarding their filter designs. We talk with the folks at AREVA as well as the Paul Scherrer Institute. My understanding, based upon our research, is that Westinghouse does have a design out there and is marketing the thing. So, we will be scheduling a meeting sometime in October to allow them the opportunity at least to present material regarding their design.

The staff will also be engaging the Japan Lessons Learned Steering Committee, as it prepares its paper. In addition, we will be working with the ACRS, and they will be reviewing the staff's work in scheduled meetings in October/November. Again, we will be meeting with the Subcommittee in early October, as shown on the slide, and our plans are to meet with the full Committee on November 1st. Again, this all will be culminated with the Commission paper that is due at the end of November.

Next slide.

Again, here is the slide. We will keep it up there for a while, while we give everyone a chance to take a look at some of the ML numbers. As I alluded to earlier, there is a number of documents that we have put in the public thing that should be available. A couple of them may not be available right now, but I do know that we have been busily trying to get a number of documents into ADAMS.

Again, as I talked about earlier, Mark Leyse, who is a nuclear safety consultant, working on behalf of NRDC, did submit some information on the record. I wanted us to check the phones to see whether or not Mark was on the phone, if he wanted to provide comments. He had indicated that he would not be able to make it to this meeting. And so, I was going to quickly summarize what he submitted to us.

If Mark is on the phone?

(No response.)

Okay. It doesn't some like he is.

But, again, this document was sent to us from Mark as well as from Corinne Hanson of the NRDC. Again, the paper, the ML numbers are ML12254A865, as well as ML12254A850. The second document is additional information they presented, but the bulk of his paper is in the first ML number I gave.

But, essentially, Mr. Leyse raises concerns about the large amounts of non-condensable hydrogen gas that would be generated during a BWR severe accident. His concern is that, if enough hydrogen were produced, the containment would fail from overpressure.

Mr. Leyse also stated that the staff should consider possible negative consequences of venting. For example, he raised some concern about the pump cavitation and the loss of injection to the reactor coolant system.

Mr. Leyse also raised concerns about the effectiveness of the suppression pool in scrubbing and retaining radionuclides. And then, he recommended that a high-capacity filter would help protect the public.

And again, this paper goes into a discussion regarding power plants in Europe as well as the impact of maybe an unfiltered release at Limerick. Again, his paper goes into that discussion. But, again, he finalizes his paper by recommending filter containment venting.

And so, that is a short paraphrase of the information. If you want to read further, you can go to that reference from Mr. Leyse.

Now we have come to the part of the agenda where I guess we will turn it over to various members of the public. Please work with us while we switch the slides over.

The first speaker will be David Lochbaum from the Union of Concerned Scientists.

Hopefully, we will get your item up.

MR. LOCHBAUM: While we are waiting, then, I would like to start out by recognizing and expressing our appreciation for the NRC changing the meeting. Originally, it was scheduled for March 6th or September 6th. It was postponed until today to accommodate largely the public. And also, flipping the order of the agenda. I realize that each of those iterations requires time and effort on the part of the NRC staff. I just want to express our appreciation for the extra effort that the NRC put in to making that happen.

That looks familiar. Next slide, please.

I would like to start by pointing out this is a schematic of a typical MARK I. This is a MARK I boiling water reactor. It is typical of the MARK II's.

In the red circle in the lower righthand corner is what most plants call the off-gas system. The off-gas system is used to process the gaseous releases during normal plant operation whenever the reactor is operating above 5 percent power.

The slightly radioactive gas is processed through a series of HEPA and charcoal filters before being released through a tall stack that further protects the public by diluting the amount of radioactivity that is in that stream to reduce the radioactive concentrations to people downstream and downwind. So, that is required. It is used day-to-day, and it is there to significantly -- and it does -- significantly reduce the amount of radioactivity that is released from the plant during normal plant operation.

Next slide, please.

During design-basis accidents, another filter system, typically called the standby gas treatment system, processes the gaseous releases from the reactor building, which would also be those from primary containment, again, through a series of HEPA filters and charcoal filters that are designed to reduce the radioactive levels by 99 percent before they are released from an elevated release point to further dilute and better protect people downwind and the workers, by the way.

Next slide, please.

In 1989, the NRC ordered plant owners to install hardened containment vents. They are shown in the red circle in the lower lefthand corner. And all MARK I's did this with the exception of Fitzpatrick in New York State. In this case, radioactive gases from the drywell or the torus can be released unfiltered through HEPA and charcoal filters through an elevated release point.

Essentially, before the NRC issued that order in 1989, all releases were filtered, normal design-basis accident and severe accident. The fix, applied in 1989, allowed severe accident releases to go out unfiltered.

Next slide, please.

MR. DENNIG: Just a quick correction: 1989 was the request. It wasn't an order. The order came in --

MR. LOCHBAUM: I was on the receiving end of that. It was a very strong request, but I agree.

(Laughter.)

MR. DENNIG: All right.

MR. LOCHBAUM: Technically, I understand the semantics.

MR. MONNINGER: But also along the line of maybe active discussion, even prior to the 1989 Generic Letter, venting was recognized within the BWR EOPs. So, you know, it was actually even prior to the 1989 Generic Letter.

And then, what the NRC did with the Generic Letter, our basis behind that was focused, essentially, on the one sequence, the TW sequence, which it is a contaminated RCS activity release, but it is not necessarily a severe accident release. The staff noted that, in requesting licensees to put that in, it would also potentially be beneficial for severe accident scenarios, but the actual basis that the staff proceeded with was the TW sequence, as opposed to the actual severe accident source-term releases.

MR. LOCHBAUM: Okay.

MR. MONNINGER: Just, you know, for conversation.

MR. LOCHBAUM: I appreciate the clarification.

This slide, it is a relative scale showing the amount of radioactivity during normal operation, in design-basis accidents, and severe accidents. Of those three, accidents is likely to have the largest amount of radioactivity involved.

The next row shows the amount of filtering provided for those releases. Normal operation and design-basis accidents are the highest because they are basically the same, HEPA filters, charcoal filters. A large, significant reduction in the amount of radioactivity going out as opposed to going into those filters. In severe accidents, particularly when you vent from the drywell, there is no filtering at all. So, it is the lowest or least amount of filtering. And the threat to the public and workers, it is smallest during normal operation, medium during design-basis accidents, and largest during severe accidents.

I don't fully understand why we are even here discussing this. This seems like an obvious no-brainer. But let's go through the exercise anyway.

Next slide, please.

There is going to be discussion about modeling. I think this is a concern we have. Ed talks about more the nuts and bolts and the details of the modeling pros and cons. But from a big picture, which I understand better -- I don't know the modeling as well as Ed does -- the little green circle is the scope for -- and this is not to scale; this is just illustrative -- this is the normal range of parameters during normal operation in the transient studies that are done for anticipated occurrences during normal operation, pump trips, et cetera.

So, it is not a single point. There is a range of points, as power levels and timing of different sequences start. But it is a relatively-small arena that one has to try to model.

Even within that relatively-small arena, mistakes are still being made, as the recent adjustments to the Minimum Critical Power Ratio in recent years has done when errors were found in that very small space. So, even 30 years later, people still make mistakes modeling that small space, consequential mistakes.

This yellow circle shows the larger space or scope for design-basis access because the timing, what breaks, when it breaks, how big a break it is, again, where it breaks, the pressurization, compartment pressurization, high-energy line-break effects, there are many more variables that are introduced into the studies. And there are still mistakes being made in those as the corrections to 10 CFR 50.46 you get from time to time, where people miscalculate peak clad temperature by 50 degrees or more. So, it is larger. It is not intentional things. It is just a very challenging thing to model; mistakes are made.

If you go into severe accident space, it is like the character Woody in Toy Story, to infinity and beyond. I mean, the number of sequences, combinations, timing, you can basically make it look very good or you can make it look very bad, as you cherry-pick amongst that huge universe of variables.

What troubles me is that the NRC and the industry are saying that that huge universe, fortunately for which we have had very limited examples to draw from, we are going to know with enough precision to say yes or no on whether filter vents are required. That seems ludicrous the surface. If you dig below the surface, it is also ludicrous, but it just takes more work to get there.

There is just no way you can justify doing an analysis of so many unknowns and say for certain that we don't need venting during severe accidents when we do during normal operation and design-basis accidents. I wouldn't want to be in the regulator's shoes following a severe accident where people lost their homes or perhaps their lives, and you didn't require severe accidents -- pointing on this mathematically-correct, but virtual-reality-impaired analysis as the basis for your decision. I wouldn't want to answer, be on the receiving end of Congress' very angry questions if that situation were to play out, particularly since it is so easy to fix, as so many other countries have done.

I also want to point out that, even if containment venting were always done during the torus vent pathway, still it is hard to credit how much credit can be given to scrubbing, because it depends on what the torus temperature is, what is the effect of that water as a scrubbing agent. Again, there are so many unknowns just with that issue, that filtering is justified, or not filtering is unjustified. It depends on how you look at it.

But we also have the capability for venting from the drywell vents, which that issue is not even in play at all. So, unless you disable the drywell vents and eliminate that as a possibility, the fact that that is on the table makes it very difficult, if not impossible, to not put filters in on that pathway.

MR. MONNINGER: And I would say within our studies the notion of potential for drywell venting is within the consideration.

MR. LOCHBAUM: Bob put up a slide earlier about the MELCOR analysis that the NRC staff is doing. I was encouraged to see that there is no probabilities or frequencies being considered, because, as this slide shows, there are so many variables, that that becomes a very frustrating exercise of limited value.

But it did say that sequences and timing was being considered. I think that also has similar problems in that there are so many different sequences with so many different timing options that can be developed, essentially, an infinite number of sequences with any number of timing options, that I don't see that you could come up with a bounding case that would tell you that not filtering is right in all those cases. Clearly, you could come up with some showing that not filtering is justified, but to say that not filtering is justified in all cases stretches credibility to the breaking point. So, I am not exactly sure why you are wasting the FTEs, but I am not paying for them, so I don't care.

We also believe that the NRC must require filtering for all containment vents, not just some of them, in order to correct a problem, unintended consequences from another federal action made in the past; namely, the Price-Anderson Act as amended. As you know, Price-Anderson provides liability protection for offsite damages from nuclear plant accidents. Basically, it is no fault. The injured party doesn't have to prove that the plant owner was at fault, just that they were harmed by the release of radiation.

That also provides the plant owner from protection against being sued for potentially allowing the thing, flipping the switch to allow radiation to go out. Price-Anderson protects the plant owners from those suits, and America is kind of known for being somewhat litigious, filing a lot of lawsuits, whatever that right word is.

And example I use is, when I bought my house in Tennessee, by buying portable fire extinguishers and installing deadbolt locks, my homeowner's insurance was reduced that first year more than those things cost because my house was more secure and better protected. So, there was an incentive to me to do that, to make my house safer and more secure.

If a plant owner spends $100 on a containment filter, that would be a good bargain, but just for the sake of illustration, that is $100 that is not going to come back. There is not going to be reduction in Price-Anderson liability insurance, although the plant is arguably safer than a plant that just dumps radiation out into the world. So, there will be less claims against the plant with the filter than the plant with Filter B, but there is no break under Price-Anderson. The same premium is paid.

So, because there is no incentive -- and that also applies to the NRC's risk space, because the NRC and the industry largely do probability studies instead of risk studies, putting in a filter on the vent doesn't change the core damage frequency up or down. It is not an issue. So, there is no break for the owner in a risk-based regulation world for putting in a containment vent. So, with all these disincentives for plant owners to install a containment filter to protect the public, the NRC needs to step in and protect the public in that void. I think that is all I will say on that one.

When we look at FLEX and some of the other things the NRC does, when I worked as a consultant for Susquehanna, they had just completed spending $100 million to put in a fifth emergency diesel generator, two reactors, two diesel generators each. They spent upwards of $100 million to put in a fifth emergency diesel generator.

The reason they did that was to provide themselves better protection against core melt, which is good for the public as well. Both parties were benefitted from that.

They also bought themselves some flexibility. In case one of the emergency diesel generators failed, the reactor could continue operating with the fifth diesel stepping in its place. So, there were plenty of financial reasons for the plant owner to spend that much money on a plant that the NRC was already happy with.

But $100, whatever the containment filters cost, there is no payback at all for the owners from that. They don't get a benefit in LCO space. They get a benefit in PRA space. They don't get a benefit in liability insurance protection space. Whatever that cost is, it is down the drain.

We think that is why the industry's goal reflects it is to provide means of preventing core damage. Again, that is a lofty goal that protects the owners and protects the public. But if that goal goes south and the core melts, their investment is gone. Price-Anderson steps in to protect them. So, there is no benefit, again, no benefit at all, for the owners to take steps to better protect the public during core melt accidents because Price-Anderson does that.

Because of that, because there is no incentive, financial incentive for the owners to do that, the NRC must -- must -- step in and protect the public from that situation, give them the reason to take the step to protect the public. Again, I wouldn't want to be in the NRC's shoes if an accident occurred and the public was harmed and a contributing factor was the lack of containment filters. That would be a tragedy made worse by the fact that it could have been avoided.

We are also concerned that, in addition to the millions of Americans who face undue harm from this situation, there are dozens, perhaps even hundreds, of plant workers that are also in harm's way. We read accounts that workers at Fukushima were stymied in their abilities to work in the control rooms, in the reactor buildings, and even outside the plants, in taking some of the mitigating actions they wanted to take, due to radiation levels. I am not saying containment filters would have totally eliminated that problem, but it certainly didn't help that the radiation leaving containment wasn't filtered. So, the containment filters not only would benefit the public, it would doubly benefit the public by allowing workers to have a better shot at taking steps to protect them.

This last point we raise, but we recognize that you probably won't be able to address it.

Next slide.

This was an embedded video that doesn't work. So, what it was is Commissioner Svinicki's speech at the Regulatory Information Conference in March of

2012. It is posted in its entirety on the NRC's RIC website. The part that I extracted but will not show you today is 38 minutes and 30 seconds into the speech through 40 minutes 3 seconds into the speech.

Commissioner Svinicki was asked a question about filtered vents. To summarize -- I wish I could play her comments, so you would get it directly -- but I hope I am fairly characterizing. It was she had looked at the issue, felt that filtered vents were not necessary because, in order to believe that filtered vents was necessary, she would have to disbelieve that many other systems and procedures would fail, to put you in a situation where that was necessary.

The trouble I have with that logic is, at that same time, the Commission voted unanimously, 5-to-0, including Commissioner Svinicki, to require reliable hardened vents be installed. The number of steps it takes and the number of failures it takes to get filtered vents is no longer or no shorter than the number of steps it takes to have reliable hardened vents.

In fact, the Commission's order makes it more likely that this radiation will go out. Because in the old days, when we had the unreliable hardened vents, you might not have gotten them open when you wanted to. Now, assuming this order is successful, it is more likely that the vents will be opened and unfiltered radiation will be released to the atmosphere. So, if anything, the Commission's order, unanimous order, makes it more necessary to filter what goes out from the reliable hardened containment vents.

It took 23 years from the time the hardened vents were installed for the NRC to require that they be made reliable. Americans shouldn't have to wait 23 more years to have filtered reliable hardened vents.

There seems to be enough evidence on the table to show that filtered vents is not only justified, it is not credible not to justify. I mean, you basically have to go into the -- I don't work for the Union of Concerned Science-Fictionists. That is about the only way I could say that that is a good idea.

It seems like there's already been way too many meetings to debate a question that only has one answer, and that is to put filters on the vents, or not have the vents. Paul Gunter has said many times that hardened vents are a workaround from having the containment that can handle all accident conditions, not just some of them. Hardened vents in the first place is a design deficiency that was corrected with the use of hardened vents. The public shouldn't have to pay the burden for designers and the NRC allowing containments not to be robust in the first place.

So, filter vents is the best workaround available for that situation. And again, we hope that all this will lead to filters being installed on that. If not, we hope the accident never occurs. It shows how dumb that decision would be not to put filters in, because it will come at a very high price that is much, much higher than the cost of the filters.

Thanks.

Any questions or clarifications, I would be glad to --

MR. MONNINGER: I guess one question would be, if filters were required, what do you believe an appropriate standard of performance for those filters would be? What would you measure them against?

MR. LOCHBAUM: I appreciate that question, and I should have included it in my remarks, but I am glad you brought it.

In my view, it is not that you have to have HEPA filters or charcoal filters. That would be one way of doing it. But, to me, whatever is on the up-filter side, whatever the radiation amount is there, the downstream side, or whatever you are using, water or whatever it is, has to be significantly reduced, like the standby gas treatment system, with about a 99-percent reduction. Again, I am not going to argue that 99, but you want a significant reduction pre-filter -- or post-filter process, before it goes out.

MR. MONNINGER: But don't you think, I guess, in evaluating them, wouldn't one need to know what they were trying to achieve in the end? You know, if you just use decontamination factors, 10, 100, 1,000, 10,000, a million, a gazillion, whatever, I mean, would you go that route? Would you go with what is available out there commercially? Would you look at some other metric out there? Someplace there has to be a yardstick.

MR. LOCHBAUM: No question.

MR. MONNINGER: Well, of course, we would be the ones that --

MR. LOCHBAUM: Right.

MR. MONNINGER: But any thoughts you would have on the yardstick? And then, if you just throw in the boilers, then what would you do with the suppression pool, with any type or no credit for the suppression pool or any type or no credit for sprays?

MR. LOCHBAUM: I would give no credit for the suppression pool. But as far as the best answer I can think of off the top of my head, which may not be the best answer, the original design for the standby gas treatment system was to handle all those releases, design-basis, severe accident, the original design. There were some deficiencies found in it, but originally it was supposed to accommodate all that. It was the 99-percent reduction.

One of the options back in 1989 would be to boost the ductwork and everything, so that system could still work during an accident. Most people took the cheaper way and just put in the hard pipe, unfiltered.

But it seems like that original standard that the NRC set that was used to judge whether the standby gas treatment system was acceptable or not would be the same one to apply today to the containment filter from another source, whether it be the torus or the drywell.

MR. MONNINGER: So, then, the capacity is standby gas, which is to handle any leakage. So, the design capacity would be leakage for standby gas. If you did do something from the containment, the capacity would have to be --

MR. LOCHBAUM: Right.

MR. MONNINGER: -- up to force.

I guess, what would be the thought behind the suppression pool, no credit for the suppression pool?

MR. LYMAN: Well, how much experimental evidence is there to justify any particular decontamination factor? How much experimental evidence do you have under various conditions? It seems you should need to justify any credit given.

MR. RICCIO: Actually, back in 1989, when we discussed, or actually prior to 1989, when we discussed this after Chernobyl, NRC's own consultant didn't want to give you any credit for scrubbing through the suppression pools because you said you would be in active space and they wouldn't know what the hell they were doing. And they would re-release everything they scrubbed through the suppression pool right back into the environment.

MR. LYMAN: But let me ask --

MR. RICCIO: You can go check it.

MR. LYMAN: But do you have experimental reports, going back to Hanauer's memo when he said General Electric is asserting these decontamination factors, but I haven't seen any evidence to support it? What do you have since then?

MR. MONNINGER: But if there was evidence to support it, you know, if there is a technical basis, you would not necessarily discredit it or not include it.

I mean, you can add assumptions, single failure, all that kind of stuff. So, is it going in, you know, regardless or is it, if there is a database out there to support it, it would be included within the considerations?

MR. LOCHBAUM: But I think just on the notion of discussion, I think it is a good question. I guess to argue that, at the end of the day, what do you have more confidence or certainty in? If you put a filter in the common line where the drywell vent and the torus vent, so that the filter is downstream of both, there is going to be some uncertainty with that, but I think you have more confidence and more certainty that that will achieve the outcome you want than you do that you are going to take credit for scrubbing the suppression pool water, that there won't be bypass -- that the drywell or the torus breakers don't fail. I think you have more uncertainty with trying to justify that to achieve the same outcome.

So, I think if you look at both of them, they are not 100 percent; they are not zero, either. But, at the end of the day, you have more confidence overall with putting in the filter downstream of where the two lines are. It is not that I would give no credit for that, for suppression pool scrubbing of that, but it is far less than just putting a filter in that line.

MR. LYMAN: Well, I think that raises a larger philosophical point. That is the issue of whether you pursue more passive measures for achieving this effect or active measures. Now the EPRI approach is using emergency measures to make sprays functional, et cetera, and those involve some sort of active intervention, right?

MR. DENNIG: When you say "the EPRI approach," you are referring to the stuff we just heard about?

MR. LYMAN: Yes, I mean the NEI/EPRI philosophy that you don't need filters because you can achieve the same reduction with containment sprays or other active measures. I think that is basically their approach, their argument, right, that they would use FLEX equipment and other means to get sprays operational again? Then, you wouldn't need the filters. But those are active measures. They require human actions, and that introduces more uncertainties.

So, it boils down to, do you want to have a more passive ability to achieve reduction in the event, that you have a severe accident and you have a degraded core, and you may need to vent? Or are you going to rely on more uncertain measures that would require some sort of active or additional active means? Of course, just opening the vents may require human intervention, but you are going to need additional actions to restore some of the functionality to those other pieces of equipment.

So, we think that increasing the passive response to the extent possible is a better approach.

MR. MONNINGER: So, part of a passive response could be rupture discs or no rupture discs. Are there any views on -- because, you know, there are pros and cons on both sides. Or you have both?

MR. LYMAN: Well, the rupture disc is pretty complex. It depends on whether you can reclose or not, right, for one thing? I think that is a slightly separate issue.

MR. LOCHBAUM: Also, I have seen some designs that actually, as you mentioned, do have both. So, you have as a last-resort the rupture disc opens under a certain pressure. Whereas, to open at lower pressures, which may be admissible when you have valves to a separate pathway -- so, that seems to be the best arrangement, but I am not here to say preclude that that is the only answer. As long as neither of those pathways leads to a filter, you have got it. You have got it right.

MR. FRETZ: Any other questions? Any other comments or anything?

(No response.)

MR. LOCHBAUM: Again, I appreciate your

flexibility in arranging the meeting.

MR. LYMAN: If I could add one more thing?

MR. FRETZ: Sure.

MR. LYMAN: With regard to the metrics that you might want to use, unfortunately, NRC doesn't have good metrics for making this kind of a decision. Because as we discussed in the Commission meeting on Tuesday, some of these issues are not going to be addressed in reducing dose to the public that are going to be evacuated or have no protective actions. You are talking about whether or not there is going to longer-term land contamination and to what extent.

So, I guess one recommendation I would make at this point is that, as part of the regulatory analysis, even though it is not in the standard guidance for doing regulatory analysis, you might want to look at land contamination issues, anticipating that there may be some action on that. That is just one recommendation.

MR. MONNINGER: So, is there some universal value that you would see us pegging the land contamination to?

MR. LYMAN: I think we would have to get back to you on that.

MR. MONNINGER: Because, you know, the thought is, in going forward with any type of assessment recommendation, we would have to look at -- and we are looking at -- all these various different issues out there.

MR. LYMAN: I mean, you could say achieving EPA long-term PADs or the need for decontamination, although I think those are probably too high. You could say ICRP, some fraction of the ICRP dose limit for the public which is 100 millirem per year. So, you might say one-tenth of that.

MR. COLLINS: That is an important question, which I hope you will give more thought to because, as risk continues to go forward, ultimately, we will need a standard for acceptability for whatever design is required. Okay? And that is a tough question.

MR. LYMAN: It can't just be the existing goals. They don't do much.

MR. RICCIO: You might reach out to Mr. Galinsky. He seems to have an opinion on that.

MR. DENNIG: We have talked about things like cesium ground showing as a dose, you know, ground showing, over a year return, that sort of thing. That is something that we are looking at.

MR. MONNINGER: Various countries throughout the world have pursued it for different reasons. There are some common threads, but it is not universal.

MR. FRETZ: Any other comments?

(No response.)

Okay. Next on the agenda is a presentation by Mary Lampert, who is the Director of Pilgrim Watch.

And I guess I will apologize in advance if this is a little bit rough. We are going to try -- Mary is on the phone. Let's say hopefully on the phone. And we will be attempting to sequence the slides based upon her discussion today.

But, first of all, I wanted to see if Mary Lampert is on the phone, and if the operator, I guess, could allow her to talk?

Hello, Mary?

MR. WACHOWIAK: Do we still have the phone open? There was something about standby or --

MR. RICCIO: Actually, since we are not going to be here, many of us have to go to other meetings, perhaps we could answer the questions that were raised in this.

MR. MONNINGER: In our presentation or in which?

MR. RICCIO: Oh, no, actually, it was from the earlier questions that were asked about --

MS. LAMPERT: Hello.

MR. FRETZ: Hi, Mary. I can hear you. I don't think they can hear you, though.

MS. LAMPERT: Why?

MR. FRETZ: Mary, now we have you online.

