MEMBER POWERS: I'm wondering how you knew that.

MR. NOWLEN