Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Containment Protection & Release Reduction with Mark I & II Containments Rulemaking

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Thursday, December 11, 2014

Work Order No.: NRC-1279 Pages 1-135

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

CONTAINMENT PROTECTION & RELEASE REDUCTION WITH MARK I & II CONTAINMENTS RULEMAKING

+ + + + +

PUBLIC MEETING

+ + + + +

THURSDAY,

DECEMBER 11, 2014

+ + + + +

The meeting was convened in room 09B04 of One White Flint North, 11555 Rockville Pike, Rockville, Maryland, at 1:00 p.m., Robert Beall, Senior Project Manager, presiding.

NRC STAFF PRESENT:

ROBERT BEALL, Senior Project Manager, Rulemaking Branch, Division of Policy and Rulemaking, NRR

TARA INVERSO, Chief, Rulemaking Branch, Division of Policy and Rulemaking, NRR

ABY MOHSENI, Deputy Director, Division of Policy and Rulemaking, NRR

RAJENDER AULUCK, NRR/JLD/PPSD/JPSB

SUDHAMAY BASU, RES/DSA/FSCB

ERIC BOWMAN, NRR/DPR/PGCB

MIKE CASE, RES/DSA
PAT CASTLEMAN, COMM/OCMKS*
TIM COLLINS, NRR/JLD
HOSSEIN ESMAILI, RES/DSA/FSCB
ED FULLER, RES/DSA
TINA GHOSH, RES/DSA/AAB*
KATHY GIBSON, RES/DSA*
JOHN LANE, RES/DRA/PRB

GLENNA LAPPERT, NRR/DPR/PRMB
JACK MCHALE, NRR/JLD/TSD
JOAN OLMSTEAD, OGC/GCLR/RMR
SEAN PETERS, RES/DRA/HFRB
MICHAEL PURDIE, NRR/DPR/PRMB
JIM SHEA, NRO/DSEA/RHM2
MARTY STUTZKE, RES/DRA
WEIDONG WANG, ACRS/TSB

ALSO PRESENT:

PHIL AMWAY, Exelon
JEFF BROWN, GRAMMES of New Jersey*
RANDY BUNT, Southern Nuclear Operating Company
PATRICK FALLON, DTE Energy
TERRI FARTHING, GEH
BILL FREEBAIRN, Platts*
JEFF GABOR, ERIN Engineering
PAULA GOTCH, GRAMMES of New Jersey*
PAUL GUNTER, Beyond Nuclear
DAN JACOBSON, Energy Operations*
MARY LAMPERT, Pilgrim Watch*
PAT MARIDA, Sierra Club
RICHARD ROTHSTEIN, Town of Plymouth*
RICHARD WACHOWIAK, EPRI

*Present via teleconference

A G E N D A

Welcome, introductions, and logistics..............5
NRC overview and planned path forward of the CPRR rulemaking.............................5
NEI presentation on updated information since the last presentation and feedback on performance criteria presented by the NRC Staff...14
Break...80
Continuation of NEI presentation..................80
Public comments/discussion......................108
Closing remarks.................................134

P R O C E E D I N G S

9:14 a.m.

MR. BEALL: Good morning. Sorry for the delay in getting started, but I would like to thank you all for your interest in today's public meeting. My name is Bob Beall, and I'm the Project Manager for the Containment Protection and Release Reduction, or CPRR Rulemaking, at the NRC. I will also be acting as a facilitator for today's public meeting.

My role today will be to try to make this meeting productive for everyone involved, but before we start I would like to introduce Mr. Aby Mohseni. Aby is the Deputy Director in the Division of Policy and Rulemaking for the Office of Nuclear Reactor Regulation.

MR. MOHSENI: Thank you very much, Bob, appreciate it. Good morning and thank you for joining us, and apologies for starting late.

Welcome folks here and on the phone to our public meeting on CPRR rulemaking, Containment Protection and Release Reduction.

I'm Aby Mohseni, as Bob mentioned. I'm the Deputy Director for Division of Policy and Rulemaking in the Office of Nuclear Reactor Regulations.

The NRC Staff is here today to discuss the path forward for the Containment Protection and Release Reduction rulemaking. In addition, NEI will present updated information from our last public meeting and provide feedback on the CPRR performance criteria.

The NRC Staff has performed a preliminary quantitative risk evaluation using a high-level conservative estimate that determined that any potential alternatives within CPRR rulemaking would not be considered a substantial safety enhancement.

The Staff's quantitative analysis shows that based on the NRC's safety policy goal, statements, Quantitative Health Objectives, QHOs, there are no individual prompt fatalities and the individual latent cancer fatality risk is well below the QHO for what is considered to be safe enough.

The NRC Staff has not performed, and does not plan to perform a human reliability analysis for this rulemaking effort. The Staff does not believe that NHHRA is necessary for the decision making process for this rulemaking given the results of the high-level conservative estimate.

The Staff presented these findings to the Advisory Committee on Reactor Safeguards Subcommittee on November 19, 2014. Members of the PRA Subcommittee did not identify technical issues with the use of high-level conservative estimate by the Staff to inform rulemaking decisions.

The NRC Staff will be developing a Commission paper that provides details of the high-level conservative estimate and a recommended path forward. The paper will describe the Staff's plans to make the requirements of the severe accident capable containment vents Order EA-13-109 generically applicable and provide the Staff's perspective that based on the more refined risk analysis a rulemaking would not be needed. In that paper, the Staff will also describe other considerations that are relevant to the issue and Staff's rationale for its recommendation on the path forward. Thank you, Bob.

MR. BEALL: Okay. Before we begin, I'd like to go over some of the logistics for the day's meeting. For those participating via the webinar or on the bridge line there will be designated points during the meeting where you'll be able to ask questions. We do have a number of people participating by phone and by the webinar today, so I'm going to do my best to try to allow everyone to participate in this meeting fully. And by that I mean have everyone to allow the discussions -- everyone to follow the discussions, as well as having time to speak.

I ask those who are participating here in the room to please turn off or silence your electronic devices. I would also like those on the phone if you could, please, mute your phone to minimize any background noise during the meeting. If you do not have a mute button on your phone, you can press *6 and that should silence your line.

During the comment period we will first take comments from the room, and then from the phone, and then from the webinar participants. I'd like to ask the webinar participants to type in your questions into the check functions of the webinar while the other groups are commenting. That will provide time for Glenda to collect your questions.

Also, I'm going to ask the speakers both here in the room and those on the phone to identify themselves and any group they are with when they speak so everyone knows who's talking.

I'd like to remind visitors in the room that you must be escorted at all times above the first floor of this building. If you need to leave for any reason, please let one of the NRC Staff members in the room know. Next slide, please.

The meeting agenda; this meeting is scheduled to last from 9 a.m. to noon today. Once the introductions and logistics are complete, the NRC Staff will discuss the current status of the CPRR rulemaking. The Staff from NEI will then make their presentations, and then we will open the meeting to the public to provide comments on the CPRR rule and the NEI presentation. We will also take a 15-minute break around 10:30.

This is a Category 2 public meeting which means that public participation is actively sought in the discussion of the regulatory issues. This meeting is not designed nor intended to solicit or receive comments on topics other than those proposed at this meeting. I would also like to mention that no regulatory decisions will be made at today's meeting.

Next slide, please.

Today's meeting is being transcribed and the meeting transcript will be included in the meeting summary. The meeting slides from today will be posted on Regulations.gov website within three business days after today's meeting. Also, the meeting summary will be posted on Regulations.gov within 30 calendar days after today's meeting. If you search for docket I.D. NRC-2013-0075 on Regulations.gov website, you will be able to find these and other CPRR-related documents.

For those here attending in person, please sign in before you leave today. The sign-in sheet is on the table in the corner of the room over there, and a list of attendees and phone participants will become part of the meeting summary that will be prepared for today's meeting summary and made publicly available. Copies of the presentations can also be found over in the corner if you have not gotten one already. Also in the corner are copies of the NRC public meeting feedback forms, and we would appreciate any feedback you may have that would help us improve these public meetings. For those on the phone or participating by the webinar, if you would like to provide feedback for this meeting, you may email them to me at Robert.Beall, B-E-A-L-L, @NRC.gov.

And, finally, I'd like to ask speakers to please remember to speak loudly enough to insure those on the phone can hear you. For those on the phone, at any point if you are unable to hear the meeting discussions, please let us know. Are there any questions about the logistics?

Okay. Let's begin by going around the table here, please. Can you please state your name and the NRC office or the group you are with.

MS. INVERSO: I'm Tara Inverso from the Office of Nuclear Reactor Regulation here at the NRC.

MR. BOWMAN: Eric Bowman from the Japan Lessons Learned Division in the Office of New Nuclear Regulation.

MR. BEALL: Bob Beall, NRC, Office of NRR Rulemaking Branch.

MS. LAPPERT: Glenna Lappert, Rulemaking Branch.

MR. STUTZKE: Marty Stutzke, Office of Research.

MR. BUNT: Randy Bunt with Southern Nuclear, also representing Steve Kraft for NEI in this meeting because he had conflicts, and with the BWR Owners Group.

MR. WACHOWIAK: Rick Wachowiak from EPRI.

MR. GABOR: I'm Jeff Gabor with Erin Engineering supporting both EPRI and NEI in the CPRR.

MR. AMWAY: Phil Amway, Exelon.

MR. BEALL: Okay, thank you. Next slide.

I'd like to start off with going over the background. As mentioned by Aby, the purpose of this meeting is to discuss the path forward for the CPRR rulemaking and to hear the information being presented by NEI on the CPRR performance criteria and update information from the last public meeting. So, what I'd like to do is start with a high-level review of the background of CPRR rulemaking.

MR. MOHSENI: Given that you already went through the introduction, I think we kind of have another room.

MR. BEALL: Okay.

PARTICIPANT: And on the phone, also.

MR. BEALL: Okay.

MR. McHALE: I'm Jack McHale from the Japan Lessons Learned Division, NRR.

MR. PETERS: Sean Peters, Office of Research.

MR. COLLINS: Tim Collins, Japan Lessons Learned Division.

MR. CASE: Mike Case, Office of Research.

MR. FULLER: Ed Fuller, the Office of Research.

MS. OLMSTEAD: Joan Olmstead, Office of General Counsel.

MR. GUNTER: Paul Gunter, Beyond Nuclear.

MR. ESMAILI: Hossein Esmaili, Office of Research.

MR. AULUCK: Raj Auluck, Japan Lessons Learned.

MR. SHEA: Jim Shea, NRO.

MR. BASU: Sudhamay Basu, Office of Research.

MR. LANE: John Lane, Office of Research.

MS. FARTHING: Terri Farthing, GEA BWR Owners Group and Fukushima Response.

MR. FALLON: Pat Fallon, DTE Energy.

MR. WANG: Weidong Wang, ACS Staff, NRC.

MR. PURDIE: Mike Purdie, NRR.

MR. BEALL: And also, anybody on the phone like to identify themselves, please?

OPERATOR: All lines are muted right now. Would you like me to open them?

MR. BEALL: Yes, please.

OPERATOR: Okay, give me one moment. All lines are now open. To reduce the amount of noise into the conference when not speaking, please utilize your mute button or press *6 to mute and unmute your line.

MR. CASTLEMAN: This is Pat Castleman from Commissioner Svinicki's staff.

MS. GIBSON: Kathy Gibson from Research.

MS. GHOSH: Tina Ghosh, Office of Research.

MR. JACOBSON: Dan Jacobson, Energy Operations.

(Simultaneous speech)

MR. BROWN: Jeff Brown also GRAMMES of New Jersey.

MS. LAMPERT: Mary Lampert, Pilgrim Watch.

MR. ROTHSTEIN: Rich Rothstein, Nuclear Matters Committee, Town of Plymouth.

MS. MARIDA: Pat Marida, Sierra Club from Columbus, Ohio.

MR. BEALL: Okay, thank you very much. If everybody can please mute their phones again on *6. Like I said, I'd like to start with giving a little background.

The Staff wrote SECY paper 12-0157 which based -- which recommended that we have installed filters based on qualitative considerations. The Commission reviewed that paper and issued a Staff Requirements Memo, SECY 12-0157, and in that paper they asked to insure that performance and risk are filtered strategies, and filters are fairly evaluated. They want us to explore the requirements associated with measures to enhance the capabilities to maintain containment integrity, and to cool the core debris. They also asked us to examine multiple performance criteria which we'll hear a little bit about today from NEI. And if we have any policy issues that we found during the analysis, they should be raised to the Commission. And, lastly, to develop a separate paper on the quantitative considerations.

The Staff has developed a comprehensive PRA methodology to support the CPRR rulemaking, and we've held several public meetings since the SRM has been issued. We've also issued a COMSECY on Expedited Spent Fuel Pool Transfer that was submitted and voted on by the Commission, and their response to the COMSECY reaffirmed that the risk was low enough that it did not rise to a substantial safety enhancement.

Also currently with the Commission is a SECY paper on Quantitative Considerations, that's SECY paper 14-0087. And then we're waiting for the Commission to give us their guidance on that.

On the next slide, I'd like to go over the process for CPRR rulemaking disposition. We start out with a high-level estimate. Then we determine whether or not the estimate is reliable and sufficient. If it's not, we go up and do -- a more detailed assessment was performed, and then we move down to is the assessment technically adequate? If it is, we look at making a rulemaking decision. If not, we try to improve the technical accuracy before we make our rulemaking decision. But if we do have the estimate of sufficient and reliable, then we start considering what kind of rulemaking decisions should be made for this rulemaking we're doing right now.

On the assumptions for high-level

conservative estimates, what we did for this was -- get my notes here a little bit, make sure I get this right. We did look at the extended loss of AC power, ELAP frequency for Mark I and Mark II BWRs. And we also looked at the individual latent cancer facilities risk which is 2 millirem per year, which is the EPA standard, and a long-term phase. We multiplied them together and we got one times E to the minus seven.

During this analysis, we assumed that FLEX was successful 6 percent of the time due to human factor scoping which is occurring within the EA-1208-049 order, and the post-Fukushima accidents that we take in response to the NTFF recommendation 2.1, which is seismic reevaluations. Therefore, the high-level conservative latent cancer facility risk with the current plant configurations is seven times ten to the minus eight; therefore, an alternative could be removed all risk for the status, of the status quo or the maximum benefit will be seven times ten to the minus eight. And this provides a very high-level conservative estimate for the possible benefit to rulemaking activities we're considering doing.

In this chart, we have the results of the high-level analysis. As was shown in the previous slide, the preliminary analysis determined that based on a high-level conservative estimate there would be no prompt fatalities, and the individual latent cancer risk is calculated to be over an order of magnitude below the Quantitative Health Objectives, or QHOs. Thus, the NRC Staff plans to recommend to the Commission that no rulemaking be pursued with respect to filtering strategies or the various alternatives.

As you can see, the high-level conservative estimate is seven times ten to the minus eight, and the more detailed analysis to the 95th percentile is seven times ten to the minus ninth. And the QHOs are 1.84 times ten to the minus six. And the red triangle is the expedited spent fuel transfer results, which you see is also -- and the Commission said that was -- we didn't have to do the expedited spent fuel transfer in the spent fuel pool.