MS. LAMPERT: Okay. You can hear me now?

MR. FRETZ: Yes, we can all hear. Thank you.

MS. LAMPERT: Oh, okay. Great. You can still hear me, right?

MR. FRETZ: Yes, we can.

MS. LAMPERT: Okay. Slide 1, as you introduced me, I am Mary Lampert, Director of Pilgrim Watch.

I am looking at the window over my desk at the Pilgrim Nuclear Reactor across open water, less than six miles. So, if they choose to vent this MARK I reactor, I am in trouble, as are the children who are on the beach in front of my house.

And so, I am speaking of the importance of filtering, certainly from a personal experience, having argued this with former Chairman Carr in the late 1980s. So, I hope we can make some progress after the lessons from Fukushima that should have been learned.

Slide No. 2.

We believe that there should be rupture disc paired with filters. A rupture disc would get as close as you could to being 100-percent passive to spin off was Ed Lyman was talking about, the difference between passive and active. So that it would not require an electric supply or operator intervention.

Obviously, a filtered vent, as David Lochbaum showed, protects public health and property, allows the NRC to satisfy its AEA statutory requirement to protect public health, safety, and property, and ensures that the operators can follow orders and will follow orders to open a vent, as opposed to having a hike and hoping that they can recover from the trouble at the reactor and not have to screw the neighborhood.

And also, as David Lochbaum pointed out, that it would ensure that the operators are not contaminated if venting occurs. So, in fact, the workers can go about their business and maybe restore the situation.

The NRC staff is faced with making a recommendation to the Commission. I see that they can up with three options. One is the status quo, which I think we are all arguing is unacceptable. The second would be to require filters paired with rupture discs and satisfy their AEA obligation. The third would be to kick the can down the road and recommend more cost/benefit analyses to determine whether the offsite consequences and costs justify having the industry spend actually a piddling amount of money to provide for public safety.

The main focus of my discussion will be that the current methodology, the MACCS2 that is NRC approved to do consequence analyses, severely underestimates the offsite consequences. So, in reality, if that code is used in this case, guarantee that there will not be any outcome whereby filters will be put into place.

Further, the MACCS, you are in a bizarre situation where the code, the MACCS2, does not incorporate the lessons learned from Fukushima. And so, it is patently absurd to use it to analyze whether or not to put in place the recommendations from what we supposedly learned from Fukushima.

However, to update a cost/benefit analysis code will take years. To tell you the truth, I am in my seventies. I do not have years left. And we have waited, I believe, long enough.

So, exercise some common sense and put the public's interest, the interest of American families, all the families that are in my neighborhood, first and not the interests of the bottom line of industry. You are going to have to -- you are straddling the fence -- you are going to have to decide whose side you are on.

Slide 3, please.

I just wanted to make a couple of comments on rupture discs. This is something that hasn't been discussed, but I remember very well a discussion on rupture disc. And as far as I could see, the only serious objections to installing a rupture disc that I have heard is that a rupture disc would prevent the ability to vent the containment at low pressure. That is, if a rupture disc is put, as I argue it should be, up close to the containment and not at the end of the line.

But this really is not a real obstacle. It is an engineering challenge, quite elemental. There is an easy fix. You can put a bypass in. What is it going to cost? A couple of thousand, a little extra pipe.

Slide 4, please.

I also remember at an NRC May 2nd meeting, public meeting, I asked the technical staff if they saw any downside to pairing a rupture disc with a filter. Mr. Dennig replied no. Unless there have been great changes since, which I would like to hear about at the end of the discussion, then I think that answers the question.

Slide No. 5, please.

Moving on to filters, I think David Lochbaum clearly answered the question. If you have filters for ordinary releases, day-to-day releases, for design-based releases, it makes absolutely no sense not to have filters for gaseous releases during a severe accident. Again, if it is public health, safety, and property, which the NRC's business is, then the answer is simple.

Slide 6, please.

Very fundamental to the discussion of filtration is how much radiological release is assumed if a vent is opened. I think both Ed and David Lochbaum brought forward that, in reality, that exact number is unknown and to pretend to know it is absurd.

But let's go back to a discussion of how effective the wetwell is in scrubbing. If you listen to industry, it is the best laundromat in the world. A 1988 report estimated that the decontamination factor of the wetwell ranged from no scrubbing or one to well over a thousand or 99.9 percent effective. They gave, as a conservative DF for a MARK I, a five, which means 80 percent of the radioactive substances, excluding noble gases, would be retained, and 20 percent released. And the DF for MARK II's was ten.

But compare, for example, to the filter system that is used in Swedish reactors that puts their scrubbing to 99.9 percent of core inventory retained if the containment has filters -- 99.9 percent.

So, the difference between releasing up to 20 percent versus .1 percent is huge, meaning that 200 times more radioactivity would be released in U.S. boiling water MARK I's versus the enhanced system that Europeans are using, and that are commercially available today.

So, it is very clear that a filter would make a substantial difference to public health and safety in the event of venting. Further, it is sort of common sense. Why would anyone bother, like the Japanese, to be putting in these filter systems if they had been convinced from real-world experience that the wetwell was sufficient in scrubbing? I think that answers the question quite well.

Another factor to consider in answering the question of how much radiological releases would occur in venting would be how long is NRC assuming, or anybody who comes up with a number, that the vent will stay open? Or how many times it is assumed that the vent might be opened in this accident scenario?

Last, industry has argued that filters would be dangerous due to backpressure. We are not arguing the backpressure would not be an issue, but it certainly should not be an obstacle.

Currently, you have a situation of when you are going to open up depending upon how much the pressure is per square inch. If you are factoring in the backpressure from a filter, you just simply change the setpoint.

Slide 7, please.

Now, moving on to the heart of my discussion is how offsite consequences are being calculated, how the MACCS2 that I understand is being used minimizes offsite consequences and costs. And I think the bottom line, because of this, you would recommend that this really isn't an option to base a decision on. Instead, you go back to the common sense that public health and safety demands the simple measure of putting on filters. Slide No. 7, more or less, summarizes the lack of effectiveness or honesty in calculations done for the MACCS2.

Slide 8.

What we need to know -- and I didn't fully understand -- was who precisely is doing the MACCS2 analysis that the decisionmaking of the staff is based upon. Is it NRC staff themselves? Was it subbed out to Sandia? Is industry doing it? I think it is important to know.

We know now that the MACCS2 is what is being used. We don't know if any tweaking of the code has been done to incorporate some of the lessons learned from Fukushima. And we don't know what other changes or what averaging was used, whether the mean was used or whether the analysis was done using the 95th percentile. We need to know this information to make any sense whatsoever of the validity of what the cost analysis led the staff to conclude.

Slide 9, please.

The problems in the MACCS2 are -- I actually had a report, which you have an ML listing to it, that was presented to the NRC Commissioners for them to read prior to their decision on economic consequences on Tuesday. And so, I will just provide a summary.

I will start off by saying that David Shannon, for example, who wrote the FORTRAN for the MACCS and the MACCS2 while at Sandia, has testified under oath that the code is worthless as far as estimating offsite cost. And I think that is significant.

Also, there is other expert testimony that was provided on this subject in the Pilgrim license renewal procedure and, also, for the New York Attorney General in the Indian Point adjudication. The hearings will begin in October.

First of all is the probability of core

damage that is assumed in the code. The core damage frequency is assumed and is based upon two events, that being Three Mile Island and Chernobyl. However, as we know, there were three additional events at Fukushima, which would make an event, the probability of core damage, 10 times what is currently assumed in the MACCS code. And that makes a big difference because we are now down to a core melt for every 2,900 reactor-years, which is much higher than the current baseline of one event per 31,000 reactor-years. This is discussed more completely in an expert testimony by Dr. Gordon Thompson for the Massachusetts Attorney General's office in Pilgrim's litigation intention filed June 2nd of 2011.

Further, the MACCS code underestimates the amount of cesium-137 that is released from the core. Instead, quite obviously, the model should be changed to have a more actual account of cesium-137 that could be released from the core, and not base it, instead, largely on noble gases and only a very small amount of cesium-137. And the offsite consequences clearly would be different.

Also, the code does not model aqueous releases. This was brought forward by Commission Apostolakis in July or August of 2011, and the Commission voted September 2011 that this was a problem and aqueous radioactive releases and damages must be included to get a full picture of the economic consequences resulting from releases. This would be, also, obviously, releases unfiltered from the vent.

Also, the code minimizes offsite consequences by the duration of an accident that it considers. They model releases only up to a day -- hello? -- only up to a day. As a potential, you could go up to four days if you used IPLUME 3. But, clearly, we have seen at Fukushima that an accident can go on not for just one day or four days, but many weeks, many months, perhaps a year.

Slide 10, please.

Another serious limitation -- and it would be the same case in modeling releases from an unfiltered vent -- is the assumption that releases travel in a straight line, that is, using a straight-line Gaussian plume which is embedded in the ATMOS module of the MACCS2 code.

We know clearly, as done the NRC, that adjacent to large bodies of water, whether it be the ocean or a lake, that winds are variable and complex. We know that winds get channeled down river valleys like the Hudson, for example, and do not move in a straight line. We know that variation in topography switches winds around. And so, what that means is a larger geographic area will be contaminated, not the pie slice that is currently assumed.

Similarly, what is probably the elephant in the living room is how the cost of cleanup and decontamination are barely considered. For example, we know, No. 1, that there is no cleanup standard agreed upon by NRC, EPA, and the Department of Homeland Security. Clearly, there is a huge difference if it is assumed you are going to clean up to, let's say, 15 millirem a year to 500 millirem or more. Without a standard, you really cannot do an honest analysis.

Furthermore, the assumption in the code is that cleanup will involve hosing down buildings and plowing under fields. We have seen from Japan, and common sense would tell you, that that isn't cleanup; that is simply moving the contamination from one spot to another.

We also know that waste removal is not modeled. And judging from the real-world experiences in Japan, or going back to 1987 to the Goiania, Brazil, incident, that waste disposal, whether it is a small amount or huge, is a problem that will take years to solve and be very, very expensive. So, the MACCS code deals with that by not modeling it.

They also only model one year for a cleanup.

Japan is talking 30 to 40. How long would it take to clean up if the vent is opened and it is not filtered? What would be done with the waste? How would anybody decide how clean my neighborhood has to be? And you can go on and on.

Hosing down my house? What? Digging up the yard? What are you going to do with the shrubbery? What are you going to do with the trees? It cannot be done. So, therefore, a consequence analysis that doesn't look at these issues, such as the MACCS2, is, frankly, worthless.

Then, you can move on to the underestimation of health cost. One example would be, how much does NRC value my life? What, $3 million? My husband would debate that, judging from our bills.

(Laughter.)

The rest of the federal government is between $5 and $9 million. Think of the difference that would make in offsite consequences.

Also, you can look at the fact that real other health effects from exposure, non-cancerous, that is not modeled, either. Other economic costs are not considered in that code, such as the multiplier effects; only the cost of the buildings per se and the farmland.

And then, at the very end of all this, in the MACCS code output file, it puts out an array of the information into the mode, the median, the 95th percentile, et cetera. And then, the user gets to choose what average they will pick to give their determination of offsite costs.

Typically, the industry has used the mean and the NRC has approved the use of the mean. But it is very clear that using a mean is essentially meaningless, and that absent using the 95th percentile in any analysis that the staff does or approves to make its final determination would be disingenuous.

So, based upon this, I would be very cautious -- that would be my advice to the staff -- in any interpretation or use they make of the analysis of using and not using a vent in making a recommendation to the Commission. Or, if the staff is going to take a middle road and recommend that the Commission does a consequence analysis themselves, then I think you have to pre-warn them on, in fact, what you are really telling them to do is nothing in a softer tone.

My last question, which would be slide No. 11, would be, is the public going to see the bases of the staff's recommendation to the Commission? If you have done a consequence cost/benefit analysis, are we going to see the actual analysis and not just hear the conclusion that you did a study and, based upon that, here's your recommendation?

So, I would like to be able to see, and I am sure other members of the public would feel the same, to be able to see all the quantification, all the studies that, in fact, have been done that form the bases of your recommendation. Because, without that, we cannot make a meaningful counterargument if we don't agree with your recommendation for the Commissioners to consider.

And last, slide 12, I will end by just asking this simple question: whose side are you on? If you are on the side of American families, if you are on the side of the children playing on the beach across the street from my house as I speak, then you have no choice but to recommend filters.

However, if you are going to come down on the side of industry's bottom line, then I guess we are all going to have to continue to rely on sheer luck that it will never have to be used. And I don't like making that kind of bet.

Look, thanks a lot. Any questions, I would be happy to answer.

I did want to respond to the last question to David Lochbaum and Ed Lyman on if you are going to come up with a standard on how much reduction a filter should provide. I understand, I have read the FILTRA system's, Westinghouse's statistics on how much they scrub out. They made the point that they comply with Swedish regulations that require 99.9 percent of the core inventory of radioactivity, excluding noble gases, be retained in the containment or filtered in the case of venting. So, that would be one model to follow.

Thank you.

I wish I could have been there to be with you all today.

MR. MONNINGER: It sounds like you have a much more pleasant view up there, though.

(Laughter.)

MS. LAMPERT: I do, depending on how well-behaved Pilgrim is today.

(Laughter.)

MR. FRETZ: Any comments from the staff on some of the points brought up or any questions or anything?

MR. MONNINGER: You know, I think we can try to respond and to have some questions. One of the things maybe going in upfront, I wanted to say thank you very much to Mary and our other guests here today. You guys have been quite active in following the various meetings we have been having and providing good input for the staff to consider. So, for following us along through this process, I do thank you very much.

I know there were a lot of questions out there on --

MR. RICCIO: I am not sure, for the reporter, are we supposed to -- is there a reporter? Are we supposed to be saying our names or anything?

MR. FRETZ: One of the things I forgot to mention earlier on was that the staff, we were able to obtain the service of a court reporter. So, this meeting is being transcribed, the morning as well as the afternoon. So, anyone can take a look at this transcript as soon as it becomes available and it comes into the public domain.

So, again, yes, please, if anyone plans to speak, please come to the microphone, so that --

MR. RICCIO: This is Jim Riccio with Greenpeace.

(Laughter.)

Going back to David's slides -- and, actually, I want to thank you, Mary. You obviously were very busy while I was off this summer.

Going back to David's slides, wouldn't it be appropriate for Ms. Svinicki to recuse herself, since she has already seemed to have made up her mind on this position prior to actually reading the NRC staff's, the results of their study over this summer or the results of what they found in Europe or the analysis you are actually working on now?

MR. MONNINGER: That is not a question for us.

MR. RICCIO: That is not a question for staff. Okay.

Well, I know for a fact that Congress is already looking at the fact that NRC has failed to install filters. And I know at least Senator Menendez has written a letter to the new Chairman, and she has responded that you are still studying the issue.

Again, it is kind of embarrassing that we are here again. I had to my international colleagues that I couldn't make a meeting with them because I had to come here and argue for filters that they have had in place since Chernobyl. This is a no-brainer, as David has already indicated.

The fact that we are here debating this seems to be a waste of agency time and the public's time because there are other things we should be dealing with, like the other meetings which you have been kind enough to alter your schedule that we can make.

We do believe you should be using land

contamination -- that is not just the public's perspective; it is also shared, seemingly, by former NRC Commissioners.

And again, we appreciate the fact that you have bent over backwards to allow us to participate, but we would actually ask that we move off the glacial pace and get this done.

I do appreciate that you have linked the two --

MR. DENNIG: Some of us are not feeling like it is a glacial pace.

(Laughter.)

I mean, we have got draft stuff due now.

(Laughter.)

MR. RICCIO: Okay. Well, perhaps if we had accomplished back in the 1980s timeframe, we wouldn't be here now. So, for those of us in the public who have been tracking it since the late eighties, it does feel rather slow.

And in light of Fukushima and in light of the fact that you haven't taken other no-brainers to reduce the risk emanating from these reactors, we will continue to try to encourage the agency to move with more rapidity.

I have been reading in the press a lot about the Chairman's claiming the independence of this agency. I think that this issue is emblematic, and how it comes out when you tell public very much about whether this agency is actually independent or not, the fact, again, that we are here 20 years later discussing the same issue doesn't give me a lot of hope. But you guys have a lot of work still to do. So, we will reserve judgment.

MR. LOCHBAUM: Just one other point to add on to what Jim added onto: if something Fukushima had happened in the United States in one of our boiling water reactors or the MARK I or MARK II containment had had an accident of that severity, and we had been as fortunate in getting people out of harm's way before the radiation got there, but people would still be outside their homes and businesses would have been closed and all of that, if the reactors were allowed to continue operating in the United States, as was not the case in Japan, it would almost be not even an issue that we would have to put filters in on those vents. I can't imagine, following a tragedy of that scale, that we would even contemplate operating reactors without filters.

If that is the case, then why not put the filters in now and skip the part where a lot of people pay a high price? You know, tombstone regulation: let's not wait for the dead bodies before we implement fixes that are on the shelves today.

So, the reason I am here today -- I could have participated remotely -- is this is very important to UCS. It speaks to something Jim says. It is a kind of litmus test. Is the NRC really protecting the public or not?

If the NRC can justify not putting filters in on these vents, then that answer is no. It is not a good answer, but, then, at least the answer is defined.

It is very important to us that the NRC take the right step here, get it right to protect the American public. It is that important to us. We will hope the NRC comes out right on its answer. But, if not, we are not just going to say, "Well, fine." We will make it a big and bloody fight."

Thanks.

MR. MONNINGER: This is John Monninger from the staff.

We do recognize the significance of the issue, the significance of the recommendation, and the potential decision by the Commission. What we would say is you know it has been studied in the past. Our recommendation was due to the Commission in July. But the only thing I would say is the staff, we requested an extension and we were granted it, because we believe this subject, this study, needed the analysis, needed the insights, needed full consideration of all the issues.

You know, something could have been presented in July, but the staff is taking the issue very seriously. As a result of that, that is why the extension came out. You know, there could have been just a forwarding of past studies and conclusions, but that is not the case. So, we will see where the chips may lie come November.

But not as much myself as these guys here and women, they have been working a considerable amount of time. You have seen our international outreach. I can't think of any other -- we go on international trips for this, that, and whatever -- but I can't think of any rulemaking or any other topical area where we have done this type of international outreach and study. We are members of international committees, but I think this is -- we will see where it comes out. But the only thing I wanted to reinforce is we recognize this is important and the staff is looking at it through that lens.

MS. GIBSON: Now this is Kathy Gibson. I am a Division Director in the Office of Research, responsible for the MACCS2 code. And I have a statement and then a couple of questions, clarification for Ms. Lambert, if she doesn't mind.

First, I would refer members of the public that may not be as familiar with the MACCS2 code as Ms. Lambert is, we included in an enclosure to the SECY paper related to the economic consequences issue. The SECY number is 12-0110, dated August 14th, 2012.

In that enclosure, we provide an overview of the MACCS code, changes that were made to the code as a result of the State-of-the-Art Reactor Consequence Analysis Project, additional features that we are working on to include with the code.

And I also wanted to make the comment that the input values that we used, we tried to be as realistic as possible. The MACCS2 code is a tool that provides information to the decisionmakers. It is go or no-go type of tool.

MS. LAMPERT: Yes, I realize that it provides information -- this is Mary Lambert -- to decisionmakers. The question is the quality of that information, what the assumptions are, and what the inputs are. I didn't get the answer to who is doing the analysis. Is it staff? Is it Sandia? Who is doing it?

MS. GIBSON: Yes, my understanding is that we are scheduling a meeting in October where we will specifically present our analysis for the consequences using the MACCS2 code. So, we will have more specific answers for you --

MS. LAMPERT: Are we going to be able to get the full analysis, so we can actually look at what was put into the code and have some of our experts analyze whether it makes any sense or whether it is garbage-in/garbage-out. I hate to sound flippant, but having looked at what Entergy put into Pilgrim's, actually, looking at all the inputs, et cetera, I know the New York Attorney General has done the same for what was put into IP's SAMA analysis.

And so, if we can't really get it and run the code through, it is not going to be worth anything. Do you know what I am saying?

MS. GIBSON: Yes, I understand. I can't speak specifically to what will be available to us, since we haven't finished the analysis, written the report, or prepared the presentation.

I did want to ask you, though, a couple of questions. I appreciate you providing this ahead of time, so we can be more prepared to cover some of the things in a meeting that is coming up.

You referred to an ML number for a paper or a report that was provided, I think you said, for the economic consequences Commission meeting.

MS. LAMPERT: I don't know what you are

talking about. Can you do it again, ask again?

MS. GIBSON: Yes. I thought you had said that you had submitted a paper for the economic consequences Commission meeting.

MS. LAMPERT: Yes, that's right.

MS. GIBSON: Okay.

MS. LAMPERT: It was submitted September 13th. It is on the Commissioner meeting website. I don't know the ML. It is entitled, "Pilgrim Watch Comment Regarding NRC Staff Analysis to Manage Radiological Releases Following a Severe Accident in BWR MARK I and MARK II Containments".

MS. GIBSON: Okay. My question is, does it cover the types of things that you laid out in your presentation today?

MS. LAMPERT: Yes. And wait a minute. Is that the same one? Let me see.

MR. MONNINGER: So, we have the August 7th --

MR. FRETZ: Mary, this is Bob Fretz.

MS. LAMPERT: Yes.

MR. FRETZ: You had sent me a letter. Is that the same paper that you are quoting or that was being referenced?

MS. LAMPERT: Yes, that is correct.

MR. FRETZ: Then, I believe we do have that, yes.

MS. GIBSON: Okay. Great. Thanks.

One last question for now.

MS. LAMPERT: And there are a ton of references. If you want any more, then give me a call because, also, I could refer you to the expert testimony provided for the New York Attorney General's office, focused on cleanup and, also, focused on meteorological modeling in ATMOS.

MS. GIBSON: Yes. Thanks. We have access to that.

MS. LAMPERT: Okay.

MS. GIBSON: I can answer your question now on who is doing the analysis. It is a combination of my staff and the staff from Sandia National Labs. And you know we are using MACCS2.

Do you have any input? You say we should incorporate lessons learned from Fukushima into the model.

MS. LAMPERT: One would be for this CDF, the core damage frequency. That would be one, obvious. Another certainly would be aqueous because, currently, you are only modeling atmospheric releases, but we are seeing from Fukushima not only the feed-and-bleed situation, but when the atmospheric releases wind up in the forest and the trees, on the soil, then it gets into the water. Then, it gets into the streams and, you know, there you go. And so, that has to be added because you are doing, at best, half a loaf or a third a load.

Also, very key would be getting the decontamination waste issue because, as you know, the MACCS2 really is based upon the assumptions of WASH-1400, which were based upon a weapons event. This is 12(a) or (b) in the New York Attorney General's adjudication for IP, where it is explained very clearly that weapons have large releases as opposed to nuclear reactors with very tiny ones. And it is far more difficult to clean up after a nuclear reactor accident because of particle size than a weapons event. But the MACCS is assuming a larger-particle size.

Also, in a weapons event, you have large mass-loadings. That clearly has an effect on cleanup, as does a weapons event based on plutonium, which is alpha. And therefore, workers can come in if they are properly suited and clean up faster than they can after a nuclear accident.

So, I mean, there is so much there, not to mention waste. I mean, Japan has set aside until the end of 2014 $14 billion just to try to deal with the waste.

I mean, it is ridiculous. I mean, when you think about it here, I am just imagining, I am just looking at my neighbor. I am looking at my property. It is over a couple of million dollars. I am up the creek.

MS. GIBSON: Okay. Thank you.

MR. LEYSE: Yes, this is Mark Leyse -- I have a question for you -- from Sandia National Labs regarding the same code.

MR. FRETZ: Okay. I guess, Mark, we can go ahead, yes.

MR. LEYSE: Okay, sure. Okay. Well, the MACCS code, as I know it, basically, that is an acronym standing for MELCOR Accident Consequence Code System. Anyway, this is a question about MELCOR, which also applies to the calculations that you have run.

Now, from what I understand, MELCOR, and also EPRI's code, MAAP, they are one-dimensional codes. But I have seen reference to a paper by, I guess, Randy Gauntt of SNL. He wrote something about a simulation of the Three Mile Island with an enhanced two-dimensional model of MELCOR.

Anyway, I just wanted to ask you, is MELCOR that you are using for these calculations, and also as part of MACCS, is that one-dimensional or is that two-dimensional?

MR. FULLER: This is Ed Fuller from --

MR. LEYSE: That is for the thermal hydraulic model, just to specify.

MR. FULLER: Yes, this is Ed Fuller, senior-level advisor for severe accidents in the Office of Research.

Both MAAP and MELCOR, I wouldn't call them any dimensional codes. They are essentially lumped-parameter codes where you have nodes and junctions for the various regions of the containment. These codes include a lot of models for phenomena that you expect would arise during a severe accident: thermal hydraulic phenomena, fission-product release transport, and deposition phenomena.

And they would, for example, calculate a release to the environment of cesium-137. That is input to the MACCS code. So, in Ms. Lambert's statement that MACCS underestimates the release from the core, she is really saying that, in her opinion, MELCOR or MAAP underestimate the release from the core.

MS. LAMPERT: Correct.

MR. LEYSE: Now, one thing, there is a recent IAEA report which has characterized MELCOR and also MAAP as doing calculations that have one-dimensional thermal hydraulic models. So, that is what I want to ask. These codes, have they been, you know, improved since that or are they, in fact, using one-dimensional thermal hydraulic models? Because that is, like I said, those codes have been characterized as that.

MR. BASU: Hello. Sud Basu from the Office of Research.

When you refer to MELCOR and/or MAAP, or for that matter any lumped-parameter code, as one-dimensional code, I think what Ed was saying previously, it is kind of tank-and-pipe type of model where you connect a number of things, and you can line up those things axially in a series, and also radially, and then connect through pipes in two dimensions, if you would.

Now how do you actually treat the thermal hydraulics? You can actually look at your flow path, and you can have reverse flow path between the two control volumes, the tanks that I mentioned previously, and you can simulate the two-dimensionality, either radially-directionally-reversed or in radial and azimuthal direction. So, there is a way to simulate the two dimensionality or multi-dimensionality thermal hydraulics, though, using so-called lumped-parameter code.

Does that answer your question?

MR. LEYSE: Maybe not quite. Just in terms of the thermal hydraulics, the modeling of that, would you characterize it as one-dimensional or two-dimensional? Which would you characterize it as? Like I said, I have come across a number of references in one IAEA report which does characterize it as one-dimensional in terms of the thermal hydraulic model.

And the reason I am pointing that out is that the same report says that codes like MELCOR and MAAP, that they predict less hydrogen production than codes like ICARE/CATHARE for a given severe accident scenario.

MR. BASU: I think I can respond to that hydrogen-production issue, but let me go back to your one-dimensionality versus two-dimensionality. For all practical purposes, MELCOR has been assessed against multi-dimensional thermal hydraulic experiments. So, in terms of characterizing thermal hydraulics, you can consider it as two-dimensional. Again, you have to keep in mind that it is a lumped-parameter code with a controlled volume kind of model. So, there is some smearing of properties within the controlled volume. So, there is that aspect. But it does simulate two-dimensionality.

Coming back to your hydrogen issue, I think you will find, if you have gone through MELCOR, there are oxidation correlations, and there are a number of oxidation correlations. The default oxidation correlation is Urbanic-Heidrick.

MR. LEYSE: Yes, I am aware that you are using that correlation.

MR. BASU: Right, but --

MR. LEYSE: I think you use it, actually, between the temperatures of 1520 and 2,880 degrees Fahrenheit, actually.

MR. BASU: Exactly, from 1,000 all the way to 2800.

So, if you look at Urbanic-Heidrick versus any other correlations, you will find that about 1200, actually about 1200, all these correlations converge. So, there is hardly any difference between the results you will get from one of the other correlations.

Now, if you go below, say about 900 or below, there is a difference. But you have to also consider at that temperature what is the oxidation effect. It is very slow. So, yes, you can produce a little more hydrogen there, depending on which correlation you use, or a little less hydrogen. But if you look at the total hydrogen production indices versus what you what you would be producing at the tail-end, at the lower end of the temperature, it is not really that significant.

MR. LEYSE: Yes. Okay. I understand that. And actually, I should probably let the meeting continue, because when I present, I will actually be addressing the issues that you are talking about regarding Urbanic-Heidrick and how that actually underpredicts the amount, when a code uses it, it actually underpredicts hydrogen generation rates. But I think I should just let the meeting conclude.

But thank you for answering the question regarding MELCOR.

MR. BASU: You're welcome.

MS. LAMPERT: Can I make a correction? To the staff member who asked what paper I was referring to, I gave the wrong one. The one I was referring to was titled, "Comment Regarding SECY-12-0110, Consideration of Economic Consequences within the NRC's Regulatory Framework". And that was submitted to the NRC Commissioners September 6th, 2012, and Bob Fretz has the ML for that.

MR. FRETZ: Right.

MS. LAMPERT: Another paper that is important, I think, is Pilgrim Watch's request for a hearing regarding the insufficiency of order modifying licenses with regard to reliable hardened containment vents, filed April 2nd, 2012.

The Atomic Safety Licensing Board ruled only on the procedural question of precedence and whether that allowed a hearing. That question on the correctness of their decision is currently filed as a petition for review, and it is before the Commissioners right now. Depending upon their decision, we will see where it goes, up or down.

Did that help? And I am sorry for providing the wrong document.

MS. GIBSON: Yes, thank you.

MR. FRETZ: Again, thank you for your clarification.

One thing I will add, those two documents will become a part of our meeting summary. For those who have the benefit of the webinar feature, the two documents that Ms. Lambert is referring to are the first two under the "other documents submitted to the NRC," again, referencing the Pilgrim Watch. And again, those two documents are available in ADAMS. They should be available right now. Again, they will become part of the meeting summary.

So, thank you for that input regarding that.

Before we move on, I would like to go ahead and finish up any sort of presentations or comments or questions from those here in attendance today. I understand that, Paul, you might have some comments --

MR. GUNTER: Yes, sir.

MR. FRETZ: -- or information you would like to present to us. So, I would like to go ahead and hear that first before we go to general questions.

MR. GUNTER: Okay. Again, my name is Paul Gunter. I am Director of the Reactor Oversight Project at Beyond Nuclear in Takoma Park, Maryland.

And I would like to address this working group more with a concern, and it is not anything new that we haven't addressed before, but I want to take this opportunity to reiterate.

Let me, first of all, just preface my remark by saying that we remain concerned, as David has pointed out, that the current effort is a workaround for a violation of the general design criteria for an essentially leak-tight containment. This is an old issue that we now find dramatically magnified by actual accidents and land contamination.

And so, the effort to now, after going through Generic Letter 89-16 and the voluntary request, which demonstrated the dramatic failure of both the previous reliable hardened vent and the well-known unreliable containment, we are now going through another iteration.

We find it of concern that the Order EA 2012-050 reflects the segmentation that has cut the filtration issue as well as the hydrogen-generation issue out of the Order, except with this very obvious truncation where the Order does require that the vent, this enhanced reliable hardened vent, shut and remain closed under severe accident condition.

But there is no analysis, there is no service, including the filtration, for that vent to open again. And so, it sort of brings us back to square one with this unreliable containment.

We have been puzzled by the agency's silence or lack of rationality for moving forward with the industry to design, fabricate, install, and potentially operate a vent with this incomplete analysis, which brings us to a much larger concern that this segmentation is more of a political problem than it is a technical issue. Because I think we all recognize, as you have recognized, that technically the vent has to close and remain closed under severe accident condition, including fuel damage. And then, we are just sort of, you know, what next? Will you need to vent the containment or not after it is closed?

And so, if you could help us understand your rationale for proceeding with a half-measure, as we see it, a very dangerous half-measure? And, in fact, as was presented in the Pilgrim testimony, perhaps a measure that is more dangerous than just leaving things as they are.

So, the concern is that, if you could provide me with some sense of, first of all, what you are going to do with the testimony and the rationale that has been presented to you today. I mean, we concur with our colleagues with regard to the obvious rationale for putting a high-capacity filter on. I am sure Mark is going to talk with a great deal of specificity and with a rational approach to the hydrogen issue, as is presented by severe accident conditions.

But we are concerned that, you know, Svinicki has already telegraphed, as a Commissioner, her take on what this Order will and will not manifest into.

And so, first of all, is it your understanding that your recommendation will be going to a notation vote before the Commission?

MR. MONNINGER: Yes.

MR. GUNTER: So, whatever is said here, it moves next to a vote of this Commission?

MR. MONNINGER: Yes.

MR. GUNTER: Okay.

MR. MONNINGER: Plus all your previous input and --

MR. GUNTER: Well, input aside, because our input and the industry input, we don't see them as equal footing. As a matter of fact, our concern, our overriding concern right now, is that the intent here is to do nothing; that the DTVS as installed, it is our concern that the industry lobby effort, as represented by NEI, and as we heard in Institute for Nuclear Power Operation's testimony before the National Academy of Sciences, they said repeatedly that the DTVS at Fukushima, one, worked. It was a success, is what they said, for Units 1 and 3.

You can look at the transcript. I was there. But the testimony of INPO reflects that the DTVS at Units Dai-ichi 1 and 3 were a success in their venting operation. This leads us to believe, along the fact that the Order is currently segmented to exclude the post-fuel-damage event, that the path that we are on right now is for a vote that will end this discussion with the current Order EA 2012-050 with no consideration of post-fuel damage. You know, this is all going to play out.

I hope that I am not disappointed again. I think that, again, it is our concern that the technical judgment of this staff, you know, from earlier testimony from this working group, I understand that you have an understanding of the value of a high-capacity filtration vent. I mean, you have reflected that in your earlier meetings. Unfortunately, they weren't transcribed, but, you know, it is clear to us that, at least in my judgment, that the staff is interested in moving forward with this high-capacity filtration vent, except that we are going to move this to a new level of evaluation. And it will be a bottom-line consideration, as we are concerned; that to leave things as much alone as we can, let's just go with what we have got, and maybe tinker, maybe paint something.

I am sorry to be facetious, but the level of how this has been just cut off by this Order, and an Order, by the way, that doesn't take any actions into regulatory space until the end of 2016. So, for us to be on an action path before you now with regard to filtration, hydrogen generation, without any timeline is really worrisome, particularly because we don't even have the justification for the continued operation of these MARK I's and MARK II's in your analysis space of how you can justify their continued operation with the DTVS, as it was demonstrated at Fukushima Dai-ichi.

So, that will conclude my remarks. If you have any comments, I am happy to dialog further on this.

MR. MONNINGER: A couple of thoughts. One -- this is John Monninger with the staff -- we do very much appreciate the comments. A couple of thoughts.

The segmentation, I believe -- and I was just joining the organization at the time -- the notion was, and the Commission directed the staff to consider filter vents in any decision for the reliable hardened vent in the Order that went out. The staff still had that underway when they prepared the Order and went forth with it.

So, it is not meant to foreclose the potential within the future for the potential for a filter vent or the potential for -- there is another terminology we use -- severe-accident-capable event, which we haven't really discussed today. We use different nomenclature, the filter vents, and then there is something else we are looking at called the severe-accident-capable vent.

But I think the thing is, as you mentioned, within the Order there was the notion of a capability to close that vent, but the Order doesn't direct them to close it. It says that "design shall have the capability to...." The actual operations would still be governed by the EOPs at the plant. There are design features.

The Order reflects design features, and that design feature says you shall have the capability to close under, but it doesn't necessarily direct it to be closed. The actual operations of it would be in accordance with the EOPs, which is the same with the old vent that you called DTVS, the old Generic Letter 89-16 --

MR. GUNTER: Right, Direct Torus Vent System.

MR. MONNINGER: Yes. You know, that one also was not necessarily severe accident design, and its operation was controlled through the EOPs.

So, with that, I would like to maybe ask a question. We used this terminology "severe-accident-capable event". That would be the notion of we go back in and we relook at the vent that we put in place with the Order and what kind of additional uprates, not including a filter, would be required in order for it to be more capable or a higher reliability under severe accident conditions, whether it is additional pressures, additional temperatures; whether it is radiation shielding; whether it is consideration for hydrogen. You know, if you had any inputs along that line?

Our paper that would go up to the Commission in November, one option, of course, is filter vents.

Another thing we have to explicitly address is additional requirements for the March Order, then, for severe accident conditions. There could be other options. One of the other options, of course, would be to do nothing else. You know, it is nothing else, severe-accident-capable event, filter event, et cetera.

So, did that make sense?

MR. GUNTER: Yes.

MR. MONNINGER: Yes. So, any thoughts you would have on what should be done with the reliable hardened event order for severe accident conditions minus the filter?

MR. GUNTER: Well, obviously, the one that comes to mind, as demonstrated by actual events at Fukushima Dai-ichi, are ignition points.

MR. MONNINGER: Right.

MR. GUNTER: It is our understanding that this vent is going to have to close fast and hard, and that, particularly with metal interface for valve closures, you can get sparks. So, again, we are puzzled by the fact that the Order only takes us halfway. I mean, I don't understand why that this Order is event-driven, as dramatically demonstrated as it was that we are only going halfway in terms of not considering the most dramatic lesson with being fuel damage. And that has been expressly cut from the Order, which will be driving, again, design, manufacture, installation.

And is everybody going to go back and do rework on this? We don't think so. I mean, we are sort of presented with this concern that it is sort of foregone conclusion where we are headed with this. Again, it is worrisome.

And I don't mean to throw that back on staff, but your scientific judgment we fear is going to go through an economic filter.

MR. DENNIG: I think in terms of there is going to be a notation vote paper, and it is going to lay out the regulatory analysis portion of things. It is going to lay out defense-in-depth arguments. It is going to lay out foreign experience. It is going to lay out the history of the issue. All of the things that you have mentioned are part of either enclosures or the body of the paper itself, things that are considered. And a range of options from leaving things with the Order the way it is through to making it severe-accident-capable with an external filter are being evaluated within the context of the paper. I don't know what else to say.

The option of making it severe-accident-capable and that it would be able to open and close with greater reliability in a severe accident situation, and then not have an external event, obviously, would depend on whatever decontamination you got from internal processes under the circumstances of the accident. So, that is the understanding of what you get with that option. And so, that is going to be discussed and laid out.

MR. GUNTER: But, again, the fundamental issue here is the unreliable containment. So, you have to provide for some analysis and evaluation that you may have to, and likely will have to, open that vent again. I think that is what driving the public nuts right now, is that under the current status, that analysis is not apparent because the filter is not there. It is not there in the Order, and the hydrogen detonation is not there in the Order. This is a big concern to us, that we are looking at an ineffective half-measure.

MR. RICCIO: This is Jim Riccio with Greenpeace again.

Yes, as Senator Menendez wrote to the Chairman, this seems imminently reasonable. We are here discussing what seems to be imminently reasonable. The perspective from the public is that you have the corporation an opportunity save their asset, but you have taken the steps yet to ensure that that attempt doesn't dose the public and their workers. That seems to be out of step.

I don't know how else to explain it. I think you get it. I can tell from your faces you get it.

I don't know what we have to do, whether we have to get more Senators to write the Commission. I don't really understand what buttons we have to push around here anymore to actually get you guys to act.

MS. LAMPERT: Well, I have an idea: wait until the accident that is inevitable to happen and then act after, like in Japan. That is a thought, Jim.

MR. RICCIO: That is what we are trying to avoid, Mary. That is why we are here today.

MR. FRETZ: David.

MR. LOCHBAUM: Yes, this is Dave Lochbaum with the Union of Concerned Scientists.

The question you asked about for severe-accident-capable valves, I am a little reluctant to answer that question because we are so convinced that filter is required. If you are against lynching, you don't want to, then, discuss what is the best rope to use if you are going to lynch. So, I am a little reluctant to answer that, but I will do it anyway.

We have our concerns about if you left the status quo or had these severe-accident-capable event valves, the reliable hardened vents, that requires a lot of operator decisions when it comes time to open those valves. One of the problems we have already is severe accident management guidelines are very poorly-trained. The NRS inspection audit after Fukushima showed there is a wide range. Some of them weren't even available in the control rooms, at least at that time.

I used to work for the NRC teaching severe accident management guidance to NRC inspectors. The first thing out of our mouth was, "You are not allowed to audit these at your respective sites. They are voluntary."

So, if you provide severe accident guidance with no filters, then there is a greater dependence on the operators to determine when that is right and when that is not right, based on conditions. What is the condition of the torus? Basically, you are asking them to guess a lot of information that probably won't be available in that severe accident and then make informed decisions based on no information or a vacuum. That gives them a good excuse for getting it wrong in hindsight, but it gives them no basis for getting it right at the heat of the moment. So, basically, you are setting up the operators for failure, and that is not what the role of the regulator should be.

MR. MONNINGER: So, the SAMGs, one of the recommendations which is still in process would require SAMGs for plants. That is per the ANPR, the Advanced Notice of Proposed Rulemaking, the integration of the EOPs, the SAMGs, et cetera.

So, I personally don't know the extent of the regulatory footprint, but SAMGs will, well, they are proposed to be, then, required. I can't say extent that the rule and the inspections, and all that, will result in, but the approach now is that SAMGs, it is a Tier 1 item that the Commission directed us to proceed forward with. What that ends up being within the next couple of years, we will see, but it is the intent that SAMGs would be required.

MR. DENNIG: From my perspective, all the -- I think you just brought up cons, not many pros -- but all those cons are in our deliberations. They are not questions that the staff isn't aware of that need answering.

So, one would have to explain how active management of it is superior to some other solution from a technical perspective or just lay out the pros and cons of that. And so, that is what we are going to do.

MR. LOCHBAUM: Well, I think it also circles back to the -- this is Dave Lochbaum again -- I think it circles back to the point I made during earlier discussions about certainties and uncertainties. If you have a filter on there, you are reducing the dependence on the SAMGs being successful, the operator's implementation of the SAMGs being effective and timely. Whereas, if you don't and you rely on them getting it right at the right moment in time, because it is not a static situation, you are decreasing the likelihood that it is a successful outcome.

So, I think if you apply the uncertainty principle, it steers you toward the right answer, no matter which --

MR. DENNIG: The Commission policy is to take into consideration uncertainties, and we are doing that. Those kinds of uncertainties are part of the problem.

MR. LOCHBAUM: I will look forward to reading that paper, then, because, hopefully, it will answer those questions.

MR. DENNIG: So do we.

(Laughter.)

I also look forward to not writing that paper.

(Laughter.)

MR. LEYSE: This is Mark Leyse speaking. I just want to add something regarding Dave Lochbaum has just articulated that the SAMGs are not defined; they are non-legally-binding at the present time. I just also want to point out that, in order to implement certain SAMGs properly, the operators need to know what the status of the reactor core is.

And just as things are right now, it is very highly probable that operators would not know what the status of the core is. With a BWR, they might be depending on trying to monitor the water level in the core, which is a very inexact science. They may be trying to depend on the temperature of the primary containment building, which is inexact, or suppression pool temperature.

It is just like with Fukushima; the operators most likely would not actually know what the status of the reactor core was. So, that would be a very big problem in terms of properly implementing SAMGs. So, I just wanted to point that out.

Thank you.

MR. RICCIO: And this is Jim Riccio with Greenpeace.

Again, to back up what David was saying about the need for this to be passive, the need to have a filter in place, while you are working Fukushima fixes, the NRC staff has simultaneously been boosting power on reactors around the country, which has reduced the accident response times for your operators.

So, again, taking pressure off your operators, not putting them in the position to have to make the tough decision, is a better position to be in. And I am sorry if I am having deja vu on this because this came up again 20 years ago, about taking pressure off your operators, not putting them in the position where they have to make the bad decision in the environment without a filter in place.

If you sense the frustration in the public's voices, it is, again, because Mary and I were at the meetings 20 years ago, and again, Paul's indication that the separation of the Order on the reliable vents from the filter indicates the direction this agency is headed. And we will do our best to change that direction, but, again, when you have a Commissioner that seemingly has already made up here mind without even seeing the evidence prepared by staff, we have an upward battle on our hands.

MR. SHADIS: Good morning, everyone.

Are you now accepting comments from the general public?

MR. FRETZ: Okay. Well, again, this is Bob Fretz. I guess the operator did say that.

We did have one question. Before we go to the public comments on the phone, I think we did have one question that was submitted, using the webinar feature. And what I have got to try to do is I have to step away to read that. So, I can turn around, and maybe the microphone can pick it up.

But the question is -- well, the question is Anna Baker -- and the question is: "What is the NRC's biggest holdup for not having a filter in the event of a nuclear explosion? Why do other countries have this and we don't?"

Okay. Again, I guess that is really maybe more of a comment than anything else, but --

MR. RICCIO: No, that is a question.

MR. FRETZ: That was a question?

MR. RICCIO: That is a question.

MR. FRETZ: Well, I guess that question --

MR. DENNIG: Our process requires us to write a notation vote paper, and that is how we are dealing with it. So, the holdup is --

MR. RICCIO: Why not answer the question of why this country doesn't have the vents that Europe has had for a generation?

MR. DENNIG: That is one of the things that gets answered in the paper.

MS. LAMPERT: We are a Third World country, Jim.

(Laughter.)

MR. RICCIO: Yes, we are kind of tired of being treated like second-class citizens.

(Laughter.)

MR. FRETZ: Okay. Any other questions from members here in attendance?

MS. LAMPERT: Mary Lambert.

I think one theme that should be brought home from this is what Ed Lyman brought up of active-versus-passive systems. That was followed up by the comment on how many unknowns there really are.

I would direct everybody to Kamiar Jamali's article on the use of risk measures in design and licensing of reactors and the examples. This also shows why any number out of a cost/benefit analysis code, any result has to be taken for what it is.

He talks about examples of uncertainties in PRAs that include "probabilistic quantification of single and common-cause hardware or software failures, occurrence of certain physical phenomena, human errors of omission or commission, magnitudes of source terms, radionuclide release and transport, atmospheric dispersion, biological effects of radiation, dose calculations," and many others. That is on page 935 of his article. I believe he works at NRC.

So far, we have talked there are so many uncertainties. We know one thing for sure, that GE MARK I boiling water reactors are poorly-designed. They have too small suppression pools. We have not a theoretical basis for that, but now we have real-world, Unit 1, Unit 2, and Unit 3.

So, therefore, the vents have to be an acceptable fix not only to relieve the pressure, the hydrogen, et cetera, so the god-awful doesn't happen, which we acknowledge can happen, but that when used, you don't contaminate the neighborhoods around. And also, so that the workers are capable of doing their work and, also, that they will follow orders.

There still is a question brought forward by The New York Times reporting on whether or not the workers decided to vent when told to or not, or whether, as The New York Times reported, they say, some say they delayed doing so because they hoped, they hoped, they hoped they wouldn't have to release all this contamination.

So, you have got to take this into consideration. Again, I would put my last slide up before you go home, and that is: whose side are you on?

And are you going to be intimidated by the Commission and Commissioners and higher-ups who have indicated, at least Commissioner Svinicki: don't confuse me with facts. We have made up our minds. If you like your jobs and you want to pay your bills, you make peace with the devil.

MR. DENNIG: I would just like to make a comment on that from the working staff level, from the technical staff. We do not feel intimidated, and we are writing a paper. And the Commissioners will get to look --

MR. RICCIO: She didn't say you are intimidated; she said she is biased.

(Laughter.)

MR. DENNIG: Okay. Okay.

MS. LAMPERT: I am glad, because I have seen that happen so many times, not with the NRC necessarily, but let's face it, it happens in most organizations.

MR. FRETZ: Okay. I think, with that, we will go ahead and turn to questions and comments from those who are participating on the phone. Maybe try to queue yourself up, and we will just go basically through anyone with a comment.

MR. LEYSE: Yes, just one thing. This is Mark Leyse.

Is there sometime when I can make my presentation?

MR. FRETZ: Okay, Mark, I wasn't aware you were able to attend. I guess we can go ahead with your presentation next.

MR. LEYSE: Oh, okay. Just one thing first. I think at one point -- I am not sure he still is on the phone -- Ray Shadis wanted to make a comment. I thought I recognized his voice. So, I thought I would let him say something that he was going to say first, and then I would follow, if that is all right.

MR. FRETZ: That would be fine.

Ray, are you on the line?

MR. SHADIS: Well, I am, and I was waiting for general comment time. However, yes, I can just go ahead real quick.

I just have two short comments. One is my understanding is that a drawback on the rupture disc option is that, once you blow the disc, you can't shut it. But I am also sensitive to the idea that you are looking for a passive relief valve.

There are many options other than a no-valve or a rupture disc. When I was a kid, we had steam heat in my home. On top of the boiler was a relief valve, and the pressure, relief pressure, was determined by the number of weights that were put at the end of a lever. In other words, it was gravity-operated. And as near as I could tell, it was failsafe, although not foolproof, because we kids used to open it all the time.

(Laughter.)

But, nonetheless, it only illustrates that a gravity-operated relief valve can be overridden. So, a mechanism can be put in place to close it, if necessary.

The other comment really has to do with the question of the vents. In reviewing the presentation materials from the Regulatory Information Conference, in which apparently some of the European folks went into why they chose to install the filters, one item was from the Swiss, I believe. They set a goal, and the goal determined whether they were going to put filters in or not. And that goal was zero fatalities.