This slide is the CPRR next steps. As was shown in the previous slide, we determined that the high-level estimate was very conservative, and so the Staff will be generating a Commission paper with preliminary conclusions and recommended path forward. We still plan on looking at doing rulemaking to make the requirements of the Order EA-13-109, which is the severe accident capable containment vent generically applicable to Mark I and Mark II BWRs. But we could be

-- we may be discontinuing certain aspect of the CPRR rulemaking.

We do plan on having additional meetings with the ACRS, both the PRA Subcommittee and the full Committee during the first quarter of 2015. And if we need to, we'll have additional public meetings before the Commission -- before the paper is sent to the Commission.

MR. BUNT: I assume you're anticipating that meeting the end of the first quarter or so by the time this paper is --

MR. BEALL: Yes.

MR. BUNT: This is Randy Bunt. Sorry.

MR. BEALL: Okay. I'd like to move on the NEI slides.

MR. BUNT: All right. Again, I'm sitting in for Steve Kraft for representing NEI because he had a conflict. He apologizes for not being here today. We're appreciative of the opportunity to present the information we've got, and the NRC work on this, and are looking forward to the schedule for getting out into the first quarter to get resolution on this topic. And with that, I'm going to turn it over to Jeff.

Now, what we are -- I mean to Rick. What we are doing is we're working this in two ways, so Erin is working as a contractor for NEI to work to some of the qualitative evaluation aspects, where the technical aspects are being worked through EPRI. And we're going to show those, and we broke them out into the two different presentations here.

MR. WACHOWIAK: So, I'll start off. Rick Wachowiak from EPRI.

We've done a basic -- a partial Level 3 PRA looking at the ELAP condition, and the intent of this presentation is to go through what our results are. And you'll probably see that they're very similar to much of the results that you had presented. I noticed that our latent cancer fatality risk numbers fall right into the middle of the range that you presented on your chart, so it looks pretty consistent.

So, a couple of things that we'll go over here. We have completed our analysis, and as a part of the process we brought in members of the industry to do a review of our work, and it was done in a day and a half workshop in Charlotte. We went over the key assumptions and the results from our analysis, and made sure that everybody understood what we were doing, and tried to see if there were additional sensitivity studies that we needed to do, or look at additional factors. That was completed here in the last month or so.

Our intent now is to publish a summary of the results and of the technical review first of the year. That can be used as a reference for what our results are. Then over the next couple of months after that we'll be working on a detailed technical report that has all of the results of the calculations. And you'll see when we get into this, we've done several thousand calculations associated with this, and documented all those. So, that'll be a pretty hefty document, but we want to get the summary results and conclusions out in a useable form right after the first of the year. Go ahead next slide.

So, the way that we looked at this, we looked at several different options. We started out with assuming that everyone -- all the Mark Is have implemented the severe accident capable wet well vent. And then we looked at different options for further reducing radionuclide releases in the -- under these ELAP conditions.

We looked at severe accident capable dry well vents, severe accident water addition, severe accident water management, which is simply severe accident water addition but it's controlled in a manner such that containment flooding does not occur, and you can preserve the wet well vent path.

As in the prior EPRI report, we looked at various schemes of vent cycling to try to minimize the releases. And also in this report, we looked at different, let me just call them classes of filters, different capabilities of filters to be added in with some of these other capabilities. And then the one other thing that we did was a passive filter configuration. It was a configuration that was provided by the NRC to us as their concept of what a passive filter configuration might look like, and we included that in our mix of cases. Next slide.

So, just so that everybody is grounded on the same page of what these different things look like, we have our base case which is just the severe accident capable wet well vent. See on the lefthand side here, it's simply a manually operated vent off the wet well, and it has the capability to be operated during severe accident conditions. Another alternative that we looked at in the base case was to add a severe accident capable dry well vent to that, so once again it's simply a manually operated vent path that are connected to the containment.

In some of our alternatives we're looking at severe accident water addition, and our conceptual thought of what this might look like is two things on this slide and the next slide. On this one, we -- something like some portable pump that can be -- take suction from an external source and put water inside of the vessel. Once again, set up so that it could be operated during the conditions in a severe accident, and especially those severe accidents that were initiated by the ELAP condition.

The next one shows -- next slide please. Shows the same sort of thing, except the water is being put into the drywell rather than into the vessel. The reason that we looked at into the vessel is that we thought the connections might be easier, or might already be there from the FLEX work that had gone on. And we also see that you can get water into the drywell post-vessel failure because the water would go into the RPV, and then with the hole in the vessel it would come out and into the containment. So, in essence, these are two different ways of getting water to the debris in the containment, and we looked to see if there was benefit to having one injection point over the other. Go ahead to the next one.

When we started looking at filters one of the cases was what we call the small filter, and by small basically it means the capacity. It has the ability hold up so much aerosol material and be able to contain so much heat. We did some surveys out in the industry to see what types were available, and we picked one of the small filter types that plants had been looking at. And then you could see in the configuration here it would be able to be aligned manually to either the drywell vent or the wetwell vent. And go ahead and go to the next slide.

This one with the larger filter, our conceptual drawing here just has a bigger filter, and that's really all the difference is, is it has a greater capacity of holding material that's been scrubbed out of the effluent path and a larger heat sink. Once again, that's based on some of the designs that are out there.

Finally, we started looking, or we looked at the passive vent with the filter. In this particular case, it's a rupture disk connected to the drywell that's always open, or the pathway is always open, but the rupture disk is providing the containment barrier here. And if the pressure goes up too high it will open up the drywell vent, pass through the filter.

This particular configuration has an issue with it, though, is that some of the pre-core damage scenarios, what we call the anticipatory venting to promote longer RCIC operation is precluded by this particular configuration because the filter would have to be isolated in order to perform that action. And that'll show up -- Jeff will show in some of the results later what the effect of that is.

One more configuration that we looked at for the vent, it's a post-core damage passive vent so it would be actuated after core damage. You would open up, manually open up the flow paths and then there would be a passive filter path. But once again, that action still has to be taken after core damage.

So, those are the configurations that we looked at, and we've also done some sensitivities on different parameters and things in the analysis. Jeff has a couple of examples of some sensitivities that we've done. Go to the next one.

This is a summary for everyone. Mostly, it's a test for your prescription on your glasses, but it does contain the list of all the cases that we considered, and what the attributes are. Behind all of this in our probabilistic analysis, see, this is the chart of cases that we did, but behind each one of those cases there's approximately 500 other evaluations that we did using MAAP and MACCS2 for the offsite consequences. Go ahead to the next one.

So, I'm going to turn over for the next part of the presentation to Jeff, and he's going to go through the results that we had and that were reviewed by our external team.

MR. GABOR: Okay. Again, my name is Jeff Gabor, supporting both EPRI and NEI. Next slide, please.

In past public meetings we've discussed in some detail the process that we came up with, again, very similar to -- in some regard to the analysis performed by the NRC Staff. We, basically, started the process by constructing both a core damage event tree to look at what are -- given an ELAP-type event, and given the FLEX equipment.

Our base assumptions were that the EA-13-109 hardened vent was implemented, the wetwell vent portion of that. Our other base assumption was that we had implemented, as the industry is doing, EPG/SAG Rev 3. And, again, those initial assumptions were documented.

PARTICIPATION: In FLEX.

MR. GABOR: In FLEX, yes, sorry. And FLEX was implemented under 049. Those were documented in previous public discussions.

But, again, a containment event tree was constructed to look at how you might progress to core damage given FLEX, given the RCIC system, given the implementation of Rev 3 of EPG/SAGs, and that came up with a certain number of potential core damage end states. Those each were then passed into a containment evaluation typically called a containment event tree, or accident progression event tree, where we look at a combination of systems and phenomenology that could occur during a severe accident that ultimately could affect the end result, the end state, which is really depicted by unique characteristics of release timing and magnitude.

And when we combined all that we end up with for each one of our alternatives 507 unique end states. Typically, in a PRA atmosphere we would choose to bin those down. In fact, a typical PRA would have binned the initial core damage states into a handful that were manageable. Same with the end states on the releases, they would typically be binned into maybe a dozen, or two dozen unique end states.

What we found was that we had the capability to actually analyze and track each one of those as a separate calculation. The benefits of that is we don't get caught in the process of justifying selecting representative sequences for a particular bin. That's always something that's scrutinized by peer reviewers, and our process avoided that.

It doesn't mean that you couldn't do that, it doesn't mean that there are like characteristics of those 507 end states, but we were actually able to model all the way through the consequence analysis any slight variations that those unique end states might create. So, we built -- we constructed MAAP input files for each of those 507, and again times the 22 alternatives that we analyzed. We executed the core damage scenarios in parallel. We constructed much like -- I believe the NRC Staff has the capability of creating more of an automated process that can take the source term release characteristics, combine it with the consequence input on weather data and population, and then actually carry out a unique MACCS or consequence analysis for each one of those. We did all the manipulation using Python scripts, and to also create the input, and then also post-process the results.

I didn't come with binders full of MAAP results. I picked some of the selected results. We have communicated some of these in past public meetings. As Rick pointed out, our summary document will provide us with an early reference for the results of the EPRI study, and then followed up with a much more detailed document in two months or so.

One of the issues that we continue to look at during our analysis was initially what the benefit of having a reliable or severe accident water addition system available. And this is something, as you know, FLEX is designed to prevent core damage, so it's kind of -- the design considerations were not severe accident. Our severe accident water addition system that we're talking about either extends that capability, or creates a new capability that allows the plant staff to add water either as Rick pointed out, either to the reactor vessel, or to the -- directly to the drywell during a severe accident. So, issues on habitability in high rad areas, and temperatures all had to be considered in crediting that type of a system.

And what I'm showing here is for one of our alternatives, which was a case where, again, like I said, we had effectively implemented EA-13-109. We had a hardened severe accident capable wetwell vent available. We looked at -- just at kind of sorting out our end states, the difference that water injection versus no water injection would have on the peak structure temperatures inside the drywell.

Primarily, what we're looking at is the drywell head as that was identified throughout SOARCA, and also followed up with the Fukushima responses, is drywell head temperatures being a critical element in preventing drywell leakage. And we find that when we do have water addition those structure temperatures remain well below 600. In fact, if you recall in our NEI-13-02 guidance we've selected a 545 design criteria for drywell vent in this case. And we're just verifying it, confirming it with water addition that is an appropriate temperature to use.

If on the other hand there is no water addition added to containment, the core debris radiates to the containment structures, core concrete attack can ensue, higher temperatures are expected, and you can see here greater than 1,000 degrees. All I'm showing here is a cumulative probability distribution, so this tells me on the blue line that 100 percent of our end states, and these are the 507 unique end states for that specific alternative, 100 percent of those resulted in a peak temperature with water addition of less than 550 degrees.

MR. FULLER: Jeff?

MR. GABOR: Yes?

MR. FULLER: Before you go to the next slide, can you give me a feeling for what the temperature range would be for the set of scenarios you looked at right at the time of vessel failure, or whenever you turned the water on?

MR. GABOR: We can do that. I don't have

those charts. One of the things that I believe will probably make it into the detailed EPRI report will be what we've defined as horsehair plots. They look a lot like the SOARCA uncertainty analysis plots, where in those cases we're actually able to plot all of the end state temperature responses as a function of time. And you can see what the distribution -- in fact, in the ones we had for our review session, we actually identified the mean and the 5th, and the 95th percentiles on there, as well.

MR. FULLER: Can you give me some feeling for what the temperatures might be?

MR. GABOR: Temperatures prior to -- majority of the high -- for cases without water, you're saying at the time of vessel breach?

MR. FULLER: At the time you've turned the water on.

MR. GABOR: At the time we turn the water on they're typically below the 500 degree threshold.

MR. FULLER: Okay. Is that --

MR. GABOR: Is my recollection.

MR. FULLER: That would be -- and if you turn the water on right at vessel failure, that's the kind of number you --

MR. GABOR: Yes. I mean, keep in mind in this

-- in the blue line, as I think you're well aware, our assumption on severe accident water addition was that it would be on at least by the time of vessel breach to provide cooling to the debris. And that time, for example, looking at the SOARCA analysis, for example, would be around the eight-hour point from SOARCA. A little bit early, could be earlier in a typical MAAP calculation. But this is actually the peak value, Ed, so this will --

MR. FULLER: Oh, peak value?

MR. GABOR: This is the peak value, so this takes account the whole time history before and after vessel breach. So, at no time, I guess I can say, at no time when water was added at the time of vessel breach as a criteria, at no time did the temperatures exceed 550 degrees in any part of the drywell. Okay?

MR. FULLER: Thanks.

MR. GABOR: The next chart, as Rick pointed out, one of our alternatives to actually Two Echo looks at adding water via the reactor vessel. The alternative Three Echo runs similar scenarios, again 507 unique end states, but looks at adding that water to the drywell. Again, we've had public discussions of these alternatives in the past. I'll remind you that when we add water to the drywell we took no credit for any atomization of the droplets through the spray headers, no thermal interactions with droplets, no aerosol scrubbing due to sprays.

The reason we took that conservative approach is that our typical spray headers are qualified or designed for a higher flow than we typically are looking at with the FLEX pumps. Systems would be over thousands of GPM, where FLEX is in the 300-500 range.

I think there would be some particles formed, there would be some enhanced heat transfer, but just due to some of those uncertainties much like your own analysis, we took a fairly conservative approach to not take credit. So, when we say drywell injection, we basically mean just adding water to the floor with no interaction with the structures.

This chart is -- again, we expanded the X axis a bit. We're looking at those same maximum temperatures in the structures within the drywell region, again focusing mostly on that drywell head because that seems to be a key point to look at. And, again, you can see with the RPV injection at no point did the peak temperatures exceed around 550 degrees. I'm not good at estimating, probably a little less than 550.

You could see there's a slight increase on the cases with drywell injection, and the reason for that I think is understood by folks doing the severe accident analysis is that post-core damage fission products that had previously been deposited inside the RPV, or potentially core material that was remaining behind inside the RPV, it provides a longer term heat source. And that heat source then can radiate out into the drywell and have some impact on the peak temperatures in the drywell. That's why the injection into the RPV is slightly better in terms of maintaining those temperatures.

But, again, at no time -- if I read this probability curve correctly, at no time did the peak exceed, let's just pick a number of 600 degrees Fahrenheit in the drywell even with just injecting into the drywell. So, we view them both as valid ways to get water onto the core debris.

I believe the NEI-13-02 guidance will echo this information, will identify that there is a slight advantage to putting the water in the reactor vessel.

MR. BASU: Jeff?

MR. GABOR: Yes?

MR. BASU: Given the uncertainties in the heat transfer characteristics that you just mentioned would you still say that the RPV injection is more beneficial than the drywell injection?

MR. GABOR: I think I would, and the basis goes beyond that. I mean, there have always been questions asked about if I put water in the drywell, where am I putting it, and will it find its way to the core debris, wherever that might be?

Injecting it into the RPV kind of avoids that issue, because in that case the water is going to follow debris, and more likely to be effective as -- and it just eliminates one of those concerns.

Again, maybe it's a personal preference, but my other consideration would be, if I had fission products deposited in the RPV, and if perhaps the core damage in the core melt phase wasn't 100 percent complete, which I think people looking at Fukushima might come to those conclusions, then putting it into the RPV helps to cool whatever might be remaining behind.