I think, if you all could see your way past all the risk numbers and dose goals, and all the rest of that, and simply agree that the goal should be zero fatalities, I think you would be, then, driven to accept the idea that anything coming out of the reactor should be filtered.

So, those are my two comments. I really don't need a response. I just wanted those to be on the record.

MR. FRETZ: Okay. Well, thank you, Ray.

I guess we will go to Mark Leyse.

MR. LEYSE: Okay. Mark Leyse speaking.

First, I would like to thank the NRC and Robert Fretz for providing me with time to speak.

I understand now that the NRC is conducting computer simulations of different severe accident scenarios using the MELCOR code and that such simulations will be used for the NRC's regulatory analysis on various filter venting options. And Electric Power Research Institute, EPRI, is also conducting analyses to determine possible alternatives to installing the filters on BWR MARK I's and MARK II containment vents.

Most likely, I think we have said even in this meeting, EPRI is using the MAAP code, M-A-A-P. That is their code.

So, in this presentation, I want to point out that the MELCOR and MAAP codes underpredict the rates of hydrogen production that would occur in a severe accident, especially the rates of hydrogen production that would occur if there were the reflooding of an overheated core.

As we discussed earlier, the MELCOR code uses the Urbanic-Heidrick correlation to help predict zirconium steam reaction rates. Urbanic-Heidrick is used between the temperatures of about 1520 degrees Fahrenheit. Actually, below that, there is really not very much oxidation. And it goes up to approximately 2880 degrees Fahrenheit. That is using this correlation.

And just real quick background, Urbanic-Heidrick, this correlation was developed in experiments that were using induction heating. This is having a very tiny specimen, maybe an inch-long little piece of zirconium that would be in the induction heater coils, and they would have steam pumped through that. And then, they would measure from weight gains or hydrogen production. They would, then, determine the different reaction rates that had occurred at different temperatures. The point is this is not very realistic in terms of accident scenario or severe accident scenario.

There have been tests done by other people with induction heating experiments where they can tweak the specimen, and depending on how they would optimize the geometry of the specimen, they would register different reaction rates. So, there are a lot of ways where one could, you know, if they wanted to, they could even manipulate such an experiment. I am not trying to say that Urbanic and Heidrick did that, but I am just pointing that out.

And now, the paper that talks about how specimens have been tweaked to register different reaction rates, the title of that paper is, "Recommendations and Supporting Information on the Choice of Zirconium Oxidation Models in Severe Accident Codes". That is by Georg Schantz, and it is a Karlsruhe, Germany, paper from 2003.

Anyway, back to what I am saying. So, I just want to point out that in October 2001 a paper was published by the OECD Nuclear Energy Agency. The title is, "In-Vessel and Ex-Vessel Hydrogen Sources". This states that computer codes, all severe accident computer codes, MELCOR, MAAP, all of them, using the available, all available zirconium steam oxidation correlations -- Urbanic-Heidrick is one of them -- they underpredict hydrogen production in severe accident scenarios, and especially if there would be the reflooding of an overheated reactor core.

This paper states, quote, "Reflooding and quenching of the uncovered core is the most important accident management measure to terminate a severe accident transient. If the core is overheated, this measure can lead to increased oxidation of the zircaloy cladding, which, in turn, can trigger a temperature escalation. Relatively short flooding and quenching times can thereby lead to high hydrogen-source rates, which must be taken into account in risk analysis and in the design of hydrogen-mitigation systems.

Until recently, the experimental database on quenching phenomena was rather scarce. The available zircaloy steam oxidation correlations were not suitable to determine the increased hydrogen production in the few available tests, among them the CORA tests and the LOFT LPFP2 experiment."

I sent that comment in with a reference, and that information is on page 9 of the paper "In-Vessel and Ex-Vessel Hydrogen Sources".

Anyway, the NRC's calculations with MELCOR, using the Urbanic-Heidrick correlation, underpredict hydrogen production rates in severe accident scenarios, especially in those scenarios where there would be a reflooding of an overheated core. And EPRI's MAAP code also underpredicts hydrogen production rates.

And there are plenty of other papers that reiterate this same point. A 1999 paper, "Current Knowledge on Core Degradation Phenomena: A Review," it is from The Journal of Nuclear Materials. It states, quote, "No models are yet available to predict correctly the quenching processes in the CORA and LOFT LPFP2 tests.

No experiments have been conducted that are suitable for calibrating the models. Since the increased hydrogen production during quenching cannot be determined on the basis of the available zircaloy steam oxidation correlations, new experiments are necessary." End of quote.

Among those new experiments -- this was 1999 -- were going to be quench facility experiments that were conducted at Karlsruhe, Germany. Anyway, as it turns out, computer safety models also failed to predict hydrogen production in the initial quench facility experiments.

In 1997, Oak Ridge -- well, I guess that was before this 1999 paper -- but, anyway, in a 1997 Oak Ridge National Laboratory report explicitly states, quote, "In the initial quench facility experiments conducted at Karlsruhe, Germany, the hydrogen generation could be determined by available zircaloy steam oxidation correlations." End of quote.

The 1997 ORNL report states that, "Hydrogen production in severe accidents can be divided into two separate phases. First, a phase in which the fuel cladding is relatively intact. That is through the initial melting of the fuel cladding. And second, a phase after the initial melting of the fuel cladding in which there is melting, relocation, and the formation of uranium, zirconium, oxygen blockages."

And it says, "About 25 percent of the total hydrogen is produced in the first phase, when the cladding is intact, and about 75 percent of the total hydrogen is produced in the second phase, when there is a melting, relocation, and formation of blockages."

Now I know that doesn't always hold true, this 25/75 percent because there was one experiment, one of the core experiments, in which during the quenching, actually, 90 percent of the hydrogen was during the quenching process.

Anyway, according to the 1997 ORNL report, computer safety models predict the rates of hydrogen production for the first phase, in which the fuel cladding is intact, quote, "reasonably well," unquote, but predict the rates of hydrogen production for the second phase, in which the fuel cladding is no longer intact, quote, "much less robustly". End of quote.

This report stresses that it is obvious -- they highlight that word -- it is obvious that computer safety models, quote, "must be capable of accurately estimating the zircaloy steam reaction rate during the period of fuel cladding degradation and blockage formation, since the majority of the hydrogen generation has been demonstrated to occur during this timeframe."

So, clearly, the safety analyses that the NRC and EPRI are now conducting regarding filtered vents for BWR MARK I's and MARK II's, they are non-conservative because the MELCOR and MAAP codes are inadequate for accurately predicting the rates of hydrogen production that would occur, especially in the phase when the fuel cladding would no longer be intact. That is just something to keep in mind. I don't know you get around that.

And something I also want to point out, as I have pointed out, Urbanic-Heidrick, the correlation is formed by induction heating very tiny specimens. Now in a BWR reactor core, you are going to have boron carbide neutron-absorber material. At the higher temperatures above 2200 Fahrenheit, you are going to have eutectic reactions between the zircaloy fuel rods and the stainless steel on the surface of the cruciform-neutron absorbers.

Anyway, at one point above 2200, the boron carbide is going to start reacting.

(Telephone technical issues.)

MR. MONNINGER: Mark, I am not sure if you can hear us. We can't hear you at the moment.

But one of my thoughts is we do have, in NRC lingo, a Tier 3 issue on hydrogen, hydrogen generation and control. We are getting that project up and going.

I know there is some relation to your concerns here, but it would seem, to a large extent, the generation, the production, and all these issues are probably most appropriately addressed within that Tier 3 issue on hydrogen generation and control.

I know this afternoon the Office of Research will be discussing their predictions from MELCOR on the amount of hydrogen release from various station blackout scenarios.

But what we want to try to do, to the extent possible, is to --

MR. LEYSE: Hello. This is Mark Leyse. I'm sorry, I was cut off when I was just speaking with you.

MR. MONNINGER: Yes.

MR. LEYSE: Yes, I believe I was talking about boron carbide when I was cut off.

MR. MONNINGER: So, Mark, could I just maybe through in 15 seconds?

One of our thoughts is, the NRC, we have a separate project. This is the filter vent project. We do have a separate study underway as a result of Fukushima on hydrogen production and control. We are going to have public meetings, stakeholder engagement, et cetera.

I know there is relevance to these issues to the filter vents and the amount of hydrogen coming out. And we will have discussions from our Office of Research this afternoon. I am just not quite sure whether some of these discussions aren't more appropriately suited to our discussions on hydrogen production and control, when we do do those stakeholder engagements.

Does that make any sense?

MR. LEYSE: Yes, this is Mark Leyse. May I continue now?

MR. FRETZ: I guess, in the interest of time -- I know we have 15 minutes left on the agenda -- if maybe we could keep the comments to a minimum?

MR. LEYSE: Okay. I wasn't quite finished with my presentation. May I finish? I don't have too much further to go.

MR. FRETZ: All right. Thank you.

MR. LEYSE: Yes. Okay. I was just talking about boron carbide oxidation in steam, which would occur at some point over 2200 degrees Fahrenheit. Boron carbide is more exothermic than zirconium. So, you are going to have a lot of heat in a BWR accident that would be generated from the oxidation of the boron carbide. That heat is going to influence the reaction rate of the zirconium. It is going to speed up the reaction rate of the zirconium, and it is going to even result in a faster temperature excursion.

Now, just to put this in perspective, there are thousands of pounds of zirconium in the core and hundreds of pounds of boron carbide. So, it is going to probably be a local effect. It is going to not have the overall effect of oxidation, but locally in hotspots it could really influence the reaction rate. So, that is all the more reason why Urbanic-Heidrick is just really unrealistic in terms of a real-world accident.

Now I want to point out that, in a July 2012 report that I wrote for Natural Resources Defense Council, the title -- it is in the record for this meeting -- the title is, "Post-Fukushima Hardened Vents with High-Capacity Filters for BWR MARK I's and MARK II's".

I point out that in a BWR severe accident hundreds of kilograms of non-condensable hydrogen gas would be produced, up to over 3,000 kilograms. Actually, I think it would actually go up above 4,000 kilograms if you had a complete meltdown.

And the rates of this hydrogen production could be as high as between 5 and 10 kilograms per second -- 5 and 10 kilograms per second -- if there were the reflooding of an overheated reactor core. And that would result in a rapid increase of the internal pressure in the primary containment.

In the reliable hardened vent piping, to accommodate such a rapid pressure increase, the vents piping would most likely need a greater diameter and thickness than what the hardened vents presently installed in BWR MARK I's have in the U.S. The diameter of those pipes is typically 8 inches in diameter.

If a hardened vent needs to be designed, actually, there is a quote in the NRDC paper on page 4 -- I won't spell it out -- but it basically talks about how designing a vent for one of these rapid-pressure scenarios might be very difficult. So, I just want to point out that a hardened vent needs to be, if it is, indeed, going to be reliable, it needs to be designed so it is going to perform well in scenarios in which there would be a rapid containment pressure increase; for example, in the scenarios in which there would be the reflooding of an overheated reactor core.

As I pointed out, I think in addition to something that Dave Lochbaum said about SAMGs' lack of definition in some cases are different approaches, it is very likely that plant operators would not know what the status of the reactor core was during a severe accident. They would have to depend on trying to figure out what the water level in the reactor pressure vessel was -- that is very not precise -- or trying to rely on the temperature of the suppression pool, things that are very delayed in terms of trying to figure out what is going on, especially in a fast-moving accident.

So, it is very probably that the operators could actually end up reflooding an overheated reactor core. So, this is something that any analysis with MELCOR or MAAP, it needs to take into consideration that scenario. That is the scenario that occurred at Three Mile Island, the quenching an overheated reactor core. I believe in a couple of minutes' time they produced around 300 kilograms of hydrogen in that accident.

Anyway, the conclusion is that, if you cannot develop a vent that would be able to accommodate these rapid-pressure increases, perhaps the NRC should either consider shutting down or not relicensing BWR MARK I's and MARK II's.

Just to conclude, I want to emphasize that if you are able to develop a hardened vent that would work -- it is a doubtful thing; it might work; it might not -- but if you do develop that, I want to point out that you should definitely have a filter for it.

In the NRDC paper, on page 5, I point out that in any accident in which there was early venting of the containment, a high-capacity filter would be needed to help protect the surrounding population who would not have time to evacuate and prevent becoming exposed to radioactive releases.

Thank you. And I am happy to answer any questions you may have. Thank you.

MR. FRETZ: Anybody? So, yes?

MR. BASU: I am Sud Basu from the Office of Research.

Thank you for the information that you shared with us. What would help is to have, if you could provide some reference to some of the numbers that you quoted in your presentation, like 5 to 10 kilograms per second of hydrogen production, that number.

MR. LEYSE: Oh, sure, I would be more than happy to. Should I email that information to Robert Fretz?

MR. FRETZ: Yes, please.

MR. LEYSE: Okay. But just in the meantime, that specific point, for rates between 5 and 10 kilograms per second, in the paper that is actually in the record that I referred to, the "Post-Fukushima Hardened Vents with High-Capacity Filters for BWR MARK

I's and MARK II's, on page 2, I have information regarding that. I do have the references for the 5 kilograms to 10 kilograms.

MR. BASU: Thank you, Mark.

MR. FRETZ: Yes, we see that, yes, Mark.

MR. BASU: I am told that we do have that reference. Bob Fretz just needed to get it. So, we will get it. Thank you.

MR. LEYSE: Okay, sure. But, nonetheless, I did introduce some information that is not in that paper or in some other comments I submitted. So, I will itemize that information with references, and I will email it to Robert Fretz.

MR. FRETZ: All right. Thank you, Mark.

MR. LEYSE: You're welcome.

MR. MONNINGER: I would just also mention, Mark, I did mention we have this effort underway to evaluate hydrogen production again, hydrogen control, et cetera. So, hopefully, you will join us for those meetings and exchanges.

MR. LEYSE: Oh, thank you. Yes, I would be more than happy to.

MR. FRETZ: Okay. Well, I would like, in whatever time we have left, to have -- any more questions from the phone? On the phone, and then we will get to you.

MR. WACHOWIAK: This is Rick Wachowiak from EPRI.

I just want to state for the record that the characterization of the work that we are doing was not exactly as the last presenter had said. We are not looking for alternatives to filters. We are looking at the merits of radiological mitigation strategies, including filters.

As we presented a couple of weeks ago, what our conclusion is or what our insight is from this is that, unless we have the things that are characterized as active systems, like the spraying and the flooding, to manage the temperatures of the debris, that the filters don't provide much additional benefit.

MR. COLLINS: And that is because?

MR. WACHOWIAK: Because there are secondary --

MR. COLLINS: Because the are other failures?

MR. WACHOWIAK: There are secondary containment failure modes that come into play based on high temperature.

MR. COLLINS: Right, it is the old melt-through thing, right.

MR. WACHOWIAK: But our study was intended to analyze the effectiveness of filtration as well as the other strategies.

MR. COLLINS: This is Tim Collins.

Yes. So, in other words, you are saying that there are two distinct challenges to the containment in severe accident that you need to address, not just filtration, but there is also a liner melt-through concern?

MR. WACHOWIAK: Liner melt-through and, also, overheating if, for some reason, you can't get the core temperature down.

MR. FRETZ: Okay. Any comments or questions from those who are on the phone?

(No response.)

Okay. Hearing none, we are going to at least temporarily close this portion of the meeting. We will be reconvening at 1:00 p.m.

MS. LAMPERT: I want to say one thing, Bob. I want to acknowledge how accommodating you have been, and thank you for it. You are a delight to work with.

Am I correct that you said that it will be transcribed? So, if that be the case, I had asked to be on this afternoon. So, obviously, there is no need for that if it is going to be transcribed.

MR. FRETZ: Yes. Yes, Mary, we were able to get a court reporter to transcribe the entire meeting from the start to finish.

MS. LAMPERT: Oh, that is great. And again, thank you very much, and thank everybody else for this opportunity.

MR. MONNINGER: Now turnaround for the transcript is generally more than a week of time?

MR. FRETZ: Yes.

MR. MONNINGER: This afternoon or tomorrow -- I am not sure what it is.

MR. FRETZ: Yes. Normally, it is a week to 10 days. So, we will get it in the public domain as soon as we can.

And I guess, with that, we will take a brief time out of an hour, and we will reconvene at one o'clock.

Thank you.

(Whereupon, the above-entitled matter went off the record at 11:58 a.m. and resumed at 1:03 p.m.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

(1:03 p.m.)

MR. FRETZ: Okay. I think enough people have been able to reconvene with us that we can go ahead and get started.

Okay. Thanks, Steve, for closing the door.

Again, this is Bob Fretz. I am a member of the Japan Lessons Learned Project Directorate and the Project Manager for the issue of filter containment vents.

We will reconvene our meeting that finished about 12 o'clock earlier this morning.

I would like to introduce Allen Notafrancesco, who is from the Office of Research, who will be presenting information regarding the MELCOR case studies that we did to help us support the regulatory analysis.

So, Allen?

MR. NOTAFRANCESCO: Okay. What I am going to present is calculations done by Sandia, and we guided them to what sequence to look at. But these are initial results of the MELCOR accident progression analysis for MARK I containments.

Next slide.

This slide just provides an overview of the topics I will be discussing: the objective, the model overview, discussion of results, insights, and follow-on activities. JLD, with the containment vent issue.

Next slide.

In the red is the MELCOR calcs that we have done and where it fits. The output goes into the MACCS code. I am talking about like cesium release fractions and then, ultimately, it feeds into the regulatory analysis.

Okay, next.

Okay. To move on, to expedite the process, we are aware of, obviously, the SOARCA work, the State-of-the-Art Consequence Analysis, and Peach Bottom was one of the reference cases. So, we started off reviewing the SOARCA activity and tried to piece together what we will do the Fukushima effort we did.

So, the baseline cases for Peach Bottom SOARCA was unmitigated station blackout sequences, no sprays, no venting. The two dominant failure modes that were revealed was liner melt-through, drywell liner melt-through, and overpressure due to drywell head flange leakage.

The various sensitivities produce, would pressurize the reactor building to some degree. So, blowout panels will open. There would be local hydrogen combustion and potential roof failure of the refueling bay.

And this slide summarizes some of the insights that we have drawn upon to start coming up with sequences to get the ball rolling early. Fukushima-like sequences, we focused-in on the long-term accidents, which was Unit 2 and 3, which demonstrated prolonged RCIC operation.

So far, the current thinking is that the dominant failure of the containment is overpressure through the drywell head flange, and potentially other penetrations would have to be identified.

The reactor building response was quite clear, a couple of explosions in Unit 1, 3, and 4.

MR. LOCHBAUM: Can I ask a question about that point? On slide 5, you point out that you are actually doing accident response, including local H2 combustion and roof failure, et cetera, from the leakage. Does the model look at potential threats to RCIC operation, this perfected RCIC operation due to what is leaking from containment, whether hydrogen or other?

MR. NOTAFRANCESCO: No, we didn't tie-in the -- because usually the combustion is afterwards, the operation, way past.

MR. LOCHBAUM: Okay.

MR. NOTAFRANCESCO: Okay?

MR. LOCHBAUM: Okay. Thanks.

MR. LYMAN: Another question. So, it doesn't appear that the drywell liner was melted through in any of the three units?

MR. NOTAFRANCESCO: Well, that is the consensus so far, I gather, unless somebody really does more investigation.

MR. LYMAN: All right. So, the Sandia model of Fukushima, it didn't find drywell or melt-through for Unit 1, is that right?

MR. NOTAFRANCESCO: That's correct. It turns out, if you look closely at the water injections of each of the units, 1, 2, and 3, it turns out it was at a nice time in which it is tough -- you could always say the water injection helped mitigate the liner melt-through.

MR. LYMAN: So, it kind of froze the core, the molten core, in place?

MR. NOTAFRANCESCO: Right, right.

MR. LYMAN: And Units 2 and 3, at least the April 2012 report, this public report, said that there was no vessel melt-through in Units 2 and 3. Is that still the consensus of the model?

MR. NOTAFRANCESCO: I think the latest

version, there is some failure of the low head and there is some core on the floor for those.

MR. LYMAN: Right. So, that isn't public yet, though?

MR. NOTAFRANCESCO: The SAM Report --

MR. MONNINGER: So, then, there's gazillions of reports out there. So, probably the April stuff you are talking about is the TECO reports.

MR. LYMAN: No, it is the Sandia --

MR. MONNINGER: It is the Sandia ones.

MR. NOTAFRANCESCO: The recent version came out the past month or two, publicly published. I think it is public.

MR. GABOR: The DOE report?

MR. NOTAFRANCESCO: Yes.

MR. GABOR: Yes, I think so.

MR. LYMAN: And then, there was one that came out in August 2012, but it is dated April, or as of April 2012. And so, that says that they were using injection rates that may have been too high.

MR. NOTAFRANCESCO: I think they probably covered themselves to say, hey, we had to freeze the assumptions, based on the knowledge of April of 2012.

MR. LYMAN: Right. Right, right.

MR. NOTAFRANCESCO: Okay?

MR. LYMAN: Okay.

MR. NOTAFRANCESCO: But I understand what you are saying, that some of the early calculations they did in Units 2 and 3 they did not damage the lower head and the core stayed intact in the vessel.

MR. WACHOWIAK: So, you said that it was based on Peach Bottom; it was done for SOARCA. Is that in an operated Peach Bottom, like it is today, or is it old power Peach Bottom?

MR. NOTAFRANCESCO: Well, it is what is consistent with the SOARCA report, whatever is documented there.

MR. WACHOWIAK: Okay. All right.

MR. NOTAFRANCESCO: And I will get to the next slide after the Fukushima slide. Okay. It is putting together these aspects I just mentioned. We are using the baseline SOARCA Peach Bottom model. We are using the same control volume, slow paths, et cetera.

Some of their modeling features, we retained some of the RCIC logic, SRV operability. There is no pump seal leakage in these assumptions.

One of the key modifications we made was to nodalize the wetwell volume a little bit because we believe there is some stratification when you have long RCIC operation. And some of the preliminary Fukushima analyses show that Unit 3, you needed to break up the wetwell to capture the pressurization.

MR. WACHOWIAK: Did you break it vertically or --

MR. NOTAFRANCESCO: No, just --

MR. BASU: Azimuthally.

MR. WACHOWIAK: Azimuthally?

MR. NOTAFRANCESCO: Let's see, we are using the same MELCOR version as the SOARCA uncertainty analysis with our study here.

MR. GABOR: I have a question on that. Jeff Gabor at ERIN.

At the ACRS presentation, Sud made the comment about a change to the melt spreading as opposed to what was done in SOARCA. Can you talk about that and why that was done?

MR. BASU: Well, I will address that.

MR. GABOR: Okay.

MR. BASU: And I will repeat what I said at the ACRS meeting. When we are talking about spreading of core debris on the concrete substrate, what really matters is the properties, in this case, of course, liquidus and solidus of the core debris down there in the concrete substrate.

Now in SOARCA, the liquidus/solidus numbers that were used are for concrete substrate. So, we made the correction to use the core debris solidus/liquidus. So, what is the net effect of that? It basically slows down the spreading.

So, in SOARCA you saw the melt almost instantly spread to the liner in what, six-seven minutes. In this case, we are seeing spreading to span about a couple of hours.

MR. GABOR: And the basis, the technical basis, I mean, does that mean that SOARCA should be updated to reflect that? Or what is the technical basis for that change?

MR. BASU: Well, I think SOARCA, you can look at the SOARCA results as a conservative result, because what you are doing is you are failing the liner as quickly as it can, with the assumption that you are making. Now if you were making the assumption that we are making for the containment venting study, you will be failing the liner a little bit later.

So, I don't think either of them needs to be updated. It is just when SOARCA was done, that was the scenario that was used. Now you can go back to the SOARCA uncertainty analysis and see what effect the change in the solidus/liquidus might have on SOARCA results. And I suspect what you are going to see is that the liner is failing a little bit later. It is still going to fail.

MR. NOTAFRANCESCO: It is definitely within the uncertainty band of these analyses. Okay.

MR. LYMAN: I'm sorry, could you explain how the stratification helped prolong RCIC? It is because of the temperature, the steam is lower --

MR. NOTAFRANCESCO: The temperature is being dumped in a small area in the wetwell. So, that gets hot. It is driving the atmosphere hotter. So, the pressurization rate is heightened 10 to 20 psi over that time. Okay?

MR. MONNINGER: As opposed to making it one uniform volume.

MR. NOTAFRANCESCO: Yes, it absorbs all the heating that is uniformly distributed.

MR. BASU: And just to be clear, we are not talking about axial or vertical stratification in this case. We are talking about localized temperature.

MR. LYMAN: So, I thought RCIC failed in SOARCA because, if you couldn't control the water level, then the steamline would float. So, you are saying that happens later or --

MR. NOTAFRANCESCO: Well, the assumption is that you say it fails at four hours. Then, you can't control it and it fills up. It goes into the steamline. Then, it messes up the pump and it stops at 5.9 hours, or something like this.

So, we took the same logic. We just moved the bar to 16 hours. It would fill up and heighten the level, and it would stop at 17.9 hours, for example.

MR. LYMAN: So, it was kind of arbitrary. You adjusted the parameters.

MR. NOTAFRANCESCO: Well, I used -- the Fukushima had extended RCIC operation. Okay? And the negative --

MR. LYMAN: So, you assume that as an input? You don't quite understand it, but you assume?

MR. NOTAFRANCESCO: Well, these are analytical exercises. I am just providing a scoping study of what you can change and what the results are, and you could see how things group and what is significant.

MR. BASU: I think if you look at Peach Bottom, for example, the battery time there is eight hours, even though in SOARCA we actually used four hours RCIC. But you could carry on RCIC for eight-plus hours.

In Fukushima Unit 2 --

MR. LYMAN: Yes, but Unit 2 lost DC power. So, they didn't have any control from the beginning, right?

MR. BASU: True. True, but when you look at Unit 3, in Unit 3 the RCIC ran for about 20 hours.

MR. LYMAN: Right.

MR. BASU: So, short of any definition as to what the duration of RCIC will be, if there is going to be a mitigation strategy, we thought we would just run a series of RCIC timing. So, we did run, actually, a case of RCIC of four hours. We ran RCIC eight hours --

MR. LYMAN: The RCIC time is an input. It is not coming organically out of calculations?

MR. BASU: Now it is an input, yes.

MR. NOTAFRANCESCO: What is happening in a core melt accident, you have got to get rid of the water after a while and then it boils down. So, the issue is, obviously, later on there is less decay power driving the accident. And I can tell you we will have less core debris on the floor with a 16-hour versus a 4-hour.

Okay. So, in the scoping study we did here, like I say, we took the 16-hour RCIC operability. We assumed core sprays or no core sprays or drywell sprays. And we assumed a 300-gpm when we activated each one of them, unless we have done some sensitivity even within that time.

But, generally, the containment venting is through the wetwell, and the sensitivity analysis varied these parameters for actuation, RCIC duration, like I say, and spray flow rate.

Again, this is the SOARCA cross-section that was used for Peach Bottom, like I say, consistent, but just to orientate ourselves.

Okay, the next slide.

MR. VIJAYKUMAR: What is the difference between the possible and actual in that?

MR. NOTAFRANCESCO: The what pathway?

MR. VIJAYKUMAR: The possible and actual. We have two scenarios here. It says, possible versus --

MR. NOTAFRANCESCO: Okay. Cycling was just left open.

MR. VIJAYKUMAR: Okay.

MR. NOTAFRANCESCO: I will get to that and you will see some cases in that regard.

Next slide.

Okay. This is a snapshot of some of the calculations we did and provides a timeline. Case 2, when it says "RCIC only," that means it is just 16 hours of RCIC, then boil down to core melt, and then we look at the dynamics in the response of the containment and the RPV.

And Case 3 is a vent case.

Case 6 is a RCIC with a core spray actuated after the lower head fails.

Case 7 is RCIC core spray and event.

And Case 14 and 15 are basically drywell sprays at 24 hours, again, the 16-hour RCIC operation.

MR. LOCHBAUM: I have got a question on some of those cases. When you say "core spray and drywell spray," those are the traditional core spray and drywell spray? It does not FLEX or --

MR. NOTAFRANCESCO: Well, I am assuming FLEX flow rate, 300 gpm.

MR. LOCHBAUM: Three-hundred-plus? Okay.

MR. NOTAFRANCESCO: No 5,000, 3,000.

MR. DENNIG: The headers are used, but the pump flow is different.

MR. LOCHBAUM: You don't have ac power back or anything like that?

MR. NOTAFRANCESCO: No.

MR. LOCHBAUM: Okay. I just wanted to clarify. Thanks.

MR. VIJAYKUMAR: One thing, I have a question here. It looked like everything, lower head failure, drywell, everything happens earlier.

MR. NOTAFRANCESCO: That's true. It turns out, when the vent -- actually, that 60 psig, it was in the regime where the core was boiling down and ready to melt. So, the venting enhanced hydrodynamic flow and really enhanced the metal-water reaction and produced more hydrogen.

So, by accident, I found the worst part in doing that. So, I will show you some plots in that area.

MR. BASU: So, you can relate to that with the hydrogen, but that should be, also, a little higher.

MR. NOTAFRANCESCO: Next page.

Okay. And I will get to some plots now next.

MR. BASU: No.

MR. NOTAFRANCESCO: Oh, you have got another one?

MR. VIJAYKUMAR: The cesium iodine and the plain iodine?

MR. NOTAFRANCESCO: Okay. It is both, right?

MR. BASU: Yes.

MR. NOTAFRANCESCO: It is both.

MR. BASU: So, what you are seeing there is the cesium. I mean, you start to see the partitioning of iodine and cesium that is shown here in the release fractions.

MR. VIJAYKUMAR: Again, the same thing, you can see that, with the vent, iodine is actually higher.

MR. BASU: Yes.

MR. VIJAYKUMAR: So, we don't want to vent them, right?

MR. BASU: But, I mean, he is going to walk you through the plots, and then we will talk about the insights from the calculations. Let's not get to whether you want to vent earlier or not at this point.

MR. NOTAFRANCESCO: Okay, next slide.

Here is a plot of those cases. What I am trying to demonstrate here is the variability of the debris mass exiting the reactor vessel. It varies because it is lumped-parameter codes. Some of the components are not hot enough to melt. So, they stay in the core.

And really, what I want to get is the next one. The next one, this one is the drywell pressure. This you see in response to venting and sprays. Now venting is here open and left open, and that is Case 3, 7, and 15. Sprays only, you see sprays only, and you still overpressure. The plateau is lower pressure failure, so you are leaking. And then, the difference in liner melt-through. You need water on the floor to prevent liner melt-through in our calculations.

Okay, next.

This is a plot of only in-vessel hydrogen production. It is kilogram-moles. And it varies, roughly, within 100 kilogram-moles.

MR. WACHOWIAK: Rick Wachowiak from EPRI.

In these cases here, the onset of core damage is right around 24 hours, and we see the increase in hydrogen at that point. Then, the failure of the vessel tends to be out, I think in most of these cases, at around the 36-hour mark.

MR. BASU: Thirty-three hours.

MR. WACHOWIAK: Well, a couple of them are 33, but I am not sure the 33's are on this one. But it looks like that -- why is the hydrogen production stopping in the middle?

MR. BASU: Okay. First of all, in terms of the failure timing, you can go back to the tables.

MR. WACHOWIAK: Yes. I picked some of that up.

MR. BASU: They were from 33 to 36 hours.

Why does the hydrogen production plateau at several points and then picks up?

MR. WACHOWIAK: And then pick up again.

MR. BASU: So, if you look at the hydrogen or CAD oxidation model, this is in-vessel.

MR. WACHOWIAK: Uh-hum, in-vessel.

MR. BASU: So, if you look at the CAD oxidation model in MELCOR, it has a criterion that says, until such time that the oxide thickness grows to a certain minimum thickness, it isn't going to defoliate or crack, thereby opening the unoxidized surface to further oxidation.

So, that is one reason why you don't see hydrogen production from time to time, because you are not being able to oxidize the pre-oxidized crack surface. That is just a criterion that is put in the MELCOR oxidation model.

The other thing is, from time to time, you also see some steam-starved conditions in the RPV. Now you know steam-starved condition, you don't expect other oxidation. That is why you see some steps.

But, really, what you ought to look into is the total inventory of hydrogen production, whether it goes that way or it goes continuously, because you can put in a different criteria in the oxidation model that says it is oxidize continuously. In other words, the surface, some fraction of the surface, will be always available for oxidation. And so, you will get a continuous curve rather than a step curve.

MR. GABOR: Yes, this is Jeff Gabor. I would like to follow up on that discussion.

So, the relocation of the core is around 26 hours, looks to be pretty consistent for all of these cases, going back to the table.

MR. BASU: Right.

MR. GABOR: And then, lower head failure does vary from, like you said, 33 up to 37 maybe for Case 2. So, just so I am understanding, you think that perhaps at around, looking at this chart, that around 32 hours and beyond, is that the point where this criteria on allowing the inside clad oxidation to occur, do you think that you are hitting the criteria at that point and that provides additional zircaloy to oxidize?

MR. BASU: You are actually hitting it in the corner. If you look at the 26-hours model, you have an initial amount of hydrogen production that is going from zero to 400 kilogram-moles. By then, you have oxidized the clad surface to a certain thickness, that it is no longer producing any further oxidation, and it is staying until -- then, the clad, the oxidized surface is cracking or defoliating at about, as you said, between 32-36 hours. That is when it is picking up the oxidation.

MR. WACHOWIAK: This is Rick Wachowiak.

From your slide 10, it is saying that the relocation is at about 26 hours. So, that looks like that is right at the time when that plateau happens. So, is that just some of the core relocating to the lower plenum, not all of the core?

MR. VIJAYKUMAR: This hydrogen is before then. You can see that everything happens about 24 hours. The 26 hours is a little bit after that. So, the first peak is before the relocation.

MR. WACHOWIAK: Before the relocation?

MR. VIJAYKUMAR: Yes. But after the relocation, you can start to see within 32 and 36, that is when all the zircaloy becomes in pieces and starts reacting with the steam.

There are two parts to this. The first part is before --

MR. BASU: The first part is before the relocation.

MR. WACHOWIAK: And then, the second part is after relocation?

MR. BASU: That is correct.

MR. LOCHBAUM: The core spray that is assumed in Case 6 or 7, what is the timing on that? Is that from failure of RCIC or --

MR. NOTAFRANCESCO: It is basically after the lower head failure.

MR. LOCHBAUM: Okay. So, that is why it is not successful in preventing --

MR. NOTAFRANCESCO: Right, right, right. I was trying to come close to Fukushima, where there was supposedly some core on the floor for Unit 2 and 3. It gets some core spray and it goes through. So, I was trying to look at hydrogen because things become steam-stopped. So, I was trying to throw some water back in the system, too.

MR. LOCHBAUM: I was just trying to understand better. I appreciate it.

MR. GABOR: I have another question. Jeff Gabor.

I know it is hard to generalize, but looking at your results, approximately, do you have a feel for what fraction of the total core remains behind, basically either in the lower head or in above the core plate, after the vessel fails? Because I think we showed in the EPRI analysis that for most of our scenarios we are typically more approaching 100 percent core melt and transport into containment.

Do you have any feel for kind of how that breaks down in your runs?

MR. BASU: Yes. If you go to, I think it is slide 12 --

MR. GABOR: Oh, that's right. Okay.

MR. BASU: And then, you look at vessel failure, which is between 33 to 37 hours, you can see for different cases there is a different amount, obviously.

MR. GABOR: So, give me an idea of what 100 percent is. Do we know that?

MR. NOTAFRANCESCO: It is about 350 metric tons.

MR. GABOR: Three fifty? Okay.

MR. MONNINGER: This is John Monninger.

Going back to Dave there, you were asking about core spray and the timing and all, or the drywell sprays. What that is important to the staff, as you heard from the staff earlier, and you actually, I think, heard EPRI mention that, it is not just vents or filtered vents; you need water on the floor.

So, in going forward with our assessment, it is not successful if one was to assume a filtered vent; that is not enough. If you want to do something, you need water on the floor also to prevent liner failure.

MR. DENNIG: It is less successful for a shorter time.

MR. MONNINGER: It is less, yes.

MR. DENNIG: So, you will be successful with nothing going on inside, cooling and removing heat, with that filter and the vent open for a period of time, longer than it would be if you didn't have it open. But, eventually, at some point, everybody's goal is to get water into the drywell and then into the vessel, if it is still intact.

And those things have always been important in terms of protecting the liner from melt-through. The more the liner is protected from melt-through, the more benefit you get from a vent or a filtered vent.

MR. MONNINGER: So, we are sort of looking at those in parallel. We had to assess for ourselves, and I think where we are coming out, when you look at some of the B.5.b and some of the guidance documents out there, it talks about the need to provide flooding for the cavity floor. So, you know, should that be our base-case assumption, that there is water on the floor, when we look at the filters or not? Or in our options should we be potentially look at requiring both? Are we potentially just looking at requiring a filter vent or are we potentially looking at requiring a filter vent plus a cavity-flooding system? Or do we assume that the cavity-flooding system is already there from the B.5.b stuff?

MR. DENNIG: The benefit of the cavity flooding goes way, way back to the Core Performance Improvement Program and IPEs. For MARK I's, getting water under the pedestal was a very beneficial action. It was recommended to the licensees to implement. So, it is an old -- I mean, it is not a new concept.

MR. LOCHBAUM: You find a new point for putting 100,000 gallons under the cavities during operation.

MR. WACHOWIAK: This is Rick again.

Could you show me on this one? I am having a hard time reading your legend. The dotted line? The lower one that is more black, it looks like it is more black, that is Case 15?

MR. NOTAFRANCESCO: Right.

MR. WACHOWIAK: Okay. And then, the next one up is like a purple on the screen, but it is apparently brown, that one is --

MR. NOTAFRANCESCO: That is Case 14.

MR. WACHOWIAK: And that is 14?

Then, when we get to some of the other ones that have the dotted lines, it is hard to tell which one is which. So, point them out, so I can take my --

MR. BASU: Sure. Yes. I am color-blind.

MR. WACHOWIAK: Yes, it is just an artifact of Excel plots.

MR. BASU: Yes. Okay.

MR. NOTAFRANCESCO: Okay, going to 15 --

MR. FRETZ: Slide 15

MR. NOTAFRANCESCO: This is gas evolution from core-concrete interaction. Even though there is water on the floor, we still predict CCI gas evolution. Okay?

MR. GABOR: Jeff Gabor.

So, I guess I had a couple of questions about this. What are the assumptions on ingression of water in the similar calculation that we showed to you guys, when we initiated sprays or flooding at containment? Based on the depth of the debris and ingression of water, we were able to quench the debris within a fairly short period of time. What assumptions go into your calculations relative to debris core?

MR. BASU: So, if you look at, again, the MELCOR model, the heat transfer from debris to the overlying water pool is sort of approximated by a simplified user-defined parameter, but that is based on the study that we have conducted. And you are familiar with some of the studies that actually EPRI coordinated. And then, they follow on the MCCI-1 and MCCI-2 program.

It is not a mechanistic model in MELCOR. Nevertheless, if you are familiar with the core-quench code, it does take the heat transfer correlations from the core-quench code and then simplifies it for MELCOR adaptation. So, you see the heat flux partitioning between the overlying pool as well as the sidewall and the basemat. That is fairly consistent with what we see in the MCCI-1 and MCCI-2.

We are obviously not seeing the quenching of debris as you are sort of modeling in the MAAP code. That is why you see, even with the water on the floor, some amount of CCI, and that is generating the hydrogen and other non-condensables.

MR. GABOR: Is it also contributing to the radionuclide release as well?

MR. BASU: Of course. Of course it will. Anytime you generate CCI or you have CCI, it will have the non-condensables as well as the radionuclide or fission products coming out of the core-concrete interaction.

MR. GABOR: Do you know approximately how deep the debris bed is in the containment?

MR. BASU: How deep? You know, I can put it on very quick. I have done all the calculations. It is probably 40-centimeter-plus.

MR. GABOR: Forty-plus?

MR. BASU: Yes. And then, you start adding concrete, remember, to that, as you are obtaining the basemat.

MR. GABOR: With this continued core-concrete attack, are there any subsequent containment failures or challenges that you see occurring?

MR. BASU: Not for the duration that we ran. We are running some of the cases to even 72 hours. We haven't seen anything. That is not to say that, if you were to run this thing for multiple days -- remember, also, as you are mixing more and more concrete into the debris, it is slowing down the ablation rate. So, at the end, you are going to get a very, very slow ablation. That is why what we are showing here is 48 hours. If we were to run this to 72 hours, you are going to see it is kind of asymptotic. It is plateauing to some level.

MR. GABOR: Is there any relationship that you see between your assumption on debris cooling and the continued CCI and the movement of the debris and potentially contacting the bottom of the shell? Do you see those two being treated consistently in your calculation?

I guess, more to the point, if you are attacking concrete, you have got the surface lubricating, would that change the assumption that you made earlier in the analysis on how the melt might spread?

MR. BASU: How the spreading goes? Again, the spreading model that is currently in MELCOR, it is parametric in nature. So, you actually play with a couple of things there. Solidus/liquidus is one of them, and the debris height is another.

If you were to look into a more mechanistic model where you consider the viscosity effect, the inertia effect, yes, you are going to see some changes. But I think those changes would be somewhat of a second-order effect. I can't, unless we sort of exercise that kind of a model -- and I don't know whether -- no, I guess you weren't there -- we were talking about DOE initiating a project or has initiated a project whereby they will be looking at the melt spread and core quench, so the implementation of that in MELCOR. So, we will see at that point whether it makes any significant difference.

MR. WACHOWIAK: Rick Wachowiak.

One of the questions I have with this on the continued CCI, we are trying to figure out if your release is being driven by a resupply of fission products from the core material that continues to be hot in a plate, the concrete, or if it is because the supply of radioactive materials in the atmosphere is coming from what is left behind in the vessel or whether it is from reheating of other surfaces and things in the containment.

So, do you have a breakdown of how much -- this is from measuring the cesium group -- how much of the cesium is in the core debris versus how much of the cesium is in the core that is left in the vessel versus how much of the cesium is on other surfaces?

MR. BASU: We have one, and Allen is looking --

MR. NOTAFRANCESCO: Slide 15, just for one case.

MR. WACHOWIAK: Okay. Yes, okay, that is one of the things that prompted my question.

MR. BASU: So, you can see that in this particular case -- this is Case 14, an example -- about half of the initial core inventory in terms of cesium is in a vent pipe.

MR. WACHOWIAK: Well, and that includes the water also?

MR. BASU: Yes.

MR. WACHOWIAK: The water in the wetwell is --

MR. BASU: Well, yes. In terms of liquid contaminants, is that what you are referring to?

MR. WACHOWIAK: Well, the water itself has trapped a whole bunch of the radioactive materials.

MR. BASU: Sure. True, yes.

MR. WACHOWIAK: So, probably the largest fraction I would have expected to be in the wetwell water.

The light green line, is that --

MR. GABOR: Is that the lower RPV?

MR. BASU: Yes.

MR. WACHOWIAK: So, that is what it left behind. Okay.

The dark blue is also stuff that is left behind. Okay.

MR. BASU: You see, what is left behind, which are actually all the lines at the bottom --

MR. WACHOWIAK: Except for the little maroon one that has got that slight blip there.

MR. BASU: Yes.

MR. WACHOWIAK: So, what that is telling me is not very much of the continued cesium can be coming from the core debris itself. It is the gases begin generated by the CCI that is helping drive other stuff out?

MR. BASU: Sure.

MR. WACHOWIAK: Okay.

MR. BASU: But you are getting over 80 percent of cesium through either the lower RPV or in the wetwell vent. So, you have 20 percent that stays, and maybe about 10 percent in the core region.

MR. WACHOWIAK: Do you think that is consistent amongst all of your cases, that kind of distribution?

MR. BASU: Well, we are looking at a case where about 80 percent is in the wetwell vent. So, you know, it varies from case-to-case.

MR. WACHOWIAK: Okay.

MR. BASU: All right?

MR. LOCHBAUM: Because of the difficulty of reading the charts, if it is not already there, could I ask that the one that is in ADAMS be the color-coded version?

MR. FRETZ: It will be colored.

MR. LOCHBAUM: Okay. Thank you.

MR. FRETZ: Yes, and full size.

MR. NOTAFRANCESCO: Okay. And besides the hydrogen generation from CCI, here is the carbon monoxide in kilogram-moles.

MR. DUBE: This is limestone-based concrete and calcium carbonate? I am not sure, what was that --

MR. BASU: I think this bottom concrete type is LCS concrete type.

MR. DUBE: If it were basaltic, there would be lot less hydrogen, right? I mean carbon monoxide. If it was basaltic-based concrete?

MR. BASU: There would be less carbon monoxide.

MR. NOTAFRANCESCO: Okay. Next slide.

Slide 17 is the cesium release fraction. It seems to be clustered, mostly on the bottom, in most of the cases. The more extreme one is Case 2.

Okay. Do you want to jump to 19?

This one is just the sensitivity based on spray actuation time versus cesium release fraction, just to get a sense of the magnitude.

The next one --

MR. WACHOWIAK: This is Rick Wachowiak.

What spray was that? Was that core spray or containment spray?

MR. NOTAFRANCESCO: This is containment spray. Containment is 300 gpm.

MR. GABOR: I guess I am struggling with these, the releases. These releases are all well below a 10th of a percent, is that correct?

MR. BASU: Yes.

MR. GABOR: So, this is the total release for scenarios with a wetwell vent and drywell sprays being actuated only? Those two actions?

MR. BASU: Yes.

MR. GABOR: And releases? And we are getting better than 99.9 percent scrubbing or efficiency?

MR. WACHOWIAK: Right. Because when you describe the case that way, it sounds like it is Case 15. When you go back to slide 17, Case 15 has almost --

MR. BASU: Fifteen is 24-hour drywell spray.

MR. GABOR: Okay.

MR. BASU: So, for this sensitivity study, we took that as the base case, if you will. Then, a couple of other cases where we actually took the drywell at eight hours instead of 24 hours, and also another case where we actually took the drywell spray at 16 hours.

MR. WACHOWIAK: Yes. So, what we are struggling with is in your case with spray at 24 hours, which looks like Case 15, I think, the release here is --

MR. BASU: I will say Case 14. There is no venting here.

MR. WACHOWIAK: There is no venting?

MR. BASU: No.

MR. WACHOWIAK: No venting?

MR. BASU: Correct.

MR. GABOR: Okay, but -- sorry, Rick --

MR. WACHOWIAK: Thank you.

MR. GABOR: In your table, back at your table that you provide for Case 14, you say that at 48 hours the cesium release was 1.12E-3. What we have been struggling with is to synch that number up with what is on this plot that you were just showing us.

MR. WACHOWIAK: This is showing 7.5E-4 from this plot.

MR. BASU: Yes, with the number that we have in it. So, what happened, when we ran the sensitivity cases, we also had a couple of other minor, I would say minor changes, that were made to the input deck. One of those was that, instead of running 16 volume wetwell that we partitioned to capture the localized thermal gradient, and that was presuming a lot of complication time, we looked at whether or not we can actually reduce the 16 volume to fewer volumes. So, we had a couple of cases with 4 volume and down to 2 volume. And then, we actually compared the results of 16 volume to 2 volume to 4 volume to see whether there was any significant difference in the result.

When we were satisfied that in all these accident progression there was no significant difference, we ran the sensitivity cases with the 2 volume wetwell nodalization. That kind of changed some of these numbers somewhat.

But, then, if you look at the magnitude here, we are still talking about below .1 percent. And so, I wouldn't really make too much out of these differences between the actuation spray time, eight hours, 16 hours, 24 hours, because they all were within the range of on some of these that you have a prediction of the fission --

MR. GABOR: I guess the conclusion we are drawing from this is that, for those sensitivities, I understand where you staggered the time that the sprays came on, every one of these cases, again, combined -- these are with a vent or not?

MR. BASU: No.

MR. GABOR: No vent?

MR. BASU: No vent.

MR. GABOR: So, even without a vent, just with the sprays alone, all of these cases show a release less than a 10th of a percent CsI or cesium?

MR. BASU: And then, if you say, all right, my base case from the 16 volume was slightly above .1 percent, okay, yes, it is slightly above .1 percent.

If we work around sensitivity with the 16 volume cases, at the cost of added time, I think we would probably see the same amount of spread.

MR. GABOR: Okay. Thanks. That helps a lot.

MR. BASU: Sure.

MR. NOTAFRANCESCO: Next one. After that one, the next one. There you go.

Okay. This is just a plot of sensitivity of flow rates. Clearly, something around 300, so 300 and above keeps it pretty flat.

Next.

MR. GABOR: Excuse me. And again, this is a case without venting?

MR. NOTAFRANCESCO: Right. Case 14 --

MR. GABOR: Fourteen is just driving a failure?

MR. NOTAFRANCESCO: That is correct.

MR. GABOR: Thanks.

MR. NOTAFRANCESCO: Drywell spray only.

MR. BASU: Drywell spray only.

MR. NOTAFRANCESCO: Next.

This is just a sensitivity of RCIC operations. Again, it is an input that drives the sequence. So, this reflected the hydrogen generation. So, a 16-hour, which is later, since there is less decay heat driving the system, it produced less hydrogen. So, that was a reasonable trend.

Okay. The next one.