MR. BASU: Okay. So, in terms of coolability maybe there is some difference that you can -- in terms of the drywell head temperature given those uncertainties, would you still say that RPV injection is --

MR. GABOR: And, again, the reason I would say that the RPV injection is preferred is because the primary heat source to the drywell is the reactor vessel. The fact that that reactor vessel at some point parts of it had achieved temperatures over -- at 4,000 degrees in order to have core melt. The RPV becomes a heat source to the drywell. And what we've seen in our analysis is the upper part of the drywell, a cylindrical portion of the drywell in the head become the hottest points in the drywell. And, again, by cooling the RPV you can effectively help bring those temperatures down.

MR. FULLER: Ed, again.

MR. GABOR: Yes?

MR. FULLER: These temperatures, are they structure temperatures, or are they gas temperatures?

MR. GABOR: Excuse me, these are actually structure temperatures. What we have -- what we'll put in the report is we've drawn these similar plots and included both the gas and the structure. And you do see a slight lag there, what you'd expect.

MR. AMWAY: This is Phil Amway. And just, you know, one of the reasons why we're looking at both RPV and drywell addition is if you look at the -- across the BWR Mark I, Mark II fleet in large majority where we're connecting to to provide the water addition can be aligned to either RPV addition point, or drywell addition point; whereas, our procedures would direct where that goes.

In a few of the plants they are actually separate systems, so one of the things we have to be able to look at is the capability to actually make those connections and to continue the water addition under severe accident conditions, so we don't want to necessarily exclude viable addition points if it makes more sense for other reasons because of habitability or accessibility reasons to make a connection to the drywell addition point versus the RPV addition point. That's why we're doing that.

MR. GABOR: Since you brought it up, Phil, are there any considerations to be -- if you ever got into one of these situations at a given plant, would both connections be made or would you make a decision which way to go?

MR. AMWAY: In the guidance in 13-02 we are only requiring one addition point be made that is feasible and connectable under severe accident conditions.

MR. GABOR: So you make the decision well before any accident --

MR. AMWAY: Yes.

MR. BEALL: I'd like to remind everybody to please identify themselves when they speak, please.

MR. GABOR: The next slide, please. As far as the MACCS evaluations were concerned I had put together a couple of slides here. The input was provided to us by the NRC. It was basically the Peach Bottom input based on the SOARCA model. We utilize 64 compass directions, included the updated dose conversion factors, modeled the six unique cohorts, utilized the network evacuation model, and I believe incorporated 2005 population and economic data.

The next chart, one of the things we were interested in, as always in our analysis, is much like the conservative evaluation done by the NRC, is how robust are our answers to potential variabilities? And one of the -- a key potential variability is population size at our sites. What we plotted here were all the Mark I sites in the U.S. out to 50 miles, and what we found in doing that is the SOARCA plant actually wasn't the highest population. There was one other plant that we identified that had a 20 percent or so higher population.

What we used this for then was to go in and perform a sensitivity analysis on our MACCS calculations utilizing this type of increase in the population just so we could say that we had bracketed all of the plants.

MR. FULLER: Jeff, this is Ed Fuller, again.

MR. GABOR: Yes?

MR. FULLER: This means that everything else when you did this bracketing, everything else in the MACCS input was characters of the Peach Bottom site.

MR. GABOR: That's true. That's true. Yes, we just changed the population. The next --

MR. STUTZKE: Question, what --

MR. GABOR: Yes?

MR. STUTZKE: -- the MACCS plan?

MR. GABOR: We weren't going to identify that today.

The next chart just looked at the preferential wind -- the wind distribution from the annual data on Peach Bottom, and you can just see that preferentially we're seeing winds out of the north northwest, just gives you kind of a quick look. Obviously, that then affects the doses that would be seen in those downwind areas. Next chart.

So, as far as our quantitative results, and you can jump to the next one, we looked at five quantitative metrics. Again, these were discussed in past public meetings. We looked at the varying core damage frequencies. We also looked at conditional containment failure probability. That, of course, is the probability that the containment will fail given a core damage event, so it's conditional on that. And that would be -- containment failure would be cases where the containment, say the drywell head failed maybe due to unavailability of a venting path to control pressure. It might involve liner melt through for the Mark I where if we don't provide water to the core debris, there's a high likelihood that liner melt through would occur and result in a rather early vessel containment breach.

Much like your own evaluations, we looked at the latent cancer fatality risk that comes directly from the consequence analysis, and then we took the output from the MACCS calculations and using a methodology that's identical to what gets done in our license renewal or SAMA calculations, the NRC methodology, we calculated what the maximum averted cost risk would be.

And if we look at, for example, at a base case risk at a plant today, that MACR, we call it, would be a dollar equivalent if we eliminated all the risk, and we put all the risk to zero, which of course you can never do zero, but it provides us with kind of an upper band, I'll call it a screening tool to look at if I did eliminate all the risk from this plant what would that maximum cost risk be? And then, obviously, you can -- if you did eliminate that, that provides you with the benefit of doing that. And then, obviously, you could then compare that to a cost to implement a particular plant modification as part of your cost benefit analysis. So, the last element is really looking at our base case where we haven't implemented any of our alternatives, and now we look at the reduced risk involved in each of our varying alternatives that we analyzed.

It's the delta that we care about, because the delta is what's compared against the cost of a filter, or the cost of severe accident water addition, or the cost of a procedure change. Identical to the process that the industry goes through as part of their SAMA analysis in support of license renewal. Next chart.

I don't think I need to go through these. It just provides a little bit more background on what I just discussed on how each of those quantitative metrics is described and what the purpose of that is. And, obviously, those last two, as I pointed out, provides us with the financial consequences which is the element that's used as part of a cost benefit evaluation. The latent cancer we mentioned as did the Staff presentation, that you use that to compare against the NRC's Quantitative Health Objective, that roughly 2E minus eight kind of number. And that, obviously, is consistent with, as you pointed out, the COMSECY on spent fuel pools, and many other regulatory actions that have been taken.

MR. FULLER: Excuse me. This is Ed Fuller again. Regarding conditional containment failure probability, did you consider using it conditional on the initiation of an ELAP versus core damage?

MR. GABOR: We did not do that yet, no. We did not.

MR. FULLER: Do you think that might be a reasonable idea?

MR. GABOR: We'll talk -- we're going to have some comments at the end of actually the NEI presentation. The Staff identified CCFP as potential performance criteria, or performance measure, and we've got comments on how that could be used.

MR. FULLER: We didn't identify it. We were suggest -- it was suggested to us by you folks.

MR. GABOR: It was on Aaron Szabo's slide at the last public meeting as something he wanted our input on.

MR. BASU: That's correct.

MR. FULLER: Okay. Well, that's good.

MR. BASU: It was in our slide, but the original CCFP came from the industry.

MR. GABOR: Correct. Okay, the next slide starts to get into comparing all of those alternatives that were on that chart, that eye chart, test chart that Rick showed you.

In this case, we've plotted those on this first chart against a pre-Fukushima reference which gives us a core damage right out of the SECY-12-157. And I think that was the SECY number three minus five type range. As I said, as we implement FLEX 12-049, as we implement the vent order, 13-109, and as we implement Rev 3 of the EPG/SAGs, which is the base for all of our alternatives, you can see where they come in. So, there's a pretty significant reduction in CDF. Yes, if you hit the next key you see part of that. The benefit we get really does come from the FLEX system and provides us with the CDF reduction.

Remember that our alternatives are geared towards the CPRR. They're geared toward protecting containment, and protecting and reducing releases so they're not going to have a significant impact on the CDF other than FLEX.

MR. FULLER: Excuse me, Jeff. At the risk of dominating the conversation, this is Ed Fuller, again. If we look at this reduction from the pre-Fukushima down to now, it's something like a factor of five or so reduction in the ELAP core damage frequency. Does that imply that you're saying that the successful implementation of FLEX to prevent core damage is in the order of 80 percent?

MR. GABOR: Yes.

MR. FULLER: Okay. Next chart.

MR. STUTZKE: More questions, please?

MR. GABOR: Yes.

MR. STUTZKE: Are you still running --

MR. GABOR: We are here.

MR. STUTZKE: Okay. If I could ask, why not EPRI's interrate calculator?

MR. WACHOWIAK: Because we didn't want you to ask.

MR. STUTZKE: Okay. And are you using them as far as dependency model, dependencies among all the human actions?

MR. WACHOWIAK: Yes.

MR. BOWMAN: Marty, don't forget to identify yourself.

MR. STUTZKE: Yes. It's Marty Stutzke from Office of Research. Okay.

MR. GABOR: And we'll have all of the details in the EPRI report. I think some of those have been transmitted, at least the initial numbers that Doug True had worked with were presented in past public meetings.

I should have started off, Marty, with when we look at these charts, and as we get into some of the other entries, you're going to tell us well, that looks a lot -- very similar to what we saw before, so what's different? Primarily, what's been changed as a result of our last discussion with you, we went back in and updated the seismic contribution to reflect, as you did, reflect the more recent data.

MR. STUTZKE: Right.

MR. GABOR: What effect that seemed to have on our core damage end states or core damage was that it put more emphasis on the early failure RCIC as a result of that.

MR. STUTZKE: Right.

MR. GABOR: Basically how it kind of played out. So, that's what's different in what you had seen before. Next chart, please.

So, if we take away the pre-Fukushima and just focus on our evaluation as part of the filtering strategies of the CPRR, you can see very -- as I mentioned earlier, very little difference in the core damage frequency across the board. Again, that makes sense because we're primarily focusing on containment in those end states and we would expect it.

One interesting point that I'm sure you'll have questions on, so we'll try to head those off, is our Case 6 Alpha, the one that Rick showed you the kind of schematic for, where we only assume a totally passive filter design.

As you're going to see, that does have some positive effects on reducing releases. Obviously, it eliminates a human action so it has a slight increase or a slight decrease in the release, and it does improve that result. But without the anticipatory -- the capability to open a vent early to extend the life of RCIC as part of our FLEX strategy, it actually has the negative impact of increasing core damage slightly. And it's the only one that does that, you can see that. It's, again, not a huge bump in the core damage frequency, but again you have to consider both that impact and the potential improvement which you'll see on a future slide with having that totally passive system.

I think that's kind of what drove our discussions with the Staff and, ultimately, resulted in you providing us with your conceptual design on what a kind of passive-type system would look like. And I think the one you gave us was the 6 Bravo Case that Rick showed you, where you would retain the capability through operator actions to do the anticipatory venting, which is our 6 Bravo there, but have -- post-core damage have a rupture disk that would eliminate the human action.

MR. ESMAILI: Quick question.

MR. BEALL: Identify yourself, please.

MR. ESMAILI: Hossein Esmaili from Office -- we are -- the configuration that you show that the rupture was inside the containment and the line --

MR. GABOR: It was inside the reactor building.

MR. ESMAILI: Inside the reactor building.

MR. GABOR: Yes.

MR. ESMAILI: And the line is open, but that is the one that doesn't allow you to do anticipatory venting.

MR. GABOR: Correct.

MR. ESMAILI: There is no way to put this rupture disk somewhere else --

MR. GABOR: You still have to manually be able to bypass it, I guess.

MR. ESMAILI: So, that you can do anticipatory venting even in the rupture disk?

MR. GABOR: Well, I think our 6 Bravo does that. IF you go back --

MR. ESMAILI: Oh, okay.

MR. GABOR: -- you can see that that

configuration did -- and that's why in this case CDF didn't change, because it did allow for that as you provided in your conceptual schematic to us.

MR. BUNT: This is Randy Blunt. It's just that when it's totally passive, you have to have failures on the other side that kind of drive this, that say that you won't get that valve closed, and you won't -- don't get that valve closed, then you'll get core damage a little bit higher than a system that doesn't have that extra valve in it.

MR. GABOR: Again, that was something that we looked at as kind of a variation on the theme that you provided. The next chart, please.

If we look at the standard definition of conditional containment failure probability which is conditional on core damage, again you see a very similar kind of characteristic here. Here we're grouping our various alternatives into cases where we don't have severe accident water addition. Those are the two red columns on the left.

If we do have severe accident water addition either to the RPV or to the drywell, you can see the reduction in CCFP. And that's basically coming from the fact that I'm able to prevent liner melt through, I'm able to prevent high temperature failures of the containment by just simply putting water on the debris.

You go over to the right and you can pick up the cases 4 Alpha through 6 Bravo where we did look at large and small external filters. You can see very marginal, if even detectible, improvements in CCFP in those cases. With the one exception you see in your —-- in the case we ran as a totally passive 6 Alpha case. In that case, again, we eliminated the human action to open the vent. We avoid containment over-pressure failure.

Keep in mind, notice the green and blue colors. We do in those cases assume that severe accident water addition is available. You essentially have to because if you don't have severe accident water addition, those cases on the right that are hashed where did analyze an engineered filter, they would look just like the red bars on the left because you would get high temperature failures, you would get liner melt through, and you would bypass your engineered filter, and it would become -- it would provide very minimal benefit to you in those cases.

MR. FULLER: Ed Fuller, again. It would be interesting to replot this using my suggested alternative for conditional containment failure probability using as the base the ELAP frequency and not the core damage frequency. It would be instructive to see what that provides.

MR. GABOR: Okay, good input.

MR. ESMAILI: Hossein Esmaili. The cases which filter or look similar to the cases with SOARCA is because of your accident progression, that you are venting at the time that you are putting water in. Right? And it takes a very little time between the time to have lower head failure until you fail. Most of the releases are occurring through uncontrolled venting rather than controlled venting.

MR. GABOR: Correct. And we'll show you a sensitivity that we did on, for example, delay liner melt through. One of the -- in some of our discussions with the Staff early, very early discussions with the Staff there were questions asked about well, the industry analysis has assumed that within 15 minutes after vessel breach you would have liner melt if you were not providing water. And that assumption is consistent with SOARCA, the NRCA SOARCA, but when I went back and I looked at your SECY evaluations, there were cases that were done where you did more mechanistic modeling of melt spread and the heat up of the liner, the spread to the liner, and what I found from those SECY cases were typical delay times between vessel breach and liner melt in the range of three hours or so. We actually did our sensitivity assuming a 10-hour delay, and I'll get to that next.

MR. ESMAILI: And you are not taking any credit whatsoever for the existing water because of the leak --

MR. GABOR: We do require an active severe accident water addition system, yes.

MR. ESMAILI: No, from the leakage that occurred before you started --

MR. GABOR: As far as taking advantage of that, all that -- taking advantage, we agree that that would be a reality both condensation on the walls and any leakage from the RPV would collect in the sump and in the drywell. That's why in our cases severe accident water addition either to the RPV, which would only come in after vessel breach, or directly to the drywell. Both of those are judged successful with a probability. They're judged successful based on the Theofanous work that says you can prevent liner melt. So, since we're treating both RPV injection and drywell injection similarly from a success standpoint for liner melt, the answer to your question would be yes, we are taking credit for that water.

MR. WACHOWIAK: But we want -- this is Rick Wachowiak from EPRI. We want to make sure, though, that we're not somehow taking credit for leaking recirc pump seals because we really don't know how much they're going to leak in these cases. We put in a maximum amount based on calculations and some tests that are done, but in an actual situation we don't know that they're going to leak that much, so you really can't count on that water being there.