This is a collection of plots, which is Case 18, which had to do with, again, 16-hour RCIC operation, but eight-hour drywell sprays, which will give you the blue line. And you will see, without venting, you will still pressurize, even with the sprays.

The red had to do with just opening the vent and keeping it open. So, you will get that type of shape.

And the green case is a cycling assumption based on 60 to 75 psia.

MR. LOCHBAUM: The 300 gpm is just a flat input? Like it doesn't --

MR. NOTAFRANCESCO: Right. It is not based on backpressure or anything.

MR. LOCHBAUM: Okay.

MR. NOTAFRANCESCO: It is just straightforward.

Okay. The next slide.

Basically, the insights from our calculations is that the presence of water is beneficial in preventing liner melt-through. Besides scrubbing fission product aerosols, it also reduced drywell temperature.

Venting is needed to preclude potential overpressurization failures, and wetwell venting is preferable. There is a need of a combination of venting and spraying to preserve the containment integrity. If you preserve the containment integrity, you will probably reserve the reactor building.

Okay. And the follow-on is the MELCOR calcs will generate the release estimates. Then, it will go into the MACCS code and the regulatory analysis. What we are going through now is trying to pick the sequences that best represent a grouping for the regulatory analysis.

Any other questions?

MR. WACHOWIAK: Yes, a couple more questions. The drywell head leakage that you said occurred at 80 psig, is that just 80 psig or is it temperature-dependent?

MR. NOTAFRANCESCO: It was consistent with the SOARCA stuff.

MR. WACHOWIAK: So, just pressure?

MR. NOTAFRANCESCO: Just pressure.

MR. WACHOWIAK: Okay. And do you remember what the size of that vent was? How many square centimeters or square --

MR. NOTAFRANCESCO: It would vary based on the delta-p.

MR. WACHOWIAK: So, you changed the area

based on the delta-p?

MR. NOTAFRANCESCO: Right, but it levels off to an equilibrium area. That is why it flattens off.

MR. WACHOWIAK: Okay. So, that is why those cases that show that you essentially vent the containment through the head all come to a constant pressure after that, and it just stays at that pressure? If you would run that longer, it would stay at that pressure?

MR. BASU: Yes, it comes to a steady --

MR. NOTAFRANCESCO: Right. And you see that profile in the Fukushima transients, too, Units 1 and 2.

MR. WACHOWIAK: Okay.

MR. LOCHBAUM: When RCIC was operating, for whatever case and whatever the assumption was, was that assumed a flat rate, the system design rate? I guess the reason I ask the question is that we had heard that at Fukushima they backed-down the RCIC flow substantially below the design flow rate, as one of the ways to try to get it to last as long as it did. So, if it is modeling based on Fukushima, that aspect is --

MR. NOTAFRANCESCO: No, we were consistent with the SOARCA.

MR. BASU: SOARCA study.

MR. LOCHBAUM: So, it would have been design RCIC flow rate, which was much, much higher than apparently they actually did at Fukushima.

MR. WACHOWIAK: With the design flow rate, though, you would end up filling, and you would have to stop and let it boil down and let it go back. Because the design flow rate out this timeframe is much, much, much higher.

MR. NOTAFRANCESCO: Right. There has to be some control. When the batteries are working, it is controlled. When there is no control, it will fill up and then it will supposedly go into the main steamlines and affect it that way, by having more going into those lines, the intake lines.

MR. GABOR: Jeff Gabor.

The demand is probably matching decay heat at that time. So, a couple hundred gpm or something like that.

Can I go back to a comment made about Fukushima, though, how they backed the flow down? For Unit 2, you have a reference for that? There is no indication that they did any operator action in Unit 2.

MR. LOCHBAUM: The Japanese team, one of the Japanese team members told --

MR. LYMAN: No, not for Unit 2.

MR. GABOR: Not for Unit 2?

MR. LYMAN: Unit 3, they used the test line or something.

MR. WACHOWIAK: The test return line. It is a way of doing flow control.

MR. GABOR: Okay.

MR. NOTAFRANCESCO: Okay. Any other questions?

(No response.)

MR. FRETZ: We will take questions from the floor.

Please identify yourself. Go to a microphone.

MR. SOLMOS: This is Matt Solmos from Westinghouse Electric.

Did you look at any early venting sequences? You know, core failure before vessel failure for venting?

MR. NOTAFRANCESCO: No. No, we just used 60 pounds, the design.

MR. GABOR: Yes, Jeff Gabor at ERIN.

At the ACRS presentation, you showed us a case that got our interest up relative to cycling and controlling of the wetwell vent, active vent --

MR. NOTAFRANCESCO: You don't see it here, do you?

MR. GABOR: We don't see it here.

(Laughter.)

Is there a reason for that? Or can we talk about that case?

MR. NOTAFRANCESCO: Well, it should have been run out longer.

MR. BASU: So, after the ACRS meeting, we took a task to actually extend the runtime to 72 hours. So, at some point in the future, we will be able to tell you. But I don't have any indication that -- the gap that you saw between the active venting and passive venting, that may close somewhat, but I have no reason to believe, based on physics or otherwise, that your passive venting is going to give you -- not passive -- active venting is going to give you significantly less release than the passive venting. You are still generating the amount of fission products, and that fission product has to go somewhere. So, if you are not releasing it, where does it stay in the circuit?

MR. WACHOWIAK: This is Rick Wachowiak.

That is where I think the main difference between what we have done and what you are seeing, is that in our cases, by the time you get out into the layer, you know, 24 hours after the additional core melt, not 24 from time zero, but from when the core has melted, our cases are pretty much done generating additional aerosols and putting them in the containment.

MR. BASU: Because you are quenching your debris.

MR. WACHOWIAK: Well, but just like you are seeing, there is no more cesium in that debris. So, even though the debris is quenched or not quenched, that can't be the source of the new material that is getting out. So, what I am trying to figure out with your cases -- and once again, because any strategy that we suggest needs to be robust and cover all the uncertainties, I need to understand why your cases continue to give you more generated aerosols.

I am thinking, but I don't know because I don't see the input, but it is looking like it is coming from the vessel, and the amount of stuff that is left behind in the vessel is continuing to generate --

MR. BASU: Some coming from the vessel, but, also, in your case, when you quench the debris, when you have water on top of it -- this is my assumption or speculation -- that you are trapping cesium there in the pool. You are not letting it be airborne or letting it go out.

MR. WACHOWIAK: And I looked at that.

MR. BASU: Yes.

MR. WACHOWIAK: And there is less than a half-of-a-percent of the cesium left in the debris after we have quenched it. So, it has all been gotten out and airborne in our cases ahead of when the debris is quenched.

MR. BASU: So, where are you putting that cesium?

MR. WACHOWIAK: On the surfaces, in the containment --

MR. BASU: So, it is depositing on the surface.

MR. WACHOWIAK: Depositing in the containment.

MR. BASU: Why would it deposit on the surface?

MR. WACHOWIAK: The sprays.

MR. GABOR: Yes, the sprays, it would wash out with the sprays. Gravitational settling.

MR. BASU: So, it is still active at that point?

MR. WACHOWIAK: Yes.

MR. BASU: So, they do spray --

MR. WACHOWIAK: Well, at 72 hours in our cases the whole containment is still filled with water. So, there is not much space left for it.

MR. DENNIG: Isn't one of the inputs into the spray, you put in the mean droplet size? That is user input?

MR. BASU: Droplet size is user input, yes. And we haven't done any sensitivity on the droplet size, but you have done it and you haven't seen really anything.

MR. WACHOWIAK: It is not a big difference. What we really see is that the sprays are cooling off the heat sinks in the drywell. And then, from condensation onto the heat sinks, it is bringing the aerosols in and depositing them on the heat sinks from that mechanism.

MR. BASU: Yes.

MR. WACHOWIAK: And if they are left inside the core and being dribbled out, that would get a different result and have more airborne for a longer amount of time than what we are seeing.

MR. BASU: Yes.

MR. WACHOWIAK: We would like to understand the difference.

MR. BASU: No, but you have seen the debris mass ejected plot. In some cases, about 90 percent of the mass was ejected. So, you have only about 10 percent, maybe 20 percent, still there that will produce additional cesium, yes.

MR. WACHOWIAK: Right, but that is when I get back to your plot on page 18. The amount of cesium that you have at 48 hours in the debris, the scale shows it at -- you know, it is the maroon line after 36 hours. There is almost nothing left in the debris. So, in your case, after about 36.1 hours, you have already released just about all the cesium that you have had in the debris into the containment. And your source would then seem to be, it is the light green line, the lower RPV.

MR. BASU: Uh-hum.

MR. WACHOWIAK: But it doesn't look like it is changing very much. So, that is where I am still --

MR. BASU: No, but --

MR. WACHOWIAK: But it doesn't have to change by very much on this scale in order to do these things. So, I would just like to understand better where your continued source of fission products is coming from.

MR. GABOR: This was important because, again, at least -- Jeff Gabor -- in the ACRS presentation, you showed with the cycling vent, the controlled vent case, that each time the vent was cycled open, there was a release. The release would just stair-step up to a maximum -- I can pull it up here -- like 4 percent or 3 to 4 percent total.

And, of course, we have been studying those and trying to figure out where that amount is coming from, where that cesium is actually coming from.

MR. BASU: Some of that -- I don't have the exact fraction -- some of that is coming from the debris that was held up in the pressure vessel.

MR. WACHOWIAK: Because some of what we are seeing with that case is that the first few stair steps kind of do the same sort of thing that yours does, but it is still well below .1 percent when you get there. But, then, we get to the point where the drywell pressure is low enough that you don't actually have to cycle the vent the next time for several days. And by the time you get to that next vent several days later, everything is settled out. The steam cooling in the drywell has cooled what we had left behind in the lower head, and I don't know if yours had actually cooled there. So, maybe we need to see the temperatures of that debris in the different locations to see what is going on with those.

But it is pretty calm by then. In our cases, it doesn't really matter what happens with the drywell vent or the wetwell vent out at that point because over those first couple of days everything is finally settled out, and everything is cooled down enough that we are not seeing the continued large stair-step. They are just teeny, tiny mouse-size stair-steps. And we don't ever get up over .1 percent.

MR. GABOR: Yes, and when we reviewed your results presented at the ACRS Committee, and we have done some comparisons because, as you know, our scenarios didn't line up completely with yours. We have actually gone back and done those comparisons. We find out that we are in pretty close agreement with most of your releases and most of your conclusions, with the exception of that cycling case. So, that is why we have really focused some attention on that.

As Rick said, in our scenarios we do end up with some fraction of the cesium in the RCS, in the reactor vessel, plated on surfaces. But by operating the sprays, we tend to see that the temperatures, even inside the vessel, are maintained, because of the cold drywell, are maintained low enough that that source term doesn't re-enter, and we don't see that release. So, the fact that you kept releasing was really the only major departure between your analysis and ours.

MR. BASU: And that is the difference in the modeling between MELCOR and MAAP.

MR. WACHOWIAK: Yes. So, that is one of the things that would help us out, is if we could understand why that is, and then address sensitivity or uncertainty cases to see if it just an inherent difference between the two codes that is going to get us there. Or is it some input value that you are using that we are using something different? I don't understand enough yet to know why we are getting such different results on those cases only. Because the other cases that we do, we are very consistent with the kind of releases that you are getting.

MR. BASU: Yes. And I agree. We probably ought to examine the input as well as the models. But, those aside, just from the fundamental standpoint, unless what you just explained, that your spray is washing your fission products and depositing on the surfaces, and those are staying on the surfaces, not letting it leave, I see no reason why in the cycle venting you will not be releasing -- let me put it another way -- you will be releasing significantly less fission products than in the so-called passive-venting case.

MR. WACHOWIAK: And the reason why it looks to us like we do get significant amount of different, less release, is because in the times when the vent is closed, a significant portion of the aerosols settle out of the atmosphere. So that when the vent is opened the next time, there is less to vent out.

MR. BASU: Yes, yes.

MR. WACHOWIAK: So, it is the continuous supply, I think, that might be --

MR. BASU: So, your vent cycling, remind us, I think the cycle frequency or duration is a few minutes?

MR. WACHOWIAK: Initially.

MR. BASU: Initially?

MR. WACHOWIAK: Initially. Then, it is hours later.

MR. BASU: Later probably, but, initially, a few minutes, right?

MR. WACHOWIAK: Yes.

MR. BASU: And the characteristic settling time, if you will, for aerosols, do you agree we settle all these aerosols in that --

MR. WACHOWIAK: That is why I say, in our cases where we are doing it, the first few stair steps that we see are very consistent with your stair steps --

MR. BASU: Okay.

MR. WACHOWIAK: -- if we keep the CCI going and continue to drive things. But we are very consistent with your first few stair steps. But, then, as ours get longer and longer apart, that is where we depart there. Right now, we are kind of grabbing at -- because we don't have enough information -- we are grabbing at why the differences are.

I see that the reason that our stair steps get smaller is because we are in the settling-out phase and we are not resupply the atmosphere with new aerosols.

MR. BASU: And none from CCI, either.

MR. WACHOWIAK: That's right. But, even if we had CCI, if we look at what is available in the debris to be released during the CCI, that is still not enough to give the effect that you are seeing.

MR. BASU: Okay.

MR. WACHOWIAK: There is not 10 to the minus 2 --

MR. DENNIG: The bottom line is that you can get really different results, depending on the code and the model and the assumptions and all these kinds of things, right?

MR. GABOR: Bob, I guess I am not sure I would agree with that. I mean, I think what we are saying is that, even with different codes and some different results, we are pretty much in alignment with the exception of this late-release case.

In fact, I was just going to follow up on Rick. As you saw in our calculations, we ran them out to 72 and in some cases, like I ran cases to 120 hours. By going to that duration -- and I think we were at 500 gpm; you were at 300 -- we get to a point where we have to isolate, per the SAMGs, we have to isolate the wetwell vent. And then, the next time we get the pressure to 60 pounds or when it repressurizes, we have to utilize the drywell vent.

So, now we are opening a vent that doesn't have the benefit of a suppression pool scrubbing of any kind. In fact, if you look -- and we provided those plots -- for the release that goes through the drywell vent, it was small. The numbers were in the 10-to-the-minus-4, 10-to-the-minus-5 range.

And it is for the reason that Rick is pointing out. It is those cycles are occurring as such a prolonged, extended period of time. By the time you get to the need for the drywell vent, you have settled out the majority of the cesium at that point.

So, everybody talks about going to a drywell vent as being a bad thing because it is unscrubbed. Our calculations don't bear that out. Because by the time you need that drywell vent, you have already scrubbed.

Again, we are talking about cases where we have got sprays functioning and we are scrubbing the atmosphere.

MR. VIJAYKUMAR: In MELCOR, it doesn't mean that it is scrubbed; it means it stays in the water. It can be up again once it settles down. If it gets hot enough again, it can leap up again.

Now with scrubbing with wetwell sprays, wetwell is the pressure is like around 80 psig's; the water temperature is like 350 degrees Fahrenheit maybe. It is hot. When it comes down, it settles on the surface, comes to the bottom pool, right at the wall break again, and the cesium goes back again.

MR. GABOR: At 300 degrees, the cesium is --

MR. VIJAYKUMAR: At 80 psig, I don't know, maybe like 400-450 degrees Fahrenheit, it comes down, right? But water evaporates again once it comes down on this. The water comes down, right, on the floor?

MR. GABOR: But I don't understand. The water is evaporating --

MR. VIJAYKUMAR: No, I am talking about the drywell floor.

MR. GABOR: Which the floor is covered with water.

MR. VIJAYKUMAR: But there is debris below it. Then, it transfers some heat for the debris. The debris transfers some heat to the water, boils out the water, right? You saw the drywell is getting hot and failing. The minute that water is evaporated, cesium is released again.

MR. GABOR: Based on a cesium-iodide or

cesium --

MR. VIJAYKUMAR: I don't know what the chemical form is, cesium-iodide, cesium hydroxide, iodine. I don't know what the chemicals form in this particular case. But the minute the water is gone, the cesium hydrogen and cesium hydroxide I believe is back in here again.

MR. GABOR: We would like to understand that because that --

MR. WACHOWIAK: The water shouldn't be gone at that point. It should still be a pool of water over the top of the debris.

MR. VIJAYKUMAR: No, you can see the drywell liner melting through. I don't think there is water on the drywell liner floor.

MR. WACHOWIAK: Yes, that is not -- the case here is the case with spray. I don't think the case with spray you fail the drywell liner.

MR. BASU: Randy Summers is here from Sandia.

Do you want to actually address the cesium hydroxide?

MR. SUMMERS: Permission to approach the bench.

(Laughter.)

I think a lot of the signature I am seeing in there looks like revaporization off of surfaces, moving from hot surfaces to colder surfaces.

The discussion here is about forms of cesium iodine that bond with --

MR. VIJAYKUMAR: No, no. On that very point, bring it back and just explain why it is going back into the moisture again. I am sorry for bringing chemical form up.

MR. SUMMERS: Yes, I am a little cold because I just walked in, but I thought maybe what I was hearing in some of this discussion was possibly, when you drop the overpressure in the containment, that some of these surfaces are hot enough that when you lower the pressure, you actually get a little more vaporization off of the surface. I think that may be something we saw.

MR. WACHOWIAK: But with containment sprays operating, your surface temperatures are still up high enough to do that?

MR. SUMMERS: If you are in the vessel.

MR. GABOR: So, in the vessel you are talking about?

MR. SUMMERS: Yes.

MR. GABOR: Okay.

MR. SUMMERS: That is what I am talking

about.

MR. GABOR: Yes, that is what our suspicion was, that this was coming from movement and revaporization in the RPV.

MR. SUMMERS: I mean, the signatures in this, these plots we are looking at here, you are seeing cesium jump off of one surface and move downstream and deposit on another surface. You can kind of see the complementary shape of those curves.

MR. MONNINGER: One thing to throw in, I know this is a lot of good discussion on the fission products, and we did listen to your guys' presentation back in August. I mean, the notion with regard to active venting and operator actions and procedures and instrumentation, et cetera, you know, I think there is a lot of uncertainty there. I think there would be, there is significant concern whether that would be a success path or not.

So, even if you were to come in and to say, "We believe controlled venting significantly decreases the source term," you have got the other part of the problem as to how are you going to demonstrate that that controlled venting is going to work? I mean, right now, it is a bunch of analyses, but there hasn't been any discussion at all with regard to how that would potentially work.

So, I hear you trying to go after the fission product, but right now I don't think there is a level of comfort that that would be, with operator actions and we are talking every --

MR. GABOR: I understand your comment. If I could ask you to go back to slide 19, would you put 19 back up?

MR. MONNINGER: I mean, you know, our recommendation is in the works. And I hear you.

MR. WACHOWIAK: And that is kind of what I think we are trying to get at here. In order to demonstrate to you that the cycled venting strategy can work with operator actions, we have to understand why it works or in cases why it doesn't work. So, that is kind of what we are trying to get at here.

Before we come to you and say, "This is what you have to do" or "This is what we think you have to do" --

MR. MONNINGER: You want proof of science.

MR. WACHOWIAK: We want to make sure that it is robust, and that we have considered the alternatives that could change it from being okay to not being okay. We need to understand why things make that transition.

MR. MONNINGER: And even if that can

potential be proven, that doesn't necessarily mean it is still a success path, though.

MR. GABOR: One of the gentlemen on the phone this morning, I thought he was going to take us down the path. He was talking about a relief valve or a valve design that sounded to me like he was going to describe an SRV or something like that.

In our calculations -- I think we talked about this on the 8th -- we actually looked at them a couple of ways. In controlled venting, we assume that we have that relief valve. So, it didn't require any operator action. It would open and close based on a dead band.

The reason we did that is because our initial calculations we did showed that early on, in order to maintain the pressure between 40 and 60 required operator actions that may not be as feasible, like you are talking about would require, too.

And then, we looked at an intermediate case where we said, okay, let's give an operator five minutes; won't do anything; won't open, won't close inside of a five-minute time period. And we looked at that sensitivity as well. So, I think there are options to achieve -- I call that a passive option -- to achieve a controlled vent.

But what I wanted to talk about on this slide, I think this, to me, is a significant slide. Because, if you remember on the 8th, when we talked about our results, we tried to get our hands around what would we consider a viable strategy. We all kind of homed-in. And I heard a similar discussion this morning with the gentleman sitting here. Based on what has been done in Europe and what people seem to be thinking about, it is something in the range of an overall decontamination of 1,000 or 99.9 percent efficiency might be a possible target. That will be up to you to determine.

But, given that -- and I look at these cases right here -- these all are within that boundary, right? These all result in cases that achieve an overall decontamination greater than 1,000.

MR. MONNINGER: And you have heard different views on suppression pool scrubbing, too.

MR. GABOR: So, let me carry on. These cases that were presented right here --

MR. MONNINGER: Right.

MR. GABOR: -- my understanding, that these cases are without a vent. Without a vent, these are cases where --

MR. MONNINGER: So, this is drywell head --

MR. GABOR: Right, I am using my drywell

head effectively as a relief valve to maintain pressure. So, this is with the drywell head releasing without being scrubbed, zero scrubbing.

And every one of these meets all the viability criteria of 1,000. I have to assume, I clearly have to say that, if I now take this case, which has -- granted it has sprays, 300 gpm -- if I now add wetwell venting on top of this, it has got to get better. We would contend that wetwell venting with cycling would make it even better. There is some debate about that, depending on debris cooling. But I have to look at these and say these show a viable strategy by just spraying the drywell.

MR. DENNIG: Right. But when you say "viable," how long are we from proof-of-concept to doing, to getting place, knowing the procedures, assuming that the human error stuff isn't a problem, from proof-of-concept, which we think is what you are trying to do? It is, potentially, we can do this. From there to implementation and demonstration of performance, what kind of timeframe is that?

MR. GABOR: Well, I guess you are talking about operator action timing or --

MR. DENNIG: I am talking about taking your concept --

MR. GABOR: And make it happen?

MR. DENNIG: -- assuming for the moment that it does give you enough, under certain circumstances, and getting that downstream to a plant and demonstrating for a plant that that is going to work, how long does that take?

MR. GABOR: This current strategy exists in our BWR SAMGs today. This strategy is there, to spray the drywell with any form of alternate injection or alternate source of water. If you go to the SAMGs, this is a clear step in our current procedures.

Now you might ask the question about the reliability of the system to provide that. That is a good question. We believe that systems like the FLEX pumps provide that reliable source.

But I guess you are taking me in a little different direction. But, just given the technical aspects of it, this at least shows me that there is a viable strategy if you take our definition of viable, meaning an overall DF of about 1,000. This demonstrates that there is a viable strategy by just simply spraying the drywell.

And I contend -- and I don't think anybody in here would disagree -- that if I add to that any amount of scrubbing in the wetwell by utilizing a wetwell vent, it can only get better than 1,000.

MR. BASU: So, what I will say to that is we should really see what the signature looks like at 72 hours, at 120 hours, and so on. This one is up to 48 hours. And we are trying to come to a conclusion based on the trend that we see up to 48 hours. There is nothing that tells me a priori that you are not going to see another jump in this temp as you extend your calculations to 72 hours. So, this could very well go above one-tenth of 1 percent. And so, this target of 1,000 that you are referring to, this will no longer be a valid argument I think at that point. So, this I think we should really see what it looks like beyond 48 hours.

MR. LOCHBAUM: If I could speak to that point also, that is within the second phase from the NRC's order earlier this year to provide seamless power supplies for phases in permanently-installed equipment. The second phase is equipment that is onsite that can be manually put in place and activated. And the third phase is stuff from offsite.

Forty-eight hours is still within phase 2. So, the equipment there under FLEX, which is intended to prevent core damage, obviously failed, or this wouldn't even in vote. So, the equipment that didn't work and lead to core damages now somehow magically healed and will come back in and provide us this great decontamination factor?

That goes back to the confidence level I mentioned earlier this morning. It didn't work. That is why we are in this boat. So, we are in that boat; we don't have this magic 99.-whatever-it-is percent. With broken equipment, you are not going to get there.

MR. MONNINGER: And that is a good discussion because the thought is you need some water on the floor, on the cavity, to prevent liner melt-through and maybe the filter vent.

PARTICIPANT: Who is talking?

MR. MONNINGER: This is John Monninger from the staff.

PARTICIPANT: Yes, I am confused when I hear people talk about "yours" and "ours". Is EPRI giving a pitch?

MR. FRETZ: We basically need to identify ourselves.

MR. MONNINGER: Yes. So, this is John Monninger with the staff, and Dave Lochbaum from UCS asked questions with regard to the NRC's analysis giving credit for sprays and is that industry's proposed FLEX equipment or not, and if it didn't prevent the core damage, why are you giving it credit for the sprays.

PARTICIPANT: So, EPRI is not there?

MR. MONNINGER: Yes, they are here, too.