MR. GABOR: I think the three-hour delay, and you probably know this better than me, but I think when I looked at the SECY analysis, the MELCOR runs in the SECY, the three-hour delay were for dry cases, so they were taking credit for any preexisting water in a delay to liner melt.

MR. ESMAILI: I don't think SECY 1201-57, I don't think we have existing water in the --

MR. BASU: This is Sud Basu from Research. There was no existing water in 1201-57. Three-hour delay was strictly because of the --

PARTICIPANT: Movement, yes.

MR. GABOR: Okay, fine.

MR. ESMAILI: So, that's what caused it.

MR. GABOR: Fine. Next slide --

MR. STUTZKE: I have a question about this

-- the base case there, the pink ones. I note that's not quite 100 percent.

MR. GABOR: Artifact of the drawing.

MR. STUTZKE: Okay.

MR. GABOR: So, your --

MR. STUTZKE: They either result in a containment failure or event.

MR. GABOR: Right.

MR. STUTZKE: And when you get event, of course, in the risk calculation there's still consequence in your adding all of this up.

MR. GABOR: Right, good point. I mean, the fact that we're sitting at around 55 percent means that when you do the more rigorous, much like the Staff's evaluation, you do the rigorous containment event tree, your accident prevention event tree quantification, you find that there is this residual risk where systems didn't work, the vents didn't work, the water wasn't available. Even though you had it, it failed to function properly.

MR. BUNT: This is Randy Bunt. This doesn't account for the likelihood of that event occurring. This is just a probability of that event getting to the end state. This has all of the cases, right?

MR. GABOR: This has all the cases, right.

MR. BUNT: No matter how likely or unlikely they are to --

MR. GABOR: They're frequency weighted.

MR. STUTZKE: Right. So, this is the release frequency divided by CDF.

MR. GABOR: Yes.

MR. STUTZKE: Okay.

MR. GABOR: The next chart, much like the Staff's comparison, although your resolution is better than our's, we say it's about 2E minus six, and you're 1.8 I think. But, nonetheless, what we did here and on the next chart -- well, not on the next chart, just on this one, is we plotted our latent cancer fatality risk probabilities against the Quantitative Health Objective in the 2E minus six rate. And, again, we tried to spread -- we tried to break out the cases the same left two bars where we don't have severe accident water addition, meaning as Marty just pointed out, they lead to liner melt, and slightly larger source terms. And then we plotted those against all of our alternative strategies, and you can essentially not see any differences across the board there. Again, as Rick pointed out, we think if we put these numbers on tops of your's, they'd fall right in the range.

The next chart would take all of the

consequence results from MACCS and look at, as I mentioned earlier, converting that to a maximum averted cost risk, which is if I got rid of all of the risk associated with this particular case, or this group of cases, what would that be worth? In our base cases and what we called Case 1 Alpha, was one where we had no water addition, again the two left bars are cases with no water addition. If we were able to eliminate all of that risk it would be worth around $2.5 million. And, again, this is an identical process that gets used for every license renewal SAMA evaluation.

If we then look at the reduction that we would get as a result of implementing all of these different alternatives, including the filter cases on the right, again with water to the reactor, or water to the drywell, you can see that that number drops down to about $1.6 million or so.

If you jump to the next slide, what we really care about is what that delta is. That's what factors into a cost benefit analysis. We compare those alternatives to doing nothing, and if we look at that, the general kinds of MACCS averted cost risks that we calculated are in the range of $1 million. And, again, what that number means to us is if I was able to implement that alternative, and for that case if I eliminated all that risk, what would that be worth in the typical cost benefit evaluation? So, we're looking at around a million. Next slide, trying to keep us on schedule. And you hit one more, I think, we get some Xs. Good.

What this is, is we've now looked at that MACR value and how it might progress as we implement various alternative strategies. What we did try to show you here is there is kind of a base amount of that risk that's independent of our strategy or alternative, and it's coming from the seismic contribution.

One of the things that we're going to include in our evaluation is a way to look at how that seismic contribution -- this was actually for our reference plant, which I guess I can say is Peach Bottom. It's no secret. And it had a specific relatively significant contribution from seismic.

If, for example, we look at the variability of that number from site to site, basically what's going to happen is that X'd out part will move down typically, because the Peach numbers were relatively high. I don't know if they were any higher or not, but it moves down or up. The relative comparison or the change in the max averted cost risk is going to stay the same, so it's really not going to have an influence on our decision as to whether a specific alternative is cost effective, because that seismic contribution affects the base case, as well as all of our alternatives.

So, Alternative 2A remember was a case where what we did was we had a severe accident water addition capability. In this case we're putting it into the reactor vessel. 2 Alpha was actually a case where we didn't have a severe accident capable drywell vent, so in that particular even, if the wetwell vent failed to operate we would relieve pressures through the drywell.

And this just breaks down the MACR is actually calculated and what elements add to that. And you see here that the venting through the wetwell has that, you know, half million or $500,000, yes, half million type contribution. Where again, the red part is indicative of the risk associated with cases where I don't have effective water addition. And in those cases, like I said, I heat up the containment, I'm going to leak through the containment, I'm going to fail the liner, and a filter or my alternative is going to have little impact on that.

Alternative 5A was a case where we had a large external engineered filter. And, again, you see that the contribution from the wetwell, the amount of radionuclides that went through the wetwell vent path, that's that green contribution that they have to the MACR, that's reduced, and it's reduced because that delta, if we could calculate it, 100,000 or whatever it is, that delta is a result of the further reduction in source term by adding the external filter to it.

Any other questions? Okay, I can do this, I think. We'll go to the end of this one, and then take our break. Is that okay?

MR. BEALL: That's fine.

MR. GABOR: So, key areas of uncertainty that we have looked at and continue to look at, they'll all be part of the EPRI, final EPRI report. Obviously, we care a lot about any plant-to-plant variability. I looked earlier at the potential impact that population size might have, but there are some other plant-to-plant variabilities that we've talked about and discussed in public meetings that we will investigate.

Human performance, the NRC has done some bounding or conservative, and some sensitivities on human performance, we intend to do the same. I mentioned earlier that contribution from seismic. It won't affect the change in the delta risk, but it will affect the values, the height of those curves. We'll do some sensitivities on the seismic contributor.

And then, obviously, there's some things in severe accident phenomenology, I mentioned liner melt through that we're investigating, but preliminary studies that we've done have indicated kind of in line I think consistent with your conservative approach, is that these factors indicate that our insights and general conclusions are pretty robust and really not sensitive to these types of uncertainties.

I picked a couple to talk about, if you go to the next slide. If you recall, we did a plant data survey. That information was provided to the NRC. We looked at -- here's a list of a lot of the different plant parameters that we investigated. We did provide that information to the Staff. We looked at that and looked at the variability and kind of focused in on a couple of the parameters that we thought might have some impact on our results and evaluated the potential uncertainty. Next slide, please.

So, one of the ones that we've talked about, I think enough times, multiple times in our meetings is the so called torus freeboard volume. By that I mean each of the sites, each of the plants through implementation of their EPG/SAG has an action item in there that says as I'm adding water to containment, if I'm adding water to containment and the torus level is increasing or the wetwell level is increasing, at what point does the operator -- is the operator told to isolate or close that wetwell vent path? Obviously, we don't want to get water into that vent path, so there's a specific instruction to isolate that path.

When we look at all the survey data, and I think in this case I was focused on the Mark I. I'm pretty sure my numbers are for the Mark Is, but I think we would see very similar, if not larger type values coming out of the Mark II plants. But what we find is a range, anywhere from 300,000 to a million, over a million gallons of water. We're not talking about 10 gallons of water, or 100 gallons of water. We're talking about at 500 gpm we're looking at the time it takes to exceed that threshold in the range of 11-32 hours, so there's a lot of time for the operators to respond to this, to react to this.

When we get into our strategy on managing the water so we don't get there, that's the kind of time that the operator is going to have to reduce flow and prevent that level from exceeding. And, obviously, it's the amount of time -- if they don't do that, it's the amount of time that they have to recognize that they need to isolate that wetwell vent path. So, there's just a lot of time.

MR. FULLER: Excuse me, Jeff. Ed Fuller

again. Do you happen to know the particular value for Peach Bottom?

MR. GABOR: The particular value for Peach Bottom? Peach Bottom, if you remember, was a 21-foot value that we've quoted.

MR. FULLER: Yes, but I --

MR. GABOR: That tends to represent more of a lower end, if I recall. It's more on the lower end. I don't know the exact time.

MR. FULLER: One is several hundred thousand.

MR. GABOR: And I should say that the 11 to 32 hours is just based on a 500 gpm injection rate. There are other secondary effects, like condensation on walls and things like heat removal through the structures that can alter that a little bit.

MR. FULLER: Yes.

MR. GABOR: It's a simplified calc, but yes, the Peach Bottom -- again, all that data was provided to the Staff. We didn't identify specific plant types, but we had a specific column for each of the Mark Is and IIs.

MR. BOWMAN: Jeff, this is Eric Bowman. Did you survey the flow capabilities, or did you just stick with the 500 gallons per minute?

MR. GABOR: For this we stuck with 500, primarily because in the guidance in 1302 -- maybe, Phil, you should speak to this.

MR. AMWAY: Yes. I mean, we saw it to the 500 gallons a minute based on -- that's what you did all the analysis on, and it's a typical value of what we would expect that we'd have to provide for decay heat removal under the FLEX strategies under the 49 order.

MR. BOWMAN: My concern would be that when we've provided that as a minimum value most licensees get enough equipment and set up their flow path so they can exceed to insure that they meet what we have set as guidance for what's good enough. And if you've got a licensee that's got 1,000 gallon per minute capability, unless they're controlling the flow rate doing severe accident water management instead of SAWA, that would, of course, cut your time available in half.

MR. AMWAY: Right. And this is Phil Amway again. And we're addressing that in the 1302 guidance, and then our subsequent procedures are going to have to define that in terms of when is the appropriate time to cut back on flow, and what actions do they need to do to make sure that they stay within that available range to preserve the wetwell vent?

MR. BOWMAN: Okay, thank you.

MR. GABOR: The next slide looked at another parameter that we've discussed in several of the public meetings, and that is at what point if I'm flooding into the drywell, at what point does water accumulate high enough so that it then can spill over into the large vent pipes that run down into the torus? And specifically from that data survey, I came up with numbers ranging from 7.4 to 36 inches.

The next slide, and I did a little histogram there that reflected that. If you recall, and as you look at our guidance on severe accident water addition, our objective is focused on limiting the thermal challenge to the containment either due to liner attack or direct thermal radiation from the debris.

Based on experiments at Argonne and other information, there could be a period of time where you could water on the debris and there still could be some limited core concrete attack. Eventually, we've seen in the experiments that does subside and does terminate, but there could be that period of time.

Our objective is not, necessarily, to limit that. Our objective is to preserve the containment integrity, and by wetting -- we believe by wetting the surface we're going to promote a crust on the upper surface of the debris and we're going to -- we will limit the upper radiation to the structures. So, given those spillover elevations, we think that provides adequate capability to wet the surface, keep that water flowing on top of the surface, maintain that upper crust temperature near saturation. And, again, that's sufficient to prevent the thermal challenges and prevent the liner melt through, as well.

MR. ESMAILI: Just a quick question. Going back to this 500 gpm -- Hossein Esmaili. This 500 gpm, you probably do not need 500 gpm to remove decay heat. Right?

MR. GABOR: Correct.

MR. ESMAILI: You know, so at some point you're going to spill over. You shouldn't put water and then for a long time, and then spillover will deduct any benefit whatsoever to the degree that -- so, I just want to make sure that we understand that there's a difference between what we are doing here, which is post-core damage water addition. Right?

MR. GABOR: Yes.

MR. ESMAILI: And the pre-core damage water addition.

MR. GABOR: Yes. In fact, our -- and I think some of the calculations I've seen Dr. Fuller run, when we look at water management, we actually reduce that down to around 100 gpm. And that's -- you know, what I find some differences in, perhaps, the uncertainties on debris cooling assumptions. In fact, using the more latest insight from the Argonne work where they get -- calculate the melt eruptions, and the enhanced particle bed formation and debris cooling, 100 gpm at least in my math analyses shows me that within a relatively short period of time, meaning say within 10 hours or so, I'm able to cool debris, quench the debris, and stop the attack. And I think that's consistent with the types of insights we're getting from Argonne.

MR. BASU: Jeff, this is Sud. I'm just going to make a couple of observations on this slide. You are making the point that there would be an upper crust formation that is going to --

PARTICIPANT: Cannot hear.

MR. BEALL: Can you speak up?

MR. BOWMAN: Speak up please, Sud.

MR. BASU: Can you hear me now?

MR. BOWMAN: Sud, there's a seat over here where we've got a microphone.

MR. BASU: That's all right. Can you hear me now?

(Off the record comment)

MR. BASU: All right, bear with me. I'm

moving to a better seat. Okay. This is Sud Basu from the Office of Research. I said that I'm going to make a couple of observations on this slide.

Number one, the fact that the upper surface crust will form and that will limit the radiation for radiation heat transfer, and so everything they come a lot on the structure. That's all correct. However, this is -- your conclusion is based on the experimental data, and if you go back to the reports that capture this experimental data, the report also says that at the reactor scale the crust is not going to be stable. So, you do expect that crust to actually break up, provide pathways for the radiation.

MR. GABOR: Also pathways for the water --

MR. BASU: Pathways for the water.

MR. GABOR: -- to penetrate the debris.

MR. BASU: Absolutely. And that brings me to the second point on the same bullet, that while you are actually limiting the outboard radiation, you are also tipping the heat underneath that crust which is going to then promote core interaction -- continue to promote core interaction.

With regard to the third bullet, water will prevent liner melt through, that is absolutely correct according to that report that you're citing. I would make the -- I would note that the report says that you have to maintain a sub margins level of about 70 centimeters which is based on a melt height or melt depth of about 45 centimeters. That tells me that you have to maintain a 25 centimeter water depth above the melt, so this is just for clarification.

MR. GABOR: Understand. Yes, I mean, I think we need -- and that's why I put the first bullet up there. We have to be clear on what our objective is. Our objective is not so much to terminate the CCI process because that's something controlled by the physics, not necessarily by the amount of water we add.

We want to add a sufficient amount of water, and as you've seen or maybe you haven't seen some of our strategies on water management, we believe that, as I think was brought up earlier, things as simple as monitoring the torus level can provide you with a lot of valuable insight as to how effective your debris cooling is. And, again, if you're putting 500 gpm on the debris and the torus level is going up, it's an indicator that some amount of that water is not being effectively used to cool the debris and you, therefore, could back off a little bit without changing the physics of what's going on. But I think you're right. I mean, crust breakup will potentially, like you say, allow for some intermittent thermal radiation, but it also is the mechanism by which we effectively cool and quench the debris because the water penetrates in. So, I view crust breakup as a positive thing that is seen in the experiments.

MR. BASU: Yes. And maintaining that 25 centimeter of water is probably not an issue for most of the plants if you go to the plant geometry.