PARTICIPANT: I mean "yours" and "ours" and when they talk about "we," "viable strategy," who is -- I don't think that the NRC talking.

MR. WACHOWIAK: This is Rick Wachowiak from EPRI.

In our presentation that we made for the staff a few weeks ago, we introduced the concept of what we called a viable strategy for reducing the release down below .1 percent or a decontamination factor of greater than 1,000.

PARTICIPANT: Okay. So, you are one of the speakers today?

MR. WACHOWIAK: Yes, I am.

PARTICIPANT: Okay. That leaves me with my final remark, with no further remarks from me. If there are any Memoranda of Understandings between EPRI and the NRC relative to these matters, I would like to see those in the transcript.

End of comment. Now I am off.

MR. WACHOWIAK: This is Rick Wachowiak.

As far as I know, right now, we are not working on this project under any Memorandum of Understanding. It is independent research that EPRI is doing and what NRC research is doing.

MR. GABOR: So, we are here in the same capacity as the rest of the people from the public.

MR. MONNINGER: So, Bob, this is what we call a Category 2 meeting, where the NRC meets with various stakeholders. We have a big round table. NRC staff is presenting, but we have also invited UCS, Public Citizen, Beyond Nuclear, EPRI, ERIN Engineering, Westinghouse, anyone else who wants to come up at the table and ask the NRC staff about our calculations.

Does that make sense?

(No response.)

All right. So, Dave, going back, that is one of our debates internally with water on the floor. So, you give credit or you don't give credit for the FLEX. So, then, we come in with a potential recommendation, not knowing which way the staff would go. We would have to look at, again, all right, so let's require again a cavity-flooding system. So, that third system or fourth system or fifth system that we are going to require, what is going to make that system there?

So, you know, it is difficult. Whether you say the FLEX equipment is there -- so assume it is not there. If we come up with a potential recommendation to add another flooding system, well, why would that one, then, magically be there where the FLEX is versus the other?

MR. LYMAN: Oh, but I think Dave is asking a more fundamental point. That is, are you running, when you talk about these things in the abstract, are you going to run a scenario from beginning to end, with all the potential failure paths? So, that is a legitimate question.

The assumption here must be that the FLEX equipment somehow did not prevent core damage; yet, it is available to be able to mitigate fission products release. So, what is the scenario that would lead to that potential?

MR. MONNINGER: So, the Case 2 would be no FLEX equipment or B.5.b equipment. It is just the RCIC, would the Case 2.

MR. LYMAN: Right, right.

MR. MONNINGER: Then, it is not in here, but there this short-term station blackout, which I forget the actual number.

MR. LOCHBAUM: Toward that end, can I ask a question about slide 10, the example matrix and the various cases? Would it be fair to draw from that, that acceptance criteria for the option that is ultimately derived would be the next-to-the-last-two rows, that you don't have drywell pressure exceed the point where it leaks through the drywell head flange, whatever that pressure is? And you also don't have drywell melt-through? So, both? If whatever you have got leads to both of those outcomes, you prevent leakage and you prevent melt-through, then you have had some success?

MR. MONNINGER: That could be an acceptance criteria.

MR. LOCHBAUM: So, that would show that you need both some kind of spray plus vents. You can't get there without both.

MR. BASU: Right. And I think if you go to the second-to-the-last slide --

MR. DENNIG: And that is generally where everybody comes out as far as the severe accident management strategies are.

MR. MONNINGER: The Europeans' industry --

MR. DENNIG: It is the reliable supply of water post-core-damage. In Europe, it is filtered venting.

MR. MONNINGER: And water.

MR. DENNIG: And water. And those are pretty much the elements.

MR. LOCHBAUM: Didn't Fukushima have SAMGs like that on March 10th of last year? I mean, they participated at the SAMG meetings in 2009.

MR. MONNINGER: You know, SAMGs, I am not sure if they are -- I don't know whether they did or not.

MR. LYMAN: So, just backing up, the dilemma or the fundamental issue here with regard to filtering vents is that, if you don't also prevent drywell melt-through, then filtering vents is --

MR. MONNINGER: Marginal.

MR. LYMAN: -- is marginal because the drywell melt-through release would be -- what? -- 10 times more than --

MR. DENNIG: Basically, if your recovery activities are unsuccessful, the vent filter by itself isn't going to take care of business. Eventually, somehow you are going to have become successful in arresting the core damage sequence at some point.

MR. MONNINGER: Cooling the debris in the cavity.

MR. LYMAN: All right. But marginal, you know, that is what we haven't seen yet. Or is it in here and I just didn't see it?

MR. WACHOWIAK: This is Rick Wachowiak from EPRI.

I don't think you see it in this presentation. But if you take a look at the presentation that we made a couple of weeks ago, about half goes through the vent and about half goes through the liner failure.

MR. LYMAN: So, it is not marginal if you can at least --

MR. WACHOWIAK: But it still only got to a DF of 20, so a .05 release.

MR. LYMAN: Right, but what is your assumption for the DF of the filtered vent?

MR. WACHOWIAK: Infinite.

MR. DENNIG: So, if you bypass the liner, you don't get much out of the vent. I mean, I think we understand that. And the question is, okay, to what extent do you know that you are not going to get liner melt-through or you are going to get it? And how do the rest of your strategies line up? And what are you trying to accomplish? I think we are trying to accomplish not having liner melt-through. So, I think that is a consideration.

MR. LYMAN: And my last question: so, you don't necessarily need to vent to be able to flood the well?

MR. DENNIG: At some point, depending on the pump, the pumping you are trying to use, yes. Yes, that becomes an issue. Pressurization becomes an issue.

MR. LYMAN: Right. So, in that case, you are going to need to vent. So, you have core damage. You may need to vent to be able to get to flooding the drywell, in which case why not have a filter or you should have a filter on the vent anyway. If you don't, then you are going to have an unfiltered release, just to be able to prevent the drywell melt --

MR. DENNIG: Yes, that is part of the equation.

MR. LYMAN: Right.

MR. KRAFT: May I? This is Steve Kraft in the audience.

So, Dr. Lyman, let me just understand your logic for a second. Because you and Dave Lochbaum have raised a number of -- we began debating several months ago. So, if I have the need to provide a 300-500-gallon-per-minute, let's call it an enhanced FLEX pump in order to handle this non-mechanistic question, okay, why have any core on the floor? And to do that, I have got to say, wait a minute, I already have a 300-gallon-per-minute FLEX pump that somehow didn't answer the mail.

And the question you are asking is, what is the scenario that gets me from A to B that makes that all work? Have I got that right?

So, if I take your logic a little bit further, doesn't that suggest to you that the true solution to the problem is making sure FLEX works, and not all this other stuff, which just so much defense-in-depth beyond that?

MR. LYMAN: Well, on the other hand, you can't provide 100 percent assurance FLEX is going to work. So, then, you are going to be left with your active ability to deal with the crisis is hampered. So, at least having a filter on the vent will give you at least some capability of filtering some release that doesn't depend on an active system. Now it may be marginal; it may not be. But, I mean, it is hard to argue that it would provide some additional protection in some scenarios.

MR. KRAFT: So, it is hard to argue 100-percent success with FLEX, and I guess I wouldn't try to argue that. Then, we are talking about what marginal success do we have. And then, you are talking about the need for, well, let's do something at the end of the vent pipe, which we now all seem to agree doesn't give that much if you can't quench the core floor, which you can't do if FLEX didn't work. And therefore, by your logic, this other stuff doesn't work.

So, now I have got core on the floor that is melting through the liner and CCI and all the other bad stuff. So, wouldn't it all make sense that, if the NRC is going to require that we do something else, that the something else happens much earlier in the sequence to improve the reliability of our ability to deal with the accident in the first place? That is kind of the logic that I am getting --

MR. LYMAN: Yes, but we aren't talking about defense-in-depth.

MR. LOCHBAUM: I have got a couple of points. One is, when FLEX was first proposed, the first time we heard it, December of last year, the industry said that the assumption of FLEX was no core damage. It is successful. And as a result of that, some of the connection points for FLEX equipment is inside the reactor building and elsewhere.

If you have core damage, your ability to make those connection points is much less likely --

MR. KRAFT: Dave, you made that point in this room early on, and we listened and we changed it.

MR. LOCHBAUM: Okay.

MR. KRAFT: We are finding alternate connections for FLEX, aren't we? Am I right about that? Plants are looking into that. People are mindful of what happens when there is core damage.

And as you know from your knowledge of the plants, it makes it more difficult because there are certain places you can't go.

MR. LOCHBAUM: Right.

MR. KRAFT: Yes. So, I think that I am reading what is going on in the industry correctly; I think we are doing it.

MR. LOCHBAUM: What if it is preferred but not required?

MR. KRAFT: I will go back and look. I will go back and look at that. That guidance came out a couple of weeks ago. I will go back and understand it.

MR. LOCHBAUM: I hope that is the case, and I will look for that, because I don't want to continue saying something that is obsolete, or whatever. So, I will look for that.

The second point, though, is I am a little concerned that the discussions today are eerily similar to the large-break LOCA concerns that pre-dated Three Mile Island, where it was thought that as long as you handled the worst-case double-ended guillotine break, that everything else would automatically be fixed and subsumed by that.

So, if you get a, quote, "beyond-design-basis event," where there is fuel damage, but not a lot of it now sitting on the floor, will this cover that as well? I am convinced that it is the case. I am not convinced that the only time you have to worry about it is when you have core on the floor plus perhaps the need for some venting.

MR. KRAFT: So, again, I think I agree with you on Three Mile Island. What we learned from Three Mile Island, along with a lot of other things, about emergency planning and everything else, was that relying on your knowledge of the double-ended guillotine break -- and really Three Mile Island was, in reality, a small-break LOCA, right? So, we learned that lesson; we learned a lot of other lessons.

This drives me into thinking about, okay, following the logic chain here, what do you put at the end of the pipe to cut off what might be some last something you have to deal with? Because it seems to me that what we have done -- I mean, okay, you don't want to accept 100-percent FLEX, but you accept a certain percentage of FLEX probability?

MR. LOCHBAUM: Sure.

MR. KRAFT: Well, thanks. Well, in that case, we don't have to have this conversation.

(Laughter.)

MR. LOCHBAUM: I will accept zero; we can discuss more than that.

MR. KRAFT: But if the work that we have done, that ERIN has done, in looking at the Tier 1 of activities -- and I don't know that we have a hard number to point to -- but we have reduced core damage frequency again by instituting all of those changes.

So, if you look at it in some rough notion of probability space, the chances of all these bad things happening are getting smaller and smaller and smaller every time we learn something new.

So, then, the question comes -- and I don't have in my mind how I do all this logic here -- but it seems to me, at the end of the day, there may be some small thing to do that would maybe cut off that last little bit of release. Whatever it is, I don't think we have identified that.

But you can't discount all this other stuff that contributed to cutting off the release. I mean, I don't know how you say that -- if you are going to say FLEX didn't work, and then forever and a day I can't put water on the floor, that is a very different scenario than getting water on the floor somehow.

MR. WACHOWIAK: Rick Wachowiak from EPRI.

One of the things, before we get into all of this, that we are trying to do, and one of the reasons why we had this meeting, at least in my mind why I wanted to have this meeting, is to address just the things that you are talking about.

We did -- "we," EPRI, for those not in the room -- we did look at the containment failure modes other than the drywell liner melt-through that could manifest themselves either with core on the floor or the core not on the floor.

And one of our objectives of the analysis is to make sure that any strategy that we call viable is still viable under the conditions that may not be exactly the same as what our base case is. So, we thought we had those bounded in the set of analyses that we did.

So, now we see the analysis that Research is doing, and in some cases it has a little bit of a different flavor. We are trying to understand that difference. So that, if it is really because more of the core is left behind in the vessel and the strategy that we propose doesn't address the core that is left behind in the vessel, then maybe we have to regroup and look for something that is different to address it.

So, those are the kinds of things that we are actually trying to do, is make sure that, whatever strategies we come up with and say they are viable, they are robustly viable under the conditions that we would reasonably expect, not just the worst-case.

And in a follow-on to that, one of the things we didn't hear much about here -- maybe it is in the next October presentation -- and there wasn't much about it in our presentation last month, is the performance of the filter itself, if we are going to do that. And right now, I will make it as an actual question. Is that going to be part of the discussion in October?

MR. BASU: John, maybe you can answer that.

I was just going to point to one of the slides that we said about the following activities that you are going to hear in October, that stuff about the consequence calculations. We going to do that filter. So, you will obviously hear some discussion on the filter in that regard.

John?

MR. MONNINGER: Yes, I think, as we complete some of the work, like this MELCOR analysis, we want to engage the various stakeholders, get feedback, et cetera. And some of the next pieces would be the consequence analysis, the MACCS analysis.

MR. WACHOWIAK: This is Rick again.

That is the next piece, but the piece that we haven't really looked at in this forum too much is what benefit does the filter, if it is installed, actually do. The tests that were done to generate the decontamination factors for sprays and bubbling through pools, and things like, that both MAAP and MELCOR contain, right now would be the same type of analysis we would use for the filter. And maybe there are some other tests that are out there from the vendors. We have heard a couple of vendors say they have some tests, but we still have questions about what it is they are filtering.

Because if we take materials that is just generated directly from within the vessel, and that is the types of materials that seemed to be tested in most of these filter tests, is that directly from there, it has got maybe some steam or other contribution to it; it passes through these things, and things get filtered out.

But what we saw at the ACRS meeting and from various other papers is that, once we have used something like a drywell spray or a drywell flooder, and we have used whatever capability of scrubbing that the suppression pool provides to us, the nature of what goes into the filter could be -- I don't know if it is -- could be different than what has been tested in filters.

We do know from hearing presentations from some of the Europeans that they didn't consider that piece of it. They didn't consider any of the pre-action from stuff going on in a BWR containment.

So, I would just get worried that, if we take something that has been tested for non-pre-scrubbed and put it on the end, it just doesn't do much. We have to understand that.

MR. DENNIG: Yes. Yes, that is a problem that we have been wrestling with. I think that you can get a start by going back to the specialist meeting in 1988. There is a lot of material in there about how the testing was done, and that an insensitivity to particle size, basically, is what we are talking about.

So that the claimed or tested efficiency in those documents is that, going from micro-particles to particles above 1 micron or 2 microns, it doesn't matter for the design of a filter. So, I mean, there is stuff out there. There isn't the testing, the proprietary testing, that the vendors have done, but there is that.

MR. WACHOWIAK: But that is in conflict with what Sandia says.

MR. DENNIG: Who at Sandia?

MR. WACHOWIAK: Well, the material that we were shown from Dana Powers.

MR. DENNIG: Well, I don't know that it is in conflict with that. I think what that is, it is spray modeling and pool modeling, which, as far as we can find, there is not much experimental information about. And there is no analysis in there about Venturis or impact filtering. I mean, that whole mechanism, we haven't done anything with. It is like it is new.

MR. WACHOWIAK: I agree. We are still at a stage where that needs to be investigated. So, part of some of the things that came up earlier saying that it is a no-brainer that we just put a vent on or a filter on, we need to understand what filter we need before we just say let's put one on.

MR. DENNIG: I think we all agree on that. It is a matter of how much do you leverage the work that was done in the intervening period between 1980 and the present as far as developing filters. As far as I can tell, the NRC's official effort went as far as doing sand filters, sandbed filters buried in the ground. And the scrubbing stuff, all these different mechanisms, we participated in the ACE Consortium, and I understand that there are questions, again, about, well, what was the spectrum and how was the measurement, and so on and so forth? But there is an awful lot of information that others are using/have used that it is a question of, do you want to leverage with that or do you have to do it yourself before you can decide what to do?

MR. WACHOWIAK: And we have to understand, once again, what they did. One of the questions that I was left from the ACRS meeting a couple of weeks ago was the filter that was presented was essentially a tank of water with some kind of spargers in the bottom, and then it had things for impaction and things for recirculating the water back. But that is essentially the same thing as a suppression pool, essentially.

MR. DENNIG: Well, no, I think that does not give any credit to the literature that is out there, either from the vendors or from academics. Like I said, as far as I can tell, at the NRC we have not engaged in any program to evaluate those mechanisms.

The contention of the foreign governments and vendors is that the technology that they are using is developed from technology that came out in the fifties for air cleaning, basically, the Venturi filter, and variants on that.

To say it is a tank of water with some spargers in it is really kind of saying that -- I mean, there is a lot of detail and a lot of engineering and a lot of testing that has gone into those devices that need to be understood, but it is not a tank of water with some spargers in it.

MR. WACHOWIAK: This is Rick Wachowiak again.

Maybe I was oversimplifying it a bit, but did those tests from the fifties include adding 1-percent decay heat to the steam that is now going to be condensed in the tank of --

MR. DENNIG: I think answers to all these questions about the steam content and the part size and all those issues, I think they have pretty much been wrung out. It is matter of getting your hands on the information.

MR. MONNINGER: I think they did have -- we, of course, have the benefit of the public and the proprietary sessions. So, I know those topics were covered, but I can't say for sure what set of slides they were in. But it was pHes, various temperatures, various flow rates, lengths of time, irradiation, revolatilization --

MR. DENNIG: All the questions they came up about flow rate and entrainment rate and passive climbing, and all those questions I believe have been answered. Whether you think the answers are sufficient or not is always your own determination, but they are not open questions, as far as I can see.

MR. LOCHBAUM: A process question you might not be address today, and if not, just tell me. The paper that is being prepared for November, the options paper for the Commission, is it just filters, yes or no, or is it filters perhaps with some of these conditions about the cavity-flooding system? Because that would introduce a new wrinkle that wasn't in the regular thing. So, do you have enough free rein to go there or not?

MR. MONNINGER: We believe we have enough free rein. We don't know the final set of options until the paper is signed and dated. And I think we have discussed in the ACRS meeting four options.

The first option -- you can call it the first or last -- is status quo, do nothing. The second option is the thing we called the severe-accident-capable event, beefing up the current system. The third option is the filter vent, and the fourth option is a performance-based criteria.

But, for any of at least the middle two, severe-accident-capable event or a filtered vent, the staff is thinking, and I believe the thinking that we have expressed publicly is there is need for our cavity-flooding system, one way or the other, whether it is you give them credit for the B.5.b or if it another pump, or whatever.

MR. LOCHBAUM: So, then, you have four options. If you had five, you might get one vote for each, and it would be a stalemate.

(Laughter.)

MR. MONNINGER: It's a stalemate?

MR. LOCHBAUM: Yes, you are avoiding that with the four options then. Very clever.

(Laughter.)

MR. KRAFT: In the utility world, what has happened is the various vendors who have these products have made presentations -- this is Steve Kraft speaking; sorry -- presentations on here is a product we have to sell you. They have not, to my knowledge, until just recently, been asked the question the other way around, which is: what if we asked you -- we want to prevent land contamination, but we want to do it by keeping the radionuclides in containment.

And each time that question is being asked of several of the vendors -- and I know you have had your meetings, too -- they sort of stop and they go, "Huh?" They have never been asked that question before. So, some of them are thinking about it.

So, there may be, as a result of the work that EPRI has done in looking at these strategies, which could include a filter, not include a filter -- so, innovative thinking that may come back into the system where we say, "You know what? Maybe there is a better mousetrap here that we can move to." So, that is something we are looking forward to as well.

And I have no doubt that Bob is right, that a lot of the research being done is based on showing the performance of a filter. Whatever the design is, whether it is water and spargers and metal mesh, whatever it is, that is a very different question than showing the performance of a system involving containment.

And when we asked those questions, they said no. So, people are thinking about it, and I think that, when we get around to recommendation time here, and we present ours and you present yours and stuff, at the end of the day, there is going to be some sort of innovative thinking that comes forward that we are all going to be able to look at and, hopefully, take advantage of.

MR. MONNINGER: I think maybe that is in line with the Option 4, the notion of a performance-based approach. That thought is maybe there is just some prescription out there, meet "X", and each plant licensee would have to come in and demonstrate how they meet "X", whether they want to take a filter off the shelf or if they want to do a combination of other things. You know, that is one consideration.

MR. DENNIG: And one of the boundary conditions, if you will, for MARK I's and MARK II's is that we have ordered a vent. The other plants we haven't ordered a vent. So, the question is, okay, you have ordered a vent. Why wouldn't you want to put a filter on that? So, that is another way to come at it.

MR. LEE: This is Richard Lee from the Office of Research.

When we look at the so-called modern venting system, our focus is this, at least for the BWR, is that after you vent through the drywell, there is a certain spectrum of droplets that are so-called penetrating droplet size that will come through. So, we are focusing on that.

If you apply another water scrubber to it, or we scrub up the things that you are supposed to scrub up again, scrubbed already -- so, those so-called penetrating particles that go through another water pool will not get the same benefit because the droplet spectrum has changed.

So, when we look at the filter, for example, the PSI or the AREVA or anything, the question we ask is, does your system scrub what is left over? How does that scrub? So, those are the questions we ask when we meet with these people, when they discuss about the filter.

So, they know that, the entire international community knows how the wetwell behaves because the models we use in MELCOR, in the European code, any other codes, are similar; the database is the same. So, they know what is there.

And everyone knows that, and the question that we focus on, what else can you scrub these so-called penetrating aerosols that are left? So, that is the part that we focus on when we look at the so-called advanced filter system. And one of those was the one that PSI came and talked about it.

MR. GABOR: This is Jeff Gabor.

A couple of things I wanted to add, I guess. Our strategies -- and we made this part of our presentation to the ACRS last week, I think; I think it was last week -- there were a couple of key elements of what was driving our analysis and why we had the mindset we did.

Clearly, as Rick pointed out earlier, our first goal, of course, is to keep it in the vessel and prevent core damage. But we also feel strongly about keeping any radionuclide releases inside containment. So, as you can see, our strategies focus a lot on flooding and spraying containment, utilizing the wetwell. So, that is another kind of guiding principle for us, even though we did look at other strategies that did involve an external filter as well. But we felt that focusing on maintaining the radionuclide population inside containment was important to us.

And then, lastly, kind of a residual, when we look at our strategies -- I forget who brought the comment up earlier about different scenarios; I think it was David -- about different scenarios, we also feel that just putting a filter on a vent in containment has limited benefit. The strategies that we have identified, and a lot of the same strategies that we saw today, including water in containment, sprays, core sprays, containment sprays, wetwell venting, a lot of those strategies can benefit a pretty wide range of scenarios and a wide range of challenges.

I mean, some of the things that come to my mind are a containment isolation failure event, where you have got some sort of a pathway open in containment, a valve, or something like that. Unless you were lucky enough to attach your filter to that penetration, it is not going to do you any good. On the other hand, spraying the drywell will do that some good, will provide benefit to that scenario.

So, if you look at our ACRS presentation, there are a couple of flowcharts in there about how we picked our scenarios and how we focused our analysis. It is safe to say that some of the scenarios that we didn't directly include would, indeed, be impacted, positively impacted, by things like flooding containment and spraying containment.

MR. MONNINGER: And I think that is what the goal should be, to keep it all within the containment. But the other part is, when you think about the MARK I's and the MARK II's, and the history of the containment performance, you know, you are really talking about changing the complete understanding of the design.

I mean, you know, the strength of the BWRs is the prevention system, the ECCS, and the CDFs are driven down, and then the containments aren't quite as robust as the PWRs. And then, you have the reverse for the PWRs. The CDFs may be a little bit higher, but containment is a little bit stronger.

Now, you know, when you are coming in and saying the goal is going to be to keep it all in containment, you know, with the historical risk record or profiles for the containments, I am not sure how you are going to move, significantly improve the BWR containments. Yes, that is my understanding --

MR. GABOR: You are talking about in response to a severe accident?

MR. MONNINGER: From a severe accident, yes. You know, from I heard from you is we are going to have it bottled up and nothing is going to come out; it is going to be a very robust, rugged design. I am taking it a little bit far.

MR. GABOR: We are going to minimize the releases. We are going to do everything we can to mitigate the releases is our goal, and by keeping it in containment, yes.

MR. MONNINGER: Right, right.

MR. WACHOWIAK: This is Rick Wachowiak from EPRI.

One question, getting back to kind of the presentation, the ultimate question that we had, is there a way that we can get an answer back later on where the core material is in these things and what is resupplying the aerosol in the drywell over long periods of time? And then, of course, your 48-hour or 72-hour runs, we would like to see those, too.

MR. MONNINGER: So, our next engagement -- and it is a public engagement -- is with the ACRS on October 2nd. The thought was to move past the MELCOR analysis and present some other stuff that we have been working on. It is a full-day ACRS meeting on Wednesday --

MR. BASU: October 3rd.

MR. MONNINGER: -- Wednesday, October 3rd. I just said the 2nd.

So, whether that is an option there to potentially cover -- I am not sure if it is an open item for the ACRS. We are also considering, but we haven't locked in, another public meeting in mid-October to talk more about the consequence analysis, et cetera.

But I guess the staff is pretty much, you know, they are under the gun pretty tight. And we would cover this in some type of public meeting, to the extent that, if we need to cover it, it would be in a pre-planned meeting, I think.

MR. GABOR: John, on the October 3rd ACRS meeting, given our past get-togethers, what additional information is going to be provided there that we haven't seen?

MR. BASU: Well, if you recall, in the September 5th meeting, we only provided an initial MELCOR analysis, not MACCS.

MR. MONNINGER: So, MACCS --

MR. BASU: So, MACCS is going to be one of the main topics of presentation, and connected to that is the regulatory analysis. To the extent that we are running some of these cases to 72 hours now, we will be providing the revised or updated results, if you will, at the ACRS meeting to inform the MACCS calculations.

MR. MONNINGER: I think we also have underway, I guess, staff evaluations or positions on different types of filtering approaches, you know, different types of defense-in-depth arguments, what we believe are the positions of other regulatory agencies around the world.

So, we sort of have the traditional regulatory analysis piece, you know, the PRA, the MELCOR, the MACCS, et cetera, but there is a lot more that goes into this decision than just that. We have to cover these potential qualitative arguments and how all this plays out with regard to the defense-in-depth also. So, you know, it is not just a cookbook reg analysis in the past. The staff has other considerations that are going into the decisionmaking. And that is actually consistent with the background. There is the regulatory analysis, and then the Commission over the years has talked about the staff presenting qualitative arguments. So, we would want to share those arguments with the stakeholders also.

MR. WACHOWIAK: This is Rick Wachowiak again.

So, what I am trying to figure out for our way forward with this is I kind of need to know the answers to some of these questions to know how to proceed with our paper. Because I would hate to be in a position where we have a set of insights that gets turned into actions through NEI and through the Owners' Groups, and then, when they get presented, that the answer comes back, "No, our NRC analysis shows something different than what you have."

And so, we need to be able to -- "we," EPRI -- need to be able to tell the industry that we have looked at the differences and we understand the differences, and either we make the argument for why our position is correct or we adjust our methods to say that, "Yes, they had a point and we didn't get it the first time through." Those are kind of our two options. Maybe we should get four, so we can have a stalemate, too.

(Laughter.)

But we have got to be able to answer those things before we come out and say, "These are our insights, and we're done." Because something was brought up here that clearly is different in some of these cases than what we are seeing. Right now, I still don't understand why your cases are different than ours. I just know that they are different.

So, if we can answer the question about where the aerosols are; what is resupplying what is in the drywell; when the atmosphere goes through the suppression pool downcomers, what kind of decontamination factors you are getting; are you continuing to supply things through the SRVs and the

T-quenchers; what kind of decontamination factors are you getting there, then we can go back through and say, okay, this is where our analysis either modeled that differently or it is just unknown, or whatever.

But, in order for us to complete, and have something that doesn't put everybody on the wrong footings here, we need to get those answers.

MR. DENNIG: Yes, my personal take is that the differences between our analyses and your analyses for selected sequences isn't going to perturb the discussion of uncertainties all that much, which is basically where things are going to wind up, is in terms of uncertainties. You know, what is the range of things that could happen? How much do you know about what could happen? And so, that is just my opinion. I mean, you could get the same results for the same sequence, and then the question is, well, how do you translate that into a decision?

MR. WACHOWIAK: Yes, well, I don't want to just try to get the same results and the same sequences. What I want to do is say that, for the strategies that we are saying could be viable, that when you analyze that for your plant, you make sure you cover the range of things that you need to be looking at to make sure that we are not missing some phenomena that we didn't consider.

We really aren't trying to come up with a strategy for a scenario. We are trying to come with viable strategies that work across a broad spectrum of severe accident scenarios. So, that is what we are trying to do.

MR. BASU: Yes, and to do that, you are looking at a particular run, case run, and trying to understand the difference between ours and yours, obviously.

This is Sud Basu from the Office of Research.

I mean, we could come up with a number of differences between the MELCOR runs and MAAP runs. To start with, you have 4-hour RCIC in MAAP; we have 16-hour RCIC. There is that difference. So, you have a different decay heat than we have in terms of the amount. There are other differences.

So, supposing we come up with that list of differences. What I am not sure or what I don't understand, how is that going to help your MAAP analysis or change any position that you may currently have?

MR. WACHOWIAK: This is Rick.

What it does for us is it helps us understand how we do sensitivity studies to explore whether the strategies will work under those conditions. So, since ours were based on four-hour RCIC runs, we did a couple of sensitivities, but nothing like your -- I think it is ultimately 18 hours or so that RCIC is run. We have since done that. We see the same kind of effects on the initial containment pressurization that you do. The spray is a little different in effectiveness than what you have, but not enough to make a difference.

So, we understand that RCIC can run for a long time -- it happened in Fukushima -- it can run for a short time. That is a classic PRA analysis where you run it for a short period of time. What do you tell the plant to do different in those cases, if anything?

As I said, and Jeff said earlier, for most of the cases that you ran, when we adjust to say the same kind of parameters and things that you put in, we see very similar results, except for the one thing on the cycle venting. And we are trying to understand that. Because, then, we have a better confidence that, if we do sensitivity analyses to say, okay, if you run it one hour, two hours, four hours -- who knows; when do you turn on the containment spray sort of thing -- if we have the ability to say that we understand what kind of things go into your code, this is where the uncertainties are, we essentially can get to the same result, not numerical cesium release result, but the same result of what to tell the plants to do over a wide spectrum of accidents and conditions for things to run. I think that is beneficial for us.

So, I wouldn't want anybody to think that all we are trying to do is match cases to get the same answer. We are trying to understand what is driving the result that you are getting. We need to do analysis with our work to show that we have covered those ranges of things that may be different from what you are doing to what we have, and, also, the ranges of things that may be different in other accident scenarios.

We said early on, in the beginning of this, we did look at different types of things. The whole core melts and comes out on the floor and spreads and fails everything or it comes out and it doesn't fail anything; it drips out; it just comes out a little bit. So, for covered in-vessel, we have one of those.

So, we want to make sure that we are not, as some of the concern was here, recommending something that under a slightly different scenario gives you completely different outcome.

MR. KRAFT: Steve Kraft.

Let me just take you back to what was said on the regulatory policy perspective from the industry.

If the industry leadership is going to align on a recommendation to your Commission that drives off of the EPRI insights and conclusions, if there is something where Rick would say, "Hey, Steve, whoops," I have got to know that. I hate to think that the statements about, "We don't see that this is going to make a difference" are predicated on your guessing what we might make our recommendation at and, therefore, it doesn't happen.

I mean, I just want to make sure that we haven't finalized that; we are still working on it. It derives from the EPRI report for sure, but if there is something, and there is a scenario missing that could be supplied, you know, I mean, the goal here is to get it right. So, let's make sure we get it right.

MR. MONNINGER: And I think we can appreciate that. I think where the staff is, the staff is pulling together our final recommendations. We will proceed with or without the industry input. We don't have the luxury of multiple more weeks. We have to engage our steering committee. We have to engage our ACRS, and we have to present our proposed results out to the public, the stakeholders, whether they agree with that or not, you know. Different sides will take different views on what we do. But we have a schedule, and we are planning on meeting the November date.

We have had several meetings. Of highest priority to us for the meetings is to engage and get alignment with our internal steering committee and our ACRS. After that would come the public meetings on the stuff we haven't covered. But we are pushing pretty strong and pretty quick.

MR. KRAFT: Steve Kraft again.

I haven't said this is a hangup or a delay, but what I am hearing now, listening to the discussion between EPRI and NRC Research is that we hate to make a recommendation that, then, there is a scenario that we all missed or a scenario that EPRI missed that might alter that recommendation.

MR. GABOR: So, this is Jeff Gabor.

I guess what I hear Rick say and Sud talking about, it could be some value -- and maybe we can do this over a conference call -- but we have made it clear the kind of details that we are looking for in terms of what is driving this late revaporization and how is that affecting your -- I think the specific case that we looked was the cycled vent case that was presented last week.

If we could have some opportunity to discuss some of those details with the staff, that would be preferred, either through a phone call --

MR. MONNINGER: And we wouldn't phone call on this. We would do everything out there, hopefully.

MR. GABOR: We were hoping to see that today. We actually sent a tip ahead of time to say we really would like to see that kind of detail.

MR. MONNINGER: Right.

MS. GIBSON: Is it not possible for you to just do the sensitivities in the analysis that we did? I mean, are we making something more complicated --

MR. WACHOWIAK: We don't know what is in your analysis.

MS. GIBSON: I'm sorry?

MR. WACHOWIAK: We don't know what is in your analysis necessarily. We are not sure which things are driving the release? So, is it something where we have to try to cause revaporization in the vessel? Or is it something where we have to try to cause revaporization from drywell heat sinks? Or is it something where we have to try to cause re-release of cesium from boiling pools of water? We are not sure which things to investigate to figure this out.

MR. FULLER: This is Ed Fuller from Research.

I believe that you will probably find, when you dig into this, that the MAAP calculation would have pretty much all the cesium out of the vessel early, so that there is no more cesium to revaporize in the vessel. Whereas, the MELCOR probably has about 20 or 25 percent of the fuel still sitting there at vessel breach.

MR. GABOR: This is Jeff Gabor.

I am not sure I agree with that.

(Laughter.)

I have said that a couple of times today. Sorry.

But, no, I think we do get pretty significant deposition inside the RCS early and in the dryers and the separators and the heads. So, we see the same behavior. What we might not be seeing is the heat-up that you are getting, what Randy alluded to earlier, the heat-up inside the RCS. We may not be seeing it because of the heat removal through the vessel into the drywell, the influence the sprays have. We may have different flows in and out of the RPV. Those are the things that will dictate this kind of response, and we just haven't seen those details yet.

MR. MONNINGER: An option, and it would, of course, have to be the staff, you know, whether we want to try to include some of it in the beginning of the ACRS meeting. We don't really see another -- I don't see a public meeting --

MR. NOTAFRANCESCO: Do you see the value of proceeding with reconciling the MAAP? The big question is sprays and its reliability. Isn't that more weight than comparing models?

We just did random or directed cases to simulate Fukushima and the results, and tried to demonstrate the issues with MARK I containments. I just don't know how far you could beat this to death to distract us from moving on to what we want to do.

MR. BASU: So, let me offer another suggestion. I can only see two possible reasons why there is a difference. One is that we are having some late release from the core. And the second is we are having revaporization which is adding inventory into the release, airborne aerosol.

So, if you take those into consideration in your calculations, and then go back and run MAAP to see whether or not you are going to get any different release, wouldn't that also satisfy your objective? Instead of waiting for us to speak in another public forum sometime October 3rd or that timeframe? If you just take those two and rerun your MAAP, see whether or not it makes any difference.

MR. LEE: This is Richard Lee from Research.

Let me understand this. Okay? The way

that the MELCOR calculation, the way that we calculate here, we calculate in SOARCA, the way that we calculate for BWR severe accidents, that we did for high burnup and MOX fuel, these are the similar things. The reason we did for high burnup and MOX is to synthesize the so-called revised design-basis source term. We had very specific in-vessel releases, ex-vessel releases, and then we late in-vessel releases. Okay?

And the way that a MELCOR progression nowadays, more that understanding is that the cause of accident has a long duration, be it the BWR or PWR. So, you have a lot of in-vessel releases, and then the ex-vessel release is smaller, but you still have the late vessel because we did not transfer -- all the fuel didn't get melted. So, you have fuel remaining in the core. In the late phase, you have fission products coming back up, not only just the deposited ones, but also the few that are still there.

So, that modeling aspect has not changed. Okay? So, I don't know why we are revisiting those types of modeling issues, because this has been set up for decades already.

MR. BASU: Yes, and I think that is what I am suggesting, that MAAP look into those processes, those phenomena, and see whether or not it makes any difference to MAAP results. Okay?

MR. WACHOWIAK: So, one other question that we have, and I am not sure that I saw in here, when you do core spraying, does it stop the late releases from the vessel, the core spray after vessel breach?

MR. BASU: Well, there is some difference in the release due to the core spray. I don't recall it stops entirely the release, but it does slow down the release.

MR. LEE: In the boiling water reactor, it is mostly a steam-stop situation. So, every time you put water back in or you drop the pressure, you are going to have steam. Steam is going to drive zirconium oxidation. The temperature goes up. And so, you are going to have more stuff coming out.

MR. SUMMERS: There is not a spray scrubbing going on in the core.

MR. WACHOWIAK: Cooling is what we are looking for.

MR. SUMMERS: If it cools the fuel, the release will go down. If it fuels zirconium oxidation --

MR. BASU: It will go up.

MR. SUMMERS: -- release will go up.

MR. WACHOWIAK: But you don't have any

plots that show which way that happened?

MR. BASU: Well, we don't have a plot of that, but you have seen the numbers here for the failure timing the vessel had. You have seen the numbers for hydrogen. Those are indicators that oxidation is taking place. So, if the oxidation is taking place, you can expect to see --

MR. WACHOWIAK: But that is all right around the time of vessel failure, and I think right around that time is where I am interested. I am interested in what is going on out 48 hours, 36 to 48 hours.

MR. BASU: Well, okay, then, also, you see some jump. So, based on the sequences, you have different phenomena taking place, cooling, as Randy mentioned, as well as enhanced oxidation from more steam.

MR. SUMMERS: So, don't hold me to it, and I want to go back and check with my guys, but I think some of that behavior you are seeing is cesium, in effect, flashing off the surface when the overpressure goes down.

MR. WACHOWIAK: And this is in-vessel?

MR. SUMMERS: In-vessel, on hot surfaces.

MR. WACHOWIAK: Hot surfaces in-vessel?

MR. SUMMERS: Yes.

MR. WACHOWIAK: Okay. So, just trying to

get in my head if there are any other questions that come out. So, if it is going from in-vessel to hot surfaces, then the next thing that comes into play is the decontamination factor that you get from the downcomers. Do you have a sense that out in those timeframes, 36 to 48 hours, what the DF of your downcomers is?

MR. BASU: Well, again, if you look at where the fission products are going by different pathways --

MR. WACHOWIAK: The answer is there is a lot of division by real small numbers.

MR. BASU: Yes, yes, yes.

MR. WACHOWIAK: We probably just made the code print that out for us, so I could look at it. We get values that are between, in many cases, you know, 40 to 50 up to some cases where it is around 1,000, depending on what the conditions are in the containment. And even at 40 to 50, those re-releases are not going to be providing a lot out through the vent, through the vent pathway.

So, my guess is that somehow you are getting decontamination factors that are more on the order of two to three during those timeframes.

MR. BASU: Well, I would have to go back and look at the numbers. I don't recall seeing 1,000 DF there, but I also don't think it was all two and three.

I think for the flange -- certainly, not the "N's" that you are getting.

MR. WACHOWIAK: Not all the cases that get to -- we don't need 1,000. We only need in that timeframe the reporting sort of number.

MR. SUMMERS: Forty to a few hundred sounds right to me.

MR. BASU: Since you were at the ACRS meeting, I showed a slide there. I said 100 to 300 a day --

MR. WACHOWIAK: Yes, that was from a paper that you said it was 100 to 300.

MR. BASU: The paper, it actually showed you from 50 to 1500.

MR. WACHOWIAK: Oh, I thought it was you and not -- so, the graph was from the paper; the number was from --

MR. BASU: From 50 to 1500. The cases that we ran, we got in the range of 100 to 300.

MR. WACHOWIAK: So, now I am even more confused how you are getting 10 to the minus 2 out through the wetwell bed. Because at the range of 100 to 300, you should be getting like the order of 10-to-the-minus-3 to 10-to-the-minus-4 whole release through that path.

MR. BASU: Why is that? I guess I didn't

follow you.

MR. WACHOWIAK: Because of the stuff that is left, the 20 percent that is left in the vessel, if you take 1 percent of the 20 percent, then you are at like a 2 times 10 to the minus 3 sort of release.

MR. BASU: Yes.

MR. WACHOWIAK: The order of magnitude doesn't quite work out with your case.

MS. GIBSON: As I said at the ACRS meeting, I think we are trying to bring a level of precision to this that just is not here. So, we could sit and talk about this all day long, but I can't see that we are resolving anything or helping the situation.

MR. WACHOWIAK: I don't want to make a flip comment.

MR. GABOR: This is Jeff Gabor.

I mean, I know a lot of people think we are wasting time here. But there is an inconsistency between the plot that you showed us today, that chart 19, which showed for cases where I just have a spray, and I allow the drywell head to sit there and burp and maintain the pressure, those types of releases right there, less than a 10th of a percent.

And if I go back now and I look at -- it is actually slide 20 from the ACRS presentation --

MR. BASU: Okay.

MR. GABOR: There was a case in there, a couple of cases in there, but one in particular that you called Case 18 was cycled venting that shows a release of 4 percent. We don't understand how those two agree, how they came from the same calculation. We don't see the connection there. They seem to disagree with each other, and that is what we are trying to understand.

MR. BASU: Okay. So, I think I explained previously that, when we ran some of the later cases, we went to 2 volume wetwell, then 16 volume wetwell. So, there is a granularity issue there that will be resolved that makes some difference in the release estimate.

The other thing is -- and I think we also talked about that at the ACRS meeting -- we ran out to 48 hours. So, we need to see what we end up with if we run it longer, and that is what we are doing. So, when we go to 72 hours, then at that point we should compare a vent-cycling case to the passive-venting case to see whether the difference that we have seen up to 48 hours is still there or not.

MR. LYMAN: Can I just throw something in here? There is also an uncertainty analysis for SOARCA, right? And I seem to recall from your presentation to the ACRS that release fractions, there were variations on the order of -- I don't know -- three or five factors. So, I mean, how precise are any of these numbers anyway?

MR. BASU: You just said it. I mean, if it is within the order of magnitude for any release fractions, I think for the severe accident code model that is pretty standard. So, we are really debating about a factor of two or something like that.

MR. WACHOWIAK: But we are not talking about a factor of two. We are talking about a difference of a 4-percent release versus a .0004-percent release. We are talking about two orders of magnitude difference on cases that we thought would come out the same.

MR. BASU: Again, is it between MAAP and MELCOR that you are --

MR. GABOR: No, it is that chart and chart 20, chart 20 from the ACRS presentation.

MR. BASU: That is the release fractions.

MR. WACHOWIAK: .04, right?

MR. GABOR: Again, slide 20 from the ACRS presentation with the same scale was the release fraction. We are comparing the same thing here. We are just trying to understand the difference; that's all.

MR. BASU: You know, I will have to go back and compare the ACRS slide, because I think we would be talking about release fraction in percentage and release fraction in absolute terms.

MR. GABOR: That would help us. Yes, that would help us.

MR. WACHOWIAK: It would also help to know if it is because you modeled it with 2 nodes versus 16 nodes also.

MR. BASU: Well, I told you that we reran it with 2 nodes as opposed to 16 nodes. We looked at the thermal hydraulic results and all the others, and they were pretty consistent. There was not much of a difference between the 16-node results with the 2-node results. That gave us confidence not to accelerate the additional time. We can go to --

MR. WACHOWIAK: So, when I look at that, that would be a place where, if the thermal hydraulics looks the same between the 2-node and the 16-node, but then the release is two orders of magnitude different, that would undermine my confidence in all of this.

MR. LEE: I need to just repeat myself again. Okay?

We do not relocate 100 percent of the core out of the core into the ex-vessel in the PWR or the BWR. So, that we really need to keep in mind because there are a few left in there that still have fission product releases. If you relocate the entire core out into the ex-vessel, you will have different type of results. So, that makes a difference in the late-vessel, in-vessel releases.

MR. WACHOWIAK: We agree with that. We agree with that. Now what we are trying to understand is, how does that difference manifest itself? But we agree that that is the case. Our thoughts, though, are that the answer will look more like this graph than the graph that was shown at the ACRS meeting.

MR. GABOR: Yes, any clarification you can provide between this and page 20, slide 20, from last week would be helpful and appreciated.

MR. WACHOWIAK: This is the kind of stuff that we should know.

MR. FRETZ: I think one of the things that I can offer, maybe to help get the dialog moving, it would be that, if there is any information that we could clarify, you know, we can maybe put that in the meeting summary and provide that clarification. So, if there is information to provide, we can add that to the meeting summary. And therefore, it will give us a chance to take this back and ponder on that --

MR. WACHOWIAK: Okay.

MR. FRETZ: -- and look at the different slides, because I don't have really the benefit of that slide 20 in front of me right now to see.

MR. LYMAN: Do you have that in ADAMS yet? Because I tried looking for it last night and I couldn't --

MR. MONNINGER: The old meeting summary?

MR. LYMAN: The ACRS meeting. It wasn't there as of Monday. Is it there now?

MR. FRETZ: Well, maybe we could follow up to see whether or not exactly that information --

MR. MONNINGER: But, I mean, with regard to the meeting summary, you know, they mention that they will put it in, but that doesn't necessarily mean the meeting summary will be out within a week or 10 days or two weeks.

MR. LYMAN: We weren't at the ACRS meeting, so we are at a disadvantage not having seen the slide, but --

MR. FRETZ: I think we are waiting for some other administrative things, like the transcript to come back and stuff like that. And there is a time lag between all that, before the meeting summary is put into the public domain.

Any other questions inside the room that we could get to? I think we have at least few minutes to maybe try to get to some comments or questions from those listing on the phone now.

I think, in the interest of time, if we could keep any comments or questions between two or three minutes, I would appreciate that, because, then, that would allow everyone a chance to at least be able to speak.

So, with that, I guess could you open up the phone bridge and we can see if anyone has any comments or questions?

I don't hear any comments. I thought we might have some comments from --

PARTICIPANT: I guess I'm on? Yes?

MR. FRETZ: Yes.

PARTICIPANT: Okay.

MR. FRETZ: A comment for two to three minutes.

PARTICIPANT: I would hope on October 3rd they would address, not presupposing that there is going to be a vent line, but if there is one, how large will it be? What capacities will it have? And that is my brief question or comment.

MR. FRETZ: Okay. Thank you.

Are there any other questions or comments on the phone?

(No response.)

Okay. I think, with that --

MR. LYMAN: With regards to the mitigating strategies where part of that obligation is that containment integrity is maintained and extending to loss of offsite power, are there any strategies, anything we are talking about here today on the part of what EPRI is proposing that wouldn't already be required under the mitigating strategies?

In other words, I mean, they already have to maintain containment integrity. That means preventing vessel melt-through, right? So, everything they are talking here is something they should already have the strategy for doing.

MR. MONNINGER: They can answer. But I believe, from the August meeting, they essentially said everything is within SAMGs, EOPs, et cetera, with the distinction of the cycling. The vent cycling would be the new aspects that takes you from the bar chart here to the bar chart there. But I believe that everything else exists within procedures, equipment, et cetera.

MR. KRAFT: Well, except -- sorry, Steve Kraft -- except talking with the industry, the learning from this may be that you go from a 300-gallon pump, 500-gallon pump, that goes through changes that we would not have contemplated unless we were not faced with -- without getting into the logic problem we are having, I think that is the kinds of things we are talking about.

And then, there may have to be -- you know, you talked a bit about, John, flood systems and you talked about bypass. Looking at different containment types, there may have to be different things done. That comes out in some work that EPRI is doing. I am just pointing out it is not strictly what we have already done before. There are things that we have identified that might have to be done additionally.

MR. LYMAN: But it is not really so much your choosing between options. It is really having a filtered vent at this point would be an enhancement pretty much to what already is supposed to be done. It is not as if there would be major changes to the current commitments under the Order if the filter vent was not chosen.

MR. MONNINGER: I don't believe so, no. You know, one question would be, if for one reason or basis or the other, the staff recommended filter, would the recommendation be from the wetwell or would the recommendation potentially be from the drywell? There is a notion that eventually they may be flooded up so high that the wetwell vent may not be there. So, there may be some logic in a filter vent from the drywell.

MR. KRAFT: Steve Kraft.

And you did allow it. Maybe it is a requirement --

MR. MONNINGER: Maybe.

MR. KRAFT: -- that you throw all that open. Because when you say one versus the other, it changes a lot of the scenario.

MR. MONNINGER: Right, right.

MR. FRETZ: I think this will close the business portion of this meeting. I think it does.

I guess, in closing, I really do appreciate everyone coming here. I think it has been a very beneficial and thoughtful discussion from a number of our stakeholders.

Again, when we contemplated this meeting, we weren't really quite sure where this was going to go or how much participation we would get. But I believe, at least in my opinion, it did exceed our expectations. I thought we had a very good dialog.

And again, we appreciate everyone's attendance and contribution to the meeting.

With that, we will close the meeting. Thank you.

(Whereupon, the above-entitled matter went off the record at 3:39 p.m.)