MR. GABOR: Okay, you want me to go on? Next was my liner melt sensitivity. We talked a little bit about this. I basically took a scenario that we had initially run where we had no water injected. At vessel breach the liner melt within 15 minutes was assumed to fail. Wetwell venting or filtering for us in that case would have been meaningless because we created a bypass immediately that would have bypassed our vent, and would have bypassed any associated external filter. Well, the question is what if that time delay was extended, what if that was three hours as in the SECY cases?

What we did is we took an extreme look at what if that was extended to a 10-hour delay? You can go to the next chart. So, if we -- we had a scenario, we had a vessel breach with no water injection, no RCIC at all, a vessel breach in the MAAP analysis at five and a half hours. Typically, we would assume that our base assumption was liner melt occurred within 15 minutes. What if we delay that 10 hours?

The additional time, what we did is we modeled effective wetwell venting during that period of time, so we had pool scrubbing. Our pool is sub-cooled. We could have added an external filter to it, we did add an external filter, you're right. I did, I ran 4 Alpha, so there's assumed decontamination, additional decontamination of 1,000 beyond the pool scrubbing numbers. And we vented at PCPL which occurs very shortly after vessel breach.

The next chart just plots out the total cesium release for that scenario. In the blue line, that was our base case where at the time of vessel breach at six hours, you see the puff kind of levels off, material that was previously deposited in the drywell and in the RPV heats up and re-evolves, and is released through the failed containment, the liner melt location. And we get a release just 3.5 percent cesium total.

Again, these kinds of numbers and these kind of scenarios are not unlike the types of results both MAAP and MELCOR compute for Fukushima in somewhat similar cases, where this one is focused on the liner melt. If I delay it on the red line I shift that out in time.

There are some reasons why these curves don't just track identically beyond that point. Obviously, in the 5-15 hour period I'm scrubbing everything through the filter, so you see the cesium release is zero, essentially zero. And out around 20 hours which I have failed the liner at that point, that's when I start to pick up on the deposited radionuclides, in this case cesium is re-evolving, it's heating up in the drywell, heating up in the RPV, and being transmitted out through the liner melt. And again, the kind of consequence differences we would see between a release of 3.5 and 2 percent would be relatively small. So, we don't view that as a kind of large uncertainty that would really alter our conclusions in a large way.

MR. ESMAILI: I have a question.

MR. GABOR: Yes?

MR. ESMAILI: This goes back to the -- to those probabilities that you showed that I'm still trying to understand why the filter has no benefit. You know, you have SAWA, and then you have SAWA plus a filter.

MR. GABOR: Yes.

MR. ESMAILI: So, at that point you have to have something -- I don't know, I'm just trying to -- you have to have something in the atmosphere, right, that goes out to the vent that you could potentially filter. So, what is the reason that these curves do not move at all when you add a filter?

MR. GABOR: They do move slightly, but I think -- I'll let him chime in but I'll steal Rick's words. What we find with the filter cases is we are filtering an already low release. We get -- agreed, the suppression, and it varies by sequence. If the pool is sub-cooled we get, obviously, as you would, a higher DF than scrubbing through the pool. Even with the pool saturated there is some deposition in containment, there's deposition in the RPV, in the drywell, and obviously in the suppression pool. So, what we see, the reason those numbers don't change, and they do, there are slight variations in the consequences, it's that we are putting a filter on a release that's already low. And it just has an undetectable impact, a delta impact when you get out to things like latent cancer fatalities and the MACRs, and all the consequence parameters that we use to make decisions with.

MR. ESMAILI: So, going back to this, the blue line. The blue line you show this puff at liner melt through? At that point, do you open the vent also?

MR. GABOR: We did. So, that would have all been filtered. As you can see, there's no release from

5 to 15 hours, zero in the red line. It's all filtered.

MR. WACHOWIAK: But the blue line, the vent does open. In this particular case, as in most of our cases, shortly after vessel breach, five, ten minutes -- actually, in this case it's the liner melt through, 15 minutes after the vessel breach there's a hole in the liner, so the material goes out through the hole in the liner. There's no need to vent in the blue line.

MR. ESMAILI: So, in the red line case then you open the vent where the blue line goes up, right?

MR. WACHOWIAK: Yes.

MR. ESMAILI: But you are delaying the liner melt through. Is that what you're saying?

MR. WACHOWIAK: That's right. So, we open the vent in the red case and we filter everything that came out in the blue line up to about 15 hours. But then after 15 hours is when we get the new delayed hole in the drywell liner. And then things that re-evolve back into the atmosphere go out through that hole, and they bypass the filter.

MR. GABOR: If you jump to my last final slide, what I -- let me finish this and then I'm going to take all your questions. What I did is I went and I looked at SOARCA. You know, what kind of temperatures -- for cases where I don't have SAWA, I don't have water addition, what kind of temperatures in the drywell do I see in the SOARCA analysis? The top plot was the base case SOARCA analysis. C is the red curve, is the area immediately above the drywell floor, so it's getting the highest temperatures as a result of thermal radiation. And you can see at the time of vessel breach -- well, it's an eye chart for me, 18 hours. In this scenario, temperatures jump up to almost -- over 700 K, which is I think if I can do math 800 Fahrenheit. There are very large temperatures immediately seen in the drywell, so if liner melt through didn't occur, the challenge on the drywell would be pretty extreme.

The bottom plot here is there was this one peer reviewer who gave -- looked at that top chart and said well, why wouldn't there be mixing, and wouldn't you get some stratification? As a result, the MELCOR model, as some of you know, was altered to represent the potential for natural circulation which we think would occur if that lower part of the drywell was, in this case, at 800K and the bottom part you see is at around 500K, you would be promoting a huge amount of thermal plumes and mixing. So, that's what they represented in the bottom chart.

And you can see even in that case within a relatively short -- all of those temperatures all the way up to the drywell head are exceeding 700K, which is 800 Fahrenheit. So, temperatures go up. Even if you delay the liner melt you need to consider other potential drywell failure mechanisms that could, again, result in bypassing a vent and bypassing a filter.

We don't prescribe that this is a success path because without water addition, we agree that this is the kind of response that you would get in a plant. So, again, it helps to understand is the sensitivity on liner melt through timing really important to our overall conclusion? So, I'm sorry, I'll take questions now.

MR. BASU: Thank you. And I agree, by the way. Sud Basu, so I have a couple of simple questions. Number one is how did you model the external filter in your calculation?

MR. GABOR: Very simple. We -- in our MAAP analysis we have the capability on any of our junctions to apply a DF, just a reduction factor.

MR. BASU: Okay.

MR. GABOR: And we applied for the -- and in our cases we did it for -- if you recall, if we don't implement a water management strategy, our typical scenario will start with a wetwell vent, isolate it later, and then subsequent venting is done through the drywell, so we have different aerosol sizes, different distributions. But our calculation with external filters would assume that DF of 1,000 would be applied to both of those release pathways, just the vent path. Anything that leaks out, obviously, by passes the filter.

MR. BASU: So, for example, large versus small, the different would be the DF value?

MR. GABOR: No, not at all. It's a good question. I get that every time, usually from you. So, apparently, I am doing a very poor -- he has -- I am doing a very poor job explaining it. The difference between large and small for us is the capacity to hold aerosol mass and decay heat. But, typically, what we see is the threshold. And in all of our scenarios we see virtually no difference between large and small if we're venting through the wetwell, because the wetwell scrubs out a lot of the aerosol particles. And we end up not that sensitive to loading the filter on an external filter, like I said, because the pool does a good job of scrubbing those particles out.

In the scenarios, the 6 Alpha case, and the 6 Bravo case where we preferentially vent through the drywell, our small filter is less effective because as you can imagine venting directly from the drywell loads the filter a lot more with aerosols and our small filter we actually -- I think we quoted from some of our survey of the data, 160 kilograms as kind of a threshold. We actually do exceed that threshold if we preferentially just vent the drywell.

MR. BASU: So, I'm glad that I asked the question again, because if you are venting through the wetwell, you are always scrubbing the pool. So, why would you apply the same DF for the drywell vent and wetwell vent?

MR. GABOR: I guess I don't get the question. I mean, we just assume a factor of 1,000 reduction in whatever goes out the vent. As I think you know, less is going to go through -- typically -- well, I shouldn't say that. Because of the pool scrubbing, you expect a smaller quantity of aerosols, radionuclide aerosols to be transferred through the vent line.

MR. BASU: That's right.

MR. WACHOWIAK: I think what Sud is getting at is the particles that are left going into the filter after the pool scrubbing tend to be the sizes that don't scrub very well in the first place. And we're -- I guess one way of doing that would be, I think kind of what you guys did, is on your wetwell filter you only put 100 DF on it or something. It was an order of magnitude different than in the drywell.

MR. GABOR: Two.

MR. WACHOWIAK: Two orders of magnitude different than the drywell. It's not going to change anything. We're affecting the margins and our results here, anyway, so by giving it the maximum benefit, you know, we see the maximum benefit on the results, so it may be less than that.

MR. BASU: Which is really tiny.

MR. WACHOWIAK: But then, you know, you've got some of the manufacturers that say they can handle that sort of thing. But, anyway, it's an interesting problem. One way of solving it, or one way of approximating it is what you did. The way that MAAP re-averages the particle size distribution at every time step makes explicitly modeling that not possible at this point, so we would have to do some sort of approximation if we wanted to.

MR. BASU: As you said, it really doesn't—-

(Simultaneous speech)

MR. BASU: So, the second question I have is on Slide 28, going back to the MACR.

MR. GABOR: The MACR, yes.

MR. BASU: I mean, you are showing MACR for base case and in the RPV injection, RPV SAWA. Right?

And 5A is the RPV SAWA with --

MR. GABOR: Filter, large filter.

MR. BASU: The large filter.

MR. GABOR: Yes.

MR. BASU: I'm assuming you ran cases with the drywell SAWA and all those --

MR. GABOR: Yes, yes.

MR. BASU: -- for MACR.

MR. GABOR: Go back a chart, just go back one. That has all of them. That's the change, that's the delta, but that's the same.

MR. BASU: Okay.

MR. GABOR: So, yes, those are all of those versions. We just picked two of the to put on that pass chart. That second chart with the red bars, I guess they're red bars, really is to highlight, and you could push it one more time, it's to highlight the fact that seismic has a significant contribution as does the residual liner melt through end states.

MR. BASU: But if I'm looking only at the green portion, and if I take the drywell SAWA, would that make much of a difference?

MR. GABOR: Again, if we go back to that other one, that would be the place you'd see that kind of variation, so you'd compare like a Two Echo with a

Three Echo, and you'll see some differences. And I think I can almost with my eyes see a slight reduction in the green one versus the blue one with RPV, or drywell injection. And that's consistent with the MAAP plot we showed you of the temperatures.

The one thing, and I think your analysis includes this, as well. If we're actually able to implement SAWA prior to vessel breach, or prior to relocation for debris in the lower head there's some likelihood that we can keep it inside the vessel. And for those cases the consequences are notably lower, so that added benefit we had mentioned is that for those -- some of those scenarios, there's obviously some uncertainty there, you at least have the potential of stopping the process before vessel breach.

MR. BASU: Thanks.

MR. GABOR: That's all I have.

MR. BEALL: Okay. Thank you very much. let's take a quick five-minute break. We're going to try to make up some time here. We have one more --

MR. WACHOWIAK: Yes, the next presentation is shorter than the one --

MR. BEALL: Okay, great. Then we'll do that. So, we'll be back on line at 11:00. Operator, can you please mute all the phones.

(Whereupon, the above-entitled matter went off the record at 10:57 a.m., and resumed at 11:04 a.m.)

MR. BEALL: Okay. This is Bob Beall, again. I'd like to restart the meeting, and we're going to move on to the second part of the EPRI presentation. And, Jeff, you said you're going to continue on?

MR. GABOR: I am. So, again, the reason for splitting these up is basically the EPRI technical evaluation will provide the technical evaluation which essentially computes things like the latent cancer fatality risk, the MACR-type numbers. That information then is transferred to NEI who will perform the cost benefit analysis. So, this presentation has that cost benefit analysis, and then also has the comments that we were requested to provide on the various performance criteria. And we discussed some of those were things that we initially talked about in our very early meetings. They were echoed back to us in the last public meeting, and we were requested to provide some additional feedback, which we're doing.

The first thing we looked at was cost benefit, potential cost benefit of just simply the severe accident water addition capability. As I think Rick showed in the figures, the system has to be able to be implemented and operated during a severe accident that goes beyond what the current FLEX capability is, and involves things like perhaps hardened pipes, dealing with potentially challenging environments, high rad thermal conditions, so the system -- so there is an additional cost to implement that type of a system.

If we look at our base case, and you can go back to the EPRI slides and pull off these -- most of these numbers, but our base case showed us that with severe accident water addition we saw a benefit around $1 million.

One of the sensitivities we're looking at based on feedback from the NRC Staff on -- and I forge where this was. It was in your last presentation, you were talking about looking at changing the dollars per person rem averted from the kind of historical value of $2,000 a person rem increasing up to a number more like $5,200. So, if we include that, that obviously will increase the benefit we see from reducing risk. And that takes it up to about $1.4 million.

The third sensitivity that we looked at was the deposition rate. The Peach Bottom model that we got from you that was used for SOARCA had a specific assumption on how rapidly the radionuclides would deposit as you move away from the site in the MACCS calculation. I think it's more near term deposition velocity.

In our standard SAMA analysis, we've typically used a value much higher than that. I'm thinking it came from NUREG 1150, but there is a difference in that deposition velocity, and it does have a fairly significant impact on the doses near the site boundary, or near the site. And that can actually -- that sensitivity looking at that range of change there, can take that benefit cost up to around $2.3 million.

If you recall, I think we provided these cost estimates to you. Our central cost estimates for SAWA for severe accident water addition range from $2.5-3.7 million. So, you can kind of see where the numbers line up here. Obviously, we're including SAWA as part of the implementation of EA-13-109, but this just kind of shows how the cost benefit calculation would fall out for that.

If you go to the next slide, we do the exact same type of calculation with the same uncertainties and sensitivity analysis for the large -- the delta for adding the large engineered filter, and you can see that there is no cost benefit to implementing the large external engineered filter.

We can look at the next slide. If we look at -- and I'm pretty sure we're looking here at the risk from the latent cancer fatality risk. If we look at a pre-Fukushima type number and make this relative to that so that that's a one value, our implementation of FLEX, and this kind of follows the trend of the previous curve we showed you of the impact that FLEX had on reducing risk. You can see what that comes in, so the -- it drops it by 80 percent or so. If on top of FLEX we also now add the severe accident water addition and the severe accident capable vent implemented under 13-109, you can see the further reduction in consequences in the latent cancer fatality risk. And then, again, if we take SAWA with the filter, again these are very consistent with the other charts we've been looking at, you can see a very marginal reduction in the risk.

MR. FULLER: This is Ed Fuller.

MR. GABOR: Yes?

MR. FULLER: Jeff, is this with respect to the latent cancer fatality?

MR. GABOR: I believe so, yes.

MR. FULLER: But not some other performance measures --

MR. GABOR: No, no. It's the ones we've been looking at. It's latent cancer fatality risk.

MR. FULLER: Thanks.

MR. GABOR: Next slide. So, the next few slides we just wanted to recap some of the -- some general insights, and then some technical insights. We see that manual actions are needed to manage severe accidents. We need -- obviously, we need things to implement our FLEX strategies. We need to take actions to successfully vent our containment. We need to take actions to initiate and implement our severe accident water addition and water management strategies.

We see that proposed guidance in NEI 13-02 for implementing the vent order really contains the essential hardware capabilities and the controls for effective accident management. In addition, the SAMGs, the BWRO SAMGs, are the appropriate place, the appropriate vehicle for directing the deployment and the use of these capabilities.

Effective actions can really play a key role and influence the accident progression. They affect the ultimate core damage state of the plant, and the source terms that come out of those severe accident evaluations. Without intervention we see things like containment failure can occur, hydrogen deflagrations outside of containment and the adjoining reactor buildings. Case in point, had Fukushima been able to successfully at three of the units successfully vent the hydrogen to the stack and avoid the release directly into the reactor building, they could have maintained -- potentially maintained some capability to enter the reactor building to help mitigate the events.

Specific actions can preserve the integrity of the fission product barriers and greatly reduce the radiological releases. The actions that we take to vent the containment via the wetwell airspace and to provide the severe accident water addition debris cooling are very effective at reducing the releases. And we find in our evaluation that additional hardware, for example, the external filtration capabilities, they can further reduce the radiological releases, maybe more for very specific scenarios than others, but overall provides the minimal safety benefit, and is far, far from being cost-effective, which we believe is consistent with the NRC's assessment.

Some of the technical insights, adding -- being able to add water and to vent the wetwell containment provides a lot of multiple safety benefits. It preserves the integrity of the containment by preventing the over-pressure and the over-temperature challenges. It provides water to the core debris that can potentially cool and quench the core debris, halt the core concrete interaction process, and reduce

-- overall reduce the fission product concentrations that are available for release from containment.

The vent path and the water avoids creating pathways where hydrogen can leak into the adjoining reactor building, and potentially as we saw at Fukushima cause these deflagrations or detonations. And, overall, these two strategies of venting and water, severe accident water addition have an impact on reducing the overall magnitude of the radionuclide release.

A couple of other technical insights. The severe accident water addition, as we said, has the largest benefit of any of the strategies that we looked at. Again, technically, severe accident water addition and the severe accident capable wetwell vent prevents containment failure, increases the margin as we've seen in our safety metrics, it increases the margin to the NRC safety goal, it reduces the release magnitude by enhancing the overall decontamination that the containment provides. It reduces the doses to the public, which is one of the metrics that we were looking at. And in terms of long-term impact offsite, which can include a lot of impacts that any release would have offsite, it can reduce those, as well.

We did identify and we discussed that injecting the -- excuse me, adding the water, severe accident water directly to the RPV may have some advantages over putting it into the drywell. As Phil pointed out, there may be some other tradeoffs and reasons to do one versus the other, but just from a technical perspective as identified in the EPRI work, it does have the potential to preserve the reactor vessel. You can actually have in-vessel retention which is -- basically stops the core damage process in vessel, prevents a lot of the ex-vessel phenomena from occurring, and can overall reduce the potential release. Injecting into the RPV allows the water to follow the debris which can enhance debris cooling, and also minimize the thermal challenges in containment. Next slide.

We find -- technically, we find that when we do --

MR. ESMAILI: Hossein Esmaili. Just regarding this water addition to the RPV and the drywell in terms of thermal challenges to the upper head, you know, when we inject water into the RPV, a very coarse spray right above the core. Like you still have a lot of structures up there that are potentially hot. And when you inject water into the drywell, it's right at the junction that is -- so, the water really doesn't see the upper structures. Whether it's your steaming inside the vessel already, you are steaming outside of the vessel, you know, I mean, we are seeing some differences but the differences should not be that great.

MR. GABOR: They're not huge, they're not huge.

MR. ESMAILI: Okay.

MR. GABOR: If you looked, if you go back and looked at that cumulative probability fancy plot that we put up there, you don't see a real significant impact, not enough where I think either one of them won't be successful in preserving containment integrity. And some of it might be in the ability of the water, and the MAAP model and probably like the MELCOR model, as we cool some of the structures even lower in the RPV, the gases that are circulating around the RPV can -- you do change the heat transfer, and you do reduce even in the upper part of the RPV, you reduce those temperatures, as well, slightly. And if you reduce those upper head temperatures, you reduce the temperature challenge in the upper drywell. But, again, neither one of them we found to change our conclusion that either of those strategies can prevent the thermal failure of the drywell.

MR. LANE: This is John Lane. I just wanted to ask a question about severe accident water addition and severe accident water management. Have they kind of morphed together a little bit in the sense that eventually you're going to have to do a little bit of management of the flow --

MR. AMWAY: I'll take that. This is Phil Amway. The difference really is SAWA is your hardware, you know, your instrumentation, pumps, flow paths, things like that that actually makes where you can get the water into where you want it to go. The management piece is, you know, do I have it at full flow capability, or is it time to throttle it back such that I preserve my wetwell vent path? So, the management piece is really using the SAWA hardware and incorporating the proper procedure controls to say we're going to manage that water addition to make sure we preserve the wetwell head.

MR. LANE: So, you really need both.

MR. AMWAY: You need both, yes.

MR. BOWMAN: This is Eric Bowman. I've heard from some licensees that there is a hardware component to this management, the capability to throttle the flow, because depending on how the implementation is done, if you just go for the severe accident water addition and haven't thought of or planned how you're going to change the flow rates, you may not be able to effectively control it.

MR. AMWAY: Yes, there could be some overlap, but predominantly I think of SAWA as hardware and SAWM is the procedures and training aspects of using the SAWA equipment.

MR. GABOR: The addition of an engineered filtration system, as we said, it can reduce the magnitude of a controlled release, the release that goes through the vent, but the incremental benefit is quite small, as you saw. The filter is not effective when you do -- when you actually look at the risk profile and you look at the -- at a true overall integrated response of the plant, the filter is not going to be effective in those cases where we have an uncontrolled release that effectively bypasses the vent.

Even the addition of an engineered filtration system to the vent line, it actually can increase, and will increase the number of actions that are required to manage the accident. We, obviously, still have to have water addition to keep that filtration system viable, and that requires actions. We believe that there are manual actions that are required to effectively vent the containment even though we did analyze the one totally passive system. And as you saw, the actual -- the core damage frequency actually increased in that case, so there was a downside risk.

There's also filter management and maintenance. We haven't really had a lot of discussion of that, but there are -- the various filtering proposals that are out there may involve purging early on, maybe involve preheating, may involve a process later where the collected radionuclides are pumped or drained back into the containment where they're better shielded and protected.

And, in addition to that, transferring the source term outside of containment can potentially impact the offsite emergency response that's going on by creating an external source term of radionuclides that could impact the ability to mitigate the event at the site. Next slide.

We believe that the severe accident water -- we see from the technical work, the severe accident water management and the vent operation are viable actions, and basically that's being looked at as a potential way to avoid the need to directly vent through the drywell by preserving the suppression pool scrubbing.

I will add that in our evaluations both in the work that we're completing for the CPRR and in the previous EPRI technical report on filtering strategies, we actually found that opening a direct drywell vent path late in the accident had relatively insignificant consequences. By the time you got to that point, enough time had passed that the radionuclides had plated out, and the actual aerosol and radionuclide releases were relatively benign at that point. Part of that is due to the fact that that occurs at a very late time, could be two days, three days into the event. Next, overall conclusions.

MR. LANE: Jeff?

MR. GABOR: Yes?

MR. LANE: One more quick question about that last slide. So, the issue of vent cycling now, you're not really talking about vent --

MR. GABOR: We haven't. We looked at that closely in the original report.

MR. LANE: It's kind of going down --

MR. GABOR: It's kind of going away just because we don't -- we included it in there, but if you look at the relative comparison, it just doesn't show that we have -- now, a specific site may actually already do that. I mean, that may be already part of their accident management strategy, so there's no -- I don't think we see a downside risk of implementing that strategy.

MR. LANE: It just adds operator action.

MR. GABOR: It does add, yes.

(Off microphone comment)

MR. ESMAILI: Hossein Esmaili. Okay, so this is good for fission product, but in terms of hydrogen control, you think that water management would be more beneficial than water addition because you don't want to overcool your containment, you know, like keep it steaming. And I remember during Fukushima, that was one of the concerns, is that these guys were trying to inject just enough water not to condense the steam because they were concerned about some air getting into the containment. So, as long as you have -- you know, if you flood up then you can potentially condense a lot of steam.

MR. GABOR: No, I agree. I agree, and that's why our strategy on Severe Accident Water Management really focuses on watching and monitoring the torus level, because I think's it's going to be a good indicator of, like you say, whether or not you're putting too much water in that could have the potential of condensing steam, or just enough to where, you know, obviously it would be good to achieve a stable situation where the steam generated is equal to the steam blowing out of the vent, and you're maintaining coverage over top of the debris, because it prevents that negative potential for reduced pressure and containment.

So, our overall final, I guess final conclusions we see is the adoption of Severe Accident Water Addition strategy provides the greatest safety benefit and it's the proposed strategy in the NEI 1302 guidance in response to particularly Phase 2 Option 2 of the ventor, and other alternatives provide a minimal additional risk benefit, risk reduction. We also see that manual actions are going to be required to manage any severe accident. There's no panacea for a passive system where you can walk away; managing the accident is the right thing to do, and that's our conclusion.

The next few slides I can get through rather quickly. You had asked us to come back around on, I guess primarily as Sud pointed out, some of the initial thoughts that we had well over a year ago on what a performance measure or performance criteria might look like, and we got some additional feedback from the staff at the last meeting. So what we did is we took each one of the ones identified by the staff and provided some background on what that measure is and what its considerations are, and tried to provide an industry position on it.

The first one we talked about was the

conditional containment failure probability; as we said, it measures the containment defense in depth, ability of the containment to maintain its integrity during a severe accident, and the problem with it is that the performance criteria for this--for the conditional metrics are somewhat problematic because they're not absolute; they're conditional on core damage, if you could imagine having a higher core damage frequency and a lower CCFP. So specific criteria really like this we don't think are practical due to the conditional nature of the parameter. It could be used as a reasonable indicator of a defense in depth type measure, but we don't view it as a specific selection criteria for judging an engineered filter or any other filtering strategy.

The next slide looks at, we talked early on if you recall, and a lot of our initial calculations focused on looking at the varying decontamination factors. At the time, we picked that because it's a relatively good surrogate for offsite consequences. It's kind of like we use LERF as a measure of risk. So it is a measure of the release reduction; the problem with it is it's very scenario specific. The NRC had a few--I remember a plot where they had DFs for various scenarios, and if you--at first glance, when you look at that chart, you see there are some cases where the DFs are large, and you see cases where DFs are low.

Without putting that into a probablistic framework, it doesn't provide you with any information. I can surely show you a scenario with a very low frequency that has a very poor DF, just like I can show you one with a high frequency or a low frequency with a higher DF. We don't see how DF can be used because of the sequency dependency, and that you really need to do an integrated probablistic risk calculation in order to make a determination on what type of containment protection or release reduction strategy is really appropriate.

Next one looks at identified by the NRC equipment and procedure availability. I think at one point--again, this was a year ago and that brain cell probably is dead, but we talked about functional capabilities I think, and I think this kind of relates to those early discussions we had. Looking at a specific capability based on--it specifies a capability based on risk insight; it's kind of consistent with what we're doing with 12-049, with mitigation strategies. It's consistent with the original 51, which is the spent fuel pool instrumentation, 13-109, where we're identifying capabilities that we want to see implemented, and it's consistent with 10 CFR 5054HH.

It's really--it's consistent with past practices for these so-called design beyond design based considerations, where we don't put a 2200 fahrenheit criteria on it like we do in DBA space. It is, we think it's a practical measure for implementing something like SAWA or a hardened vent because you can clearly set an objective, a functional kind of requirement for it, but in terms of using it as a performance criteria to decide which is a better filtering strategy or release reduction strategy, it really doesn't provide any help for that. It's a much higher level, more focused on functional response.

Next one looks at dose and the total population dose. It is a good figure of merit for looking at public health and safety, and it's already explicitly accounted for in a standard cost benefit analysis. That's what ends up coming into play; it's that person rem that gets input into the NRC methodology on cost benefit. We believe that it's not necessarily, it's not needed in this case as a selection criteria for filtering strategies, and in fact, it would constitute double counting in this case because it is indeed already a specific factor that's imbedded in our cost benefit analysis.

The next one that was put out as a potential criteria was the so-called practically eliminate a long-term relocation. It clearly is a measure of offsite land contamination. To a large extent, again, the cost benefit evaluation does include the cost of contaminated land, so that's part of a standard consequence analysis which feeds our cost benefit analysis. So again, our opinion is, our position is that we actually concur with recent Commission positions on this, that it's not a regulatory factor. We believe keeping our focus on public health and safety is the right thing, and again, much like the dose calculation, we've already included that in our cost benefit analysis because it's part of the output we get from Max that tells us what the cost of land contamination is, so it would constitute double counting as well.

And then I believe the last one is the margin to the QHO, the quantitative health objective, which was the basis for your determination. We believe it is a good measure of the influence on public health and safety. It's used by the NRC in virtually--in many areas for regulatory basis, it was used in the expedited spent fuel pool transfer as you indicated earlier this morning. It can be a useful screening tool to focus directly on public health and safety. Again, it's a good screening tool to find out if these strategies have substantial benefit margin to the QHO.

And then finally, we think that the, in conclusion, that the equipment and the procedure availability criteria we'll call it, or performance measure really provides for these beyond design basis kinds of implementation, really does provide a reasonable measure for implementing things like hardened vents and FLEX and SAWAs, severe accident water addition. It's a good mechanism to identify what kind of attributes we expect out of those systems. The margin to the QHO is a very useful screening tool, but ultimately, you know, the cost benefit remains the adequate decision making tool for looking at various alternatives that perhaps don't screen out when you do a QHO-type evaluation. And finally, we do support, as was on your initial slide, codification of the A13-109 requirements and the water strategies that we put in the NEI 1302 guidelines.

MR. BEALL: Thank you Jeff.

MR. CASE: Can I do a quick question about cost? This is Mike Case. Back on the first slide for severe accident water addition, the cost estimate is $2.5 million to $3.7 million; can you give me a general idea of what's in that estimate?

MR. AMWAY: This is Phil Amway; some of those details are in the information we provided, I forget when. Was it October--in the fall of this year, but at a high level what we were looking at was the modification of the water addition points we use for FLEX to make sure that they were also severe accident capable in terms of being able to get to that connection point in a severe accident, make the connections, and it would involve some level of modification, whether it's valves, piping, that type of thing to make it severe accident capable.

MR. GABOR: Again, dealing with high RAD areas and potentially thermal, you know, increase in thermal areas is really what constitutes those costs.

MR. WACHOWIAK: This is Rick Wachowiak, and if I remember right, the way that they did that, that included everything, including the procedure changes--

MR. AMWAY: That's right.

MR. WACHOWIAK: -- and all--

MR. AMWAY: We did the estimates--

MR. WACHOWIAK: Plus contingency I think is in there.

MR. AMWAY: Yes. We did the estimate based on the typical things we would do for any modifications. It's the engineering costs, it's the material cost, procedures, training, the whole thing that we'd have to do to go from, you know, the pre-modification state to the post-modification implementation and testing.

MR. GABOR: It didn't--and we saw a similar presentation from the staff I think in a previous meeting; what it doesn't include is any regulatory costs associated with that. We didn't factor that in.

MR. MOHSENI: I had a question; this is Aby Mohseni. Going back to your conclusion page, there were two conclusion pages; the first one. The adoption of severe accident water addition strategies providing the greatest safety benefit; is that more or less a euphemism that we use for substantial safety gain and substantial safety benefit, that this actually meets that? Is that what you're saying?

MR. GABOR: No.

MR. MOHSENI: What are you actually saying here?

MR. AMWAY: This is Phil Amway, and going back to the other charts that we saw, where you know, you saw FLEX made a big change in core damage frequency, and then the next slide where SAWA, once you get beyond core damage, that SAWA made the best improvement compared to any of the other things that we do, whether it's water management, filters, so on, et cetera. We're not trying to equate it to any regulatory framework and how to assess that, it just that the options that we looked at, SAWA provided the best overall improvement in plant performance. I think slide 4 in this presentation gives you an overview of it, too.

MR. GABOR: Yes, the other one in the EPRI here earlier, EPRI presentation I'm looking on slide 12, we had--in this case it was specific to just the conditional containment failure probability, but we found that if we implemented severe accident water addition, all of the alternatives pretty much sought a common reduction in risk, and that the differences among some of the vent cycling or RPV versus dry well injection, even water management, and then including filters, their deltas were all fairly small. The big deal came from the SAWA.

MR. BOWMAN: That's slide 24 you mean, right? There are several slides that show the same figure?

MR. GABOR: Yes, yes.

MR. BOWMAN: This is Eric Bowman; I've got a question for you, Randy. On the final set of insights and conclusions, the conclusion slide you say you support the codification of 13-109 requirements and the water strategies. On slide 6 for this one, as the final bullet, you've got the BWR Owner's Group, SAMGs, and by that I presume you mean the EPG/SAG is the appropriate vehicle to directing the deployment and the use of it?

MR. BUNT: Yes.

MR. BOWMAN: If we do wind up making the requirements, including the severe accident water addition management generically applicable in the rulemaking, what do you see as being the posture of the EPG/SAG? Because to date, it hasn't been docketed by the owner's group.

MR. BUNT: This is Randy Bunt. What I would anticipate would be the criteria that we would have guidance in our procedures that direct severe accident water addition and severe accident water management, and then the utilities would submit and have it available for review the sections of those guidance documents that would lead to that. That would be how I would envision that would play out. That's the intent that we see in 1302, the guidance for that, where we talk about having the procedural direction to do that type of function. So I wouldn't see the whole--all of the guidance of Rev 3 fall in that purview, even though by the time we get here, the current mitigating strategies, discussion of that topic I know is subject to backfit and other evaluations of the mitigating strategies, so I imagine that's part of where your question is coming from, but it may or may not fall out of that rule.

MR. BOWMAN: I'm just curious for--because I'm also working on the mitigation beyond design basis eventual rulemaking, and we have to consider what do we do for regulatory guidance for severe accident management guidelines in general.

MR. BUNT: Correct.

MR. BOWMAN: If they become a requirement, how do we point to the owner's group guidance documents, or do we point to the owner's group guidance documents, and what level of review would be appropriate. Is it the intent to extract the information on the severe accident water addition and water management from the EPG/SAG--

MR. BUNT: No--

MR. BOWMAN: --and provide that for some form of review and approval, or how do you envision that happening?

MR. BUNT: We have not discussed that yet.

MR. BOWMAN: Okay.

MR. BUNT: At the minimum, it would be that you would be looking at how sites individually implement that. We would like to do as much of that generically as possible; that's been our focus on this order and this rule, is to address those generically and have single reviews of process by the utilities, and we want to continue that mind set here, so however we could do that, and maybe it would be an excerpt, maybe it would be a workshop, maybe--there would be some way that we would follow up with that engagement and making that information transparent for the regulator and for the utilities to be able to review it. We really haven't gotten to the detail level of that because it's on the proprietary nature of overall guidance, so that's why I'm a little hesitant on exactly that.

MR. BOWMAN: I completely understand, and we're struggling with the path forward with the other rulemaking as well, so. But any insights you've got--

MR. BUNT: But as a minimum I would expect--how I would envision that news would go out is that we would have criteria that plants would submit that section of their guidance and probably flow chart elements of that that would get you there, and that would be subjected to part of the compliance documentation for the rule, and that would be subject to the future inspections for compliance under the rule to keep it going. That's kind of how I would envision that would work at a plant specific basis, but to give you the right background and to make it more generically reviewable, there's something we would do early on in both houses to be able to make that happen the most cost-effective way.

MR. BOWMAN: Thank you.

MR. MOHSENI: Again, going back to your slide 21, the conclusions you draw. Cost benefit remains an adequate decision making criteria. You know, what you did appears to be the quantitative assessment in a cost benefit analysis. Did you come across any features that were not quantifiable and yet relevant?

MR. GABOR: I guess within the context of a cost benefit analysis, I would say no. I mean I think we pretty much followed what we all do on license renewal and on SAMA; we followed the same process. We look at the--obviously we feel you have to--you should look at the uncertainties, and we think there's--the insights and conclusions are robust, there's enough margin there that those uncertainties don't change the overall conclusion.

MR. MOHSENI: Appreciate it, thank you.

MR. BEALL: Okay, at this time I'd like to open the meeting to the public and other stakeholders to provide an opportunity to us for input of questions. Please remember to speak loud enough to ensure that those on the phone can hear you, and to identify yourself and any group you are with. I'll first open the floor up to participants in the room, and then on the phone. While we listen to the questions and comments for those in the conference room and on the phone, if you're participating by the webinar and have a question or comment, please type it into the chat function of the webinar, and this will give Glenna enough time to collect your questions. So I'd like to start with comments here in the room.

MR. GUNTER: Yes, my name is Paul Gunter with Beyond Nuclear. So I'd like to follow up on the last question, and Mr. Gabor's response, because here is our bone of contention, that the staff in its deliberations through SECY 2012-0157 looked at the issue both quantitatively and qualitatively, and in no uncertain terms concluded that there was a cost benefitted substantial safety enhancement, and they used what we saw as a full equation. In a dissenting vote, or I should say a supporting vote on SECY 2012-0157, Chairwoman McFarland noted that the staff did not use half the equation.

And so you know, what we've seen here today I don't think disputes the fact that if you go the quantitative route, you are using half the equation, and SECY 2012-0157 determined that if you go that route, it's not cost beneficial. But because of the large uncertainties that the backfit rule and all the supporting NRC guidance as we read it and as best as I can understand it support the incorporation of both quantitative and qualitative assessments in such a critical issue as severe accident mitigation and the alternatives.

So given all of that, first question. How is it that the staff now dismisses the expert opinion and the independent expert opinion that could be gained to further enlighten what we see as a clear and genuine dispute here between what the staff concluded and was well documented in 0157, and the conclusion here that NEI and the owners groups don't find any qualitative factors that would influence the alternatives? So I mean there's a striking contradiction here, and it appears that the staff is embarking on contradicting itself by shutting down the rulemaking process, where you could in fact elicit and enlighten this dispute through incorporation of, you know--for example, did you use, did you look at the National Research Council of the National Academies Appendix L, which looked at the cost benefit for severe accident mitigation, and determined that NRC has to open it up more.

You used the Peach Bottom reference, a $6 billion SOARCA cost analysis, where the National Academies points out the real factor is now surpassing $200 billion with Fukushima. So there's again this conflict between theory and reality, and the fact that you're closing out the rulemaking to that kind of enlightenment is very, very egregious. It does not serve building confidence in this agency, and it does not serve any sense that these reactors are safer because you have theoretically diminished the defense in depth that staff sought to build in 0157. So how are you justifying removing expert opinion now at this critical juncture, particularly when you have contentious views even within these--on the SAWA meetings. You know, I've been sitting in on some of these, and they've been contentious. I mean, it's suppressed, but if you read between the lines, there's not agreement, and that may iron out, but it's not a smooth operation particularly for eliminating public comment.

So how are you going--you know, what justifies first of all removing the public and removing the qualitative argument? Are you actually going to go back and deconstruct 0157 now? I mean, I think that the, you know, if you look at the ACRS meetings, if you look at the depth and breadth of the SECY itself, you're obligated to go back and make some explanations now on why none of that counts. You know, why--how can you erase that without going back and in this future paper that you're now to present to the Commission, I think you have an obligation to now deconstruct your own analysis and afford what was determined to be a cost-benefitted, substantial safety enhancement. You folks need to be really careful and considerate right now, because this is a very critical juncture for the agency, for the industry, for public health and safety, and that's a big, big, big deal.

MR. MOHSENI: Just--if I may add just a point to that. And thank you, Paul; you make good points. Just--the rulemaking process is, as you know, folks have been participating in these public meetings, and this is one of them.

PHONE PARTICIPANT: Could you speak up, please?

MR. MOHSENI: Yes, the rulemaking process that we have obviously has opportunities for engagement with the stakeholders, and this is one of them, and a part of the rulemaking process includes a reg analysis, regulatory analysis that will inform the decision. You don't know actually what the outcome of a rulemaking is unless you actually do the regulatory analysis to understand the pros and cons of what options you have and what values you gain. And so this is part of that process. It's not a foregone conclusion; ultimately it's the Commission that decides where to go, and clearly the staff will develop its perspectives based on the information it gathers and it's not unusual for differing opinions to all be on the table; it's a healthy discussion.

We don't expect everyone to line up necessarily if there are challenges, and we'll pursue that. This is no exception; we will follow our disciplined process and I appreciate Paul's comments obviously. We'll abide by that. I just wanted to add those comments.

MR. GUNTER: So will you deconstruct 0157?

MR. MOHSENI: It's--we're still developing it. It's not--this is part of that process of learning more. The analysis that was done by the staff since the Commission directed us to go proceed with rulemaking, the TRA that was done is informing us. It's not--we would not have done it if we already knew the answer. If the answer was that simple, you wouldn't go through the process of trying to understand various alternatives and where the value is. So the answer, we don't have an answer that--deconstructing is not necessarily the way I would characterize it, but certainly having an open mind to asking ourselves are we doing the right thing for the right reasons, and we'll just--the staff perspective is one of the elements that the Commission will have before it, ACRS will have its own opinion that advises the Commission, and obviously this is transcribed, this meeting, so it's all on the table, and we'll have--it's not an easy decision as you can tell.

None of these decisions generally end up being extremely simple that you don't need a process of deliberations amongst the staff, amongst the stakeholders to fully appreciate the magnitude of the decision and its implications for going forward, and we'll do our best, as you mentioned. It's not a matter of deconstructing, it's more a matter of continuing to understand more about the implications. And we don't know where it's going to end up, the Commission will have its ultimate opinion on it, and we will provide as much as we can information that's available for them to make that decision.

MR. BEALL: Okay, thank you Aby. Are there any additional questions in the room? Okay, I'd like to move to the phone next. Is there anybody on the phone who would like to have a question?

MS. GOTCH: Paula Gotch from GRAMMES. In listening to your presentation, it occurred to me, it's like Fukushima never happened. Everything is based on models and theory, a lot of it. What Fukushima proved and is still proving as I understand it is these models did not play out as expected. It's as if the faith in the models continues despite the fact that the models didn't really answer many of the questions of what happened in Fukushima.

For instance, the MACCS program there. They said that there would not be a hydrogen explosion at a certain time in one of the reactors right at the time the explosion occurred. The MELCOR, all the MELCOR predictions, not all of them, but some of them could not explain what happened. Since we really have not analyzed Fukushima fully because we can't even get into some of these buildings, it seems to me you're basing your very assured, technical presentation on models that did not work out at Fukushima. And I heard in your October meeting, I heard one of the engineers say "Now of course if I had an engineered-hardened vent, I wouldn't have to worry about all of this, but in lieu of that, this is all the stuff I would do." And since the filtered vents are used all over the world, I don't see--it is incredulous to say to me that it doesn't matter that we put them on or not.

In terms of the cost benefit analysis, I just heard somebody say we're figuring $2,000 a person. I just read somewhere recently the Highway Department says between $6,000 and $8,000 a person they put a value on human life. Can't the nuclear industry be at least as, you know, treasure a human life to raise it from $2,000 when you're figuring out how it's not worth it to bother? Just look at what happened at Fukushima in terms of the water management. There was a problem evidently with the readings they were getting. They were thinking they had a certain level of water, and they were way off. It was very difficult while the accident was going on to really know what the water level was.

And so I'm going to stop there, but all I'm saying is you speak with great assurance about something that to me has no basis of experience except Fukushima, and in Fukushima the models did not work out. Thank you for your time.

MR. BEALL: Thank you. Operator?

OPERATOR: Yes?

MR. BEALL: Can we--we just got three beeps, does that mean the--

OPERATOR: Yes, I found a line and I muted it.

MR. BEALL: Okay. All right, thank you. Any other questions on the phone?

MS. LAMPERT: Yes.

MR. BEALL: Can you state your name please and organization?

MS. LAMPERT: Yes, this is Mary Lampert from Pilgrim Watch. To follow up on the importance of including both quantitative and qualitative, before the Senate EPW meeting with NRC a few weeks ago, that was brought up. Both Commissioner McFarland and Commissioner Baran spoke very strongly of the importance of qualitative assessment. The question here, however, is the adequacy of the quantitative analysis that has been done and in a short period of time, but it is clear that it's totally insufficient.

For example, you mentioned--and if I'm incorrect, please correct me--that you were not considering land contamination, you are only looking at public health. Well that is an absurd statement on its face, because land contamination effects human health from resuspension and ingestion. You're narrowing the impact of human health as I understand it, only to fatal cancers, ignoring long term incidents, ignoring other radiation-linked disease as discussed in BR7. You are also not looking at the external cost to individuals from health affects; you are also not basing the risk on low dose, on current assessments from BR7, from Cardis studies of workers, from the Techa River studies by Christina, and if you look at the Candace and Techa studies, you'd see one cancer death per 100 rem, which is considerably different from what is assumed in your analysis.

By using the MELCOR analysis, you are incorporating into the analysis all the flaws of that model. A, the meteorological input is a straight line Gaussian plume, inappropriate for many of the reactors that would benefit from a filter that are in coastal areas or by large water bodies. There's not discussion of how you average probability; the code gives a choice from a mean to 95%. We have no--I assume that clean up and decommissioning methods were the same as in the MACC code, which is hosing and plowing, which is not clean up.

Were aqueous discharges considered in your analysis? Because as releases wind up in a water body, they also then wind up on beaches, become airborne, or into the food supply, et cetera. Before the ACRS, you talked about looking at impact only to 10 miles; where is the lead shield at 10 miles? That ignores a great unknown, what the meteorological conditions are at the time of the release. We certainly can bring some more concentrated release beyond 10 miles.

Also, you pointed out that you assume 95% were available--able to evacuate. Where does that come from, where we know the bases for that are the extremely flawed ETE, which is under review in a 2.206 petition that has been ongoing since 2013. You talked about FLEX; one minute it's 60% effective I heard during this conversation, then now we're talking about 80%; it all rests on the human factor. We have a contention up here in Massachusetts about the absurd Rube Goldberg method that Entergy is using to provide supplemental water, which you would give that a zero likelihood of being effective.

So we're going through the analyses, which we would like to have the quantitative analysis made public so independent analysts can look at it and see the multiple flaws, and then add to the flaws of your quantitative, which is your justification for not doing a complete analysis, we would add the absence of a qualitative analysis. What this is is starting with the answer that industry does not want to pay for filtration. Many of these Mark I reactors, because they're located in deregulated environments and not making money, they don't know how long they're going to follow the Vermont Yankee route, so why get involved in spending more money. So the staff acquiesces, backtracks, and comes up with a bogus quantitative analysis, gobbly gook, to save industry money. That's the bottom line, which is the bottom line. End of comment.

MR. BEALL: Okay, thank you Mary. Is there anybody else on the phone who would like to say something?

MR. FREEBAIRN: Yes, hi, this is Bill Freebairn calling from Platts; I have some questions. I'm trying to determine in the explanation of the staff evolving position whether the conclusion that there's not a substantial safety benefit to ordering filters, what baseline is that compared to? Is that versus no severe accident capable event, or is it versus the 15 events as they exist today?

MR. MOHSENI: Generally--this is Aby Mohseni. Generally, the comparison is with the performance criteria in here, which is the QHOs, qualitative health objectives. At this stage, that's the level of analysis that we have so far that would indicate that the quantitative analysis does not indicate that we are gaining any significant health benefits from the analysis done so far under conservative assumptions. Did you want to add any--

MR. FREEBAIRN: So there's no substantial safety benefit either, right?

MR. BOWMAN: I think he was asking what the baseline for that determination was, and the baseline would be with the requirements of the mitigating strategies order EA-12049 being implemented as well as the severe accident capable hardened venting system for Mark I and Mark II BWR containment licensees with severe accident water addition. Is that correct? This was Eric Bowman, by the way.

MR. FREEBAIRN: Yes, I mean I do want to know what the--I mean, if you're saying that something has no substantial safety improvements, you're saying that that is versus some other condition.

MR. BOWMAN: Yes, that's--the baseline--

MR. FREEBAIRN: Yes, so the other condition is they've already installed severe accident capable hard fence, and you've got the water addition; is that correct?

MR. BOWMAN: That's correct.

MR. FREEBAIRN: And so is it correct also that this analysis is only--is done before you get to a backfit analysis, right? So you're not--you're proposing not to perform a backfit analysis?

MR. MOHSENI: Well, the steps are, you know, if there is a substantial safety benefit, then you do a cost benefit analysis as part of the backfit to see if it pans out. If it doesn't, then obviously you recommend to the Commission the results of that.

MR. FREEBAIRN: Sure, so it would be correct to say that if the staff does in fact recommend--conclude that there's no substantial safety benefit to this, that they would probably recommend not proceeding--they wouldn't proceed to a backfit or a cost benefit analysis?

MR. MOHSENI: That's correct, you wouldn't--

MR. FREEBAIRN: That you would not get to the point where you would consider qualitative factors, I assume?

MR. MOHSENI: Well no, that's--

MR. FREEBAIRN: That the qualitative factors thing is related to the backfit analysis, right?

MR. MOHSENI: Not--no, actually you do consider qualitative considerations as well. So the discussion so far has shown that in the context of quantitative analysis, which is something that everybody was focusing on and emphasizing and recommending, and there are directions to us to kind of put more emphasis on quantitative analysis to support decision-making as opposed to quickly jumping to qualitative considerations. But there are cases where qualitative considerations are part of that process. That's what--

MR. FREEBAIRN: But they can't--so they haven't--but they can't have an impact on your decision on whether something is a substantial safety--

MR. MOHSENI: Oh yes they can. They can.

MR. FREEBAIRN: Yes?

MR. MOHSENI: Depending on the nature, you know, for example, on security issues, it's very hard to quantify gains and benefits, so we heavily rely on qualitative assessments to reach a decision about proceeding with rulemaking in the area of, say emergency planning or--

MR. FREEBAIRN: So in this specific case, you've decided the qualitative factors were not sufficient to recommend rulemaking?

MR. MOHSENI: Well we're not there yet, but we're working as you can hear from the discussion today, we are really exploring to ensure that we have at least the quantitative part understood. Whether or not--as when the staff proceeds with its efforts, we'll learn more about what other considerations--as I said at the beginning in my opening remarks--other considerations will have to come in if they are relevant. And that's the question I asked at least from the stakeholders who made their presentations, where there are any areas that might have been relevant and yet not easily quantifiable, so therefore, we would take those into considerations. We would be welcoming any, you know, in our public discussions, if there are some qualitative considerations that some stakeholders believe ought to be considered, we'd be open to listening to those and taking those under consideration.

MR. FREEBAIRN: But you said--it's been said that the staff is pretty much going to recommend that no rulemaking go forward, so it would seem like you've already prejudged that.

MR. MOHSENI: Not quite. We are--you know the process is going to inform us as we deliberate further with the staff after listening in and reaching out to the stakeholders, and internally have some internal deliberations with our internal stakeholders as to what are the factors before us, and to what extent have we been able to quantify those factors, and to what extent there are considerations that haven't been quantified that need to have some qualitative considerations. So we're not there yet, although the information, at least quantitatively, is suggesting that quantitatively, we're not going to be able to justify moving forward, but that's the quantitative side. As I said, it doesn't tell you much about whether or not we've really completed listening more to each other, the stakeholders, to find out if there are any other features relevant to informing the decision making process for rulemaking. If there are other factors that we need to consider and include in our future SECY paper to the Commission, and let the Commission make the final call.

MR. FREEBAIRN: Of course. And so are you--but the decision that you're coming to in the quantitative analysis you're coming to is that the conclusion in the regulatory analysis of SECY 12-0157 were incorrect; isn't that true?

MR. MOHSENI: Not exactly. You know, one could have an oversimplification of the process. You know, the fact the SRM says consider rulemaking, the word "consider rulemaking" means begin to explore. Begin to explore what appears on the surface that you may end up somewhere, but it's not a foregone conclusion where you end; you have to actually do the process, go through what you heard today; there's a lot of work that's gone into this. The staff has--

MR. FREEBAIRN: No, I'm saying that the regulatory analysis of SECY 12-0157 doesn't--it says pretty conclusively that there is a substantial safety benefit and proceeds to have access to the shelters.

MR. MOHSENI: Well we offered that to the --as the Commission SRM directed us to consider rulemaking with the conditions that they had in their direction to the staff. And so obviously, you know, the process of rulemaking involves a deliberate decision making process to consider all the pros and cons and options available, and that's part of the job and reaching out to the stakeholders to get insights as part of that process, and it's not a foregone conclusion where we end up. That's--I don't know if I can tell you anything more about the process. You know, we're learning a lot in the analysis that has been done by both the staff and stakeholders; we're asking hard questions to fully understand the implications of what we're learning. We're not dismissing what we're learning, but it's not a foregone conclusion where the Commission will end up on this.

MR. FREEBAIRN: I understand, but is it possible that because you're analyzing the benefit of just the filters versus the hardened vents, that your analysis is somewhat different from that in SECY 12-0157, which was analyzing filters on hardened vents versus nothing?

MR. MOHSENI: As you can see, now we have insights that we didn't have back then. The analysis is available to us, at least to this stage, quantitatively, that is informative to us. We cannot ignore what we have learned, and what it does to our going forward depends on what other features are there that need to be considered in going forward, and what we ultimately--the staff's perspective will be shared with the Commission, and the decision is ultimately that of the Commission.

MR. FREEBAIRN: All right. Thank you very much.

MR. MOHSENI: You're welcome.

MR. BEALL: Are there any more questions on the phone?

MR. BROWN: Yes, this is Jeffrey Brown from Grandmothers, Mothers and More for Energy Safety in New Jersey. I would like to know what value the staff would put on human life that would make this change worthwhile. If one looks at the cost of caring for cancer, you're looking at tens if not hundreds of thousands of dollars. If one looks at any legal settlement of somebody injured for loss of employment, heaven help us if it's a hedge fund manager, but you're talking hundreds if not millions of dollars. so at what point can the staff use a different figure for running the same calculation and determining whether or not it's really cost effective? Thank you.

MR. MOHSENI: You know, I don't have the document, I know we are working on revising the document that actually has the person rem value involved, and as it was indicated, it used to be $2,000 person rem, that's different than life. And it's important to note that we didn't--and that has been revised to $5,200 if I'm not mistaken, and that's a person rem value, and that's for large population exposure. That's one way of assessing impact. It is related to public health and safety--okay.

MS. INVERSO: This is Tara Inverso from the rulemaking branch. What Aby is talking about is the dollar per person rem conversion factor, which we are still developing here at the staff level at the NRC. But when that is updated, it will be issued in the form of a new reg, it will update the previous new reg on it, and right now we're developing the draft reg. I believe the schedule is you get that out for public comment about mid-calendar year 2015 time frame, so the public will definitely have a chance to submit formal written comments on that, and we'll likely have a public meeting on that, too.

MR. MOHSENI: Thank you. Thank you for that clarification. Appreciate it.

MR. BEALL: Okay, any more questions on the phone?

MS. GOTCH: I just have a statement to make, or maybe it is a question. Paula Gotch again. I know that you like to say that these are public meetings, and therefore the public is involved in all this process, but you know, 20 minutes at the end of a meeting or whatever, I would not call that meaningful involvement. My question is, you have the NEI and the EPRI presenting this long thing. Where is the process where you get independent scientists and independent experts to look at this and go over it, and have input? I don't mean just a letter that someone can stick in a file drawer and forget; I mean meaningful decision making impact.

The reason I'm saying this is it feels like to me the NRC, commissioners and all, are making governmental policy decisions. In other words, what's safe enough for you, great unwashed out there. What is safe for you? That to me, since government is to protect people, that's a policy decision, and it seems like right now, the industry and the utilities and the NRC are making those kinds of civic decisions, and I really don't feel that a lot of people on the phone lines feel they are really involved in a big way in deciding this. We kind of feel like I'm sorry, with all the reassurances you've given, we've been working with the NRC for over 10 years now, and practically everybody else on the phone line maybe longer.

We have found out that it's kind of a game; you let us say what we want, you pick the experts, other experts chime in, and then you go ahead and do whatever the Commission decides anyway, and God knows how they make their decisions. So all I'm saying is if you say oh, well this is something that clearly is decided with the public, that is really not--well it's not what--Steven Colbert would call it truthiness. It doesn't feel like the real truth. Thank you for your time.

MR. BEALL: Okay, any other comments on the phone? Hello?

MR. ROTHSTEIN: Yes, Rich Rothstein here.

I emailed in a question, but I didn't know if it got to you. I just saw repeated with an email. I'm just wondering about the concept of ALARA as low as reasonably achieveable, does that apply just really to routine plant releases? What about ALARA for potential populated accident releases, and shouldn't ALARA involve cost benefit considerations as I've heard today?

MR. BEALL: If you typed in a question in the webinar, can you please just ask the question now on the phone line?

MR. ROTHSTEIN: I'm not sure I'm following. I--Rich Rothstein, I just asked the question that I typed in, because I wasn't sure if you saw it typed in when I sent it.

MR. MOHSENI: And perhaps if we have your email, we can get back to you on answering that question. I'm looking around and I don't see an ALARA expert in the room here, but it's a good question, and can we have your email address so we can respond back to you?

MR. BEALL: Or actually, he can send the question to me--

MR. ROTHSTEIN: I think the NRC will have it, because I did register for this webinar, so I provided my email address there rather than reading it over the phone right now.

MR. MOHSENI: Got it. Got it. Appreciate it, and we'll get back to you on the answer to that.

MR. BEALL: Okay, actually why don't you send--can you send your question to me? This is Robert.Beall.

MR. CASE: Rich, this is Mike Case; let me just give you a partial answer. The way I internalized your question was is there an equivalent concept to ALARA when we're doing rulemaking, and the answer is no, there's not a formal corollary to ALARA when we're doing rulemaking, but when you hear us talk about qualitative factors, that's sort of a similar type concept. So we'll do all the numerical things that we can do, and then we compare it to the criteria, and then the process allows us to think about and involve qualitative factors. So that's probably the closest conceptual corollary to what you're asking. So when you hear the folks talking about qualitative factors, they're really talking about are there other things that we should take into account to make the situation better. So that's sort of the short answer to your question.

MR. BEALL: Okay. Is anybody going to bring up any other questions?

MR. BOWMAN: How does ELAP--

MR. BEALL: Sud, can you read that?

MR. BOWMAN: It says how an ELAP due to a loss of grid from a security event factoring into your NEI analysis, and if I was to answer the question, I would say that we do not quantify security events for our probability of occurrence, so it wouldn't have been taken into account, but was the EPRI or NEI analysis, did you guys quantify any security events?

MR. BEALL: I don't think so.

MR. BOWMAN: Okay. Can you try another one? What level of HRA was done for the SAWA management strategies?

MR. MOHSENI: Can you read the question aloud so everyone hears?

MR. BOWMAN: I just read it aloud. The question there is what level of human reliability analysis was done for SAWA management strategies?

MR. STUTZKE: We're not discussing that yet.

MR. MOHSENI: We basically are not planning to do intense HRA analysis for the rulemaking; the reason for that was the slide that was put up there, we did a very conservative screening of the consequences, the gains, and under those circumstances, we saw that the substantial safety gains were not justified, and therefore any more refinement of the analysis, which then would get into an HRA would only widen the gap between the QHOs and where the benefits are. And because we couldn't justify it, even at the conservative level, we did not--we are not recommending to do any detailed HRA.

MR. BEALL: Okay. Is that the last of the questions? Okay. I want to thank everyone for their participation today. As I mentioned earlier, the meeting slides will be on regulations.gov within three business days, and the meeting summary from today with the transcript will be within 30 calendar days. Please remember to search for them on regulations.gov, and our docket ID there is NRC-2013-0075.

MR. BUNT: I have one comment I'd like to--this is Randy Bunt again. We know in the previous schedule, we talked about there was a draft regulatory basis due December of 2014; are we saying that COMSECY is going to be that structure, or is there going to be another document out for review?

MS. INVERSO: This is Tara Inverso from the rulemaking branch, and that draft regulatory basis that was being published for comment was an internal metric.

MR. BUNT: Okay.

MS. INVERSO: Our first milestone is the final regulatory basis due in September 2015, so as we develop the SECY paper and pending the Commission direction on that, we'll provide updates on scheduling for any documents that are out for public comment.

MR. BUNT: Right. Thank you.

MR. BEALL: Okay. Also, if you haven't signed in if you're in the room here with the attendance sheet, please do so before you leave. Thank you very much, and--

MS. GIBSON: Excuse me, can I ask a question?

MR. BEALL: Sure. Can you state your name and your organization?

MS. GIBSON: Yes, Kathy Gibson. The question about the HRA was for industry, not for the NRC. I know the answer for the NRC.

MR. BEALL: Okay, thank you Kathy. Okay, this meeting is adjourned. Thank you very much for being here.

[Whereupon, the proceedings were concluded at 12:28 p.m.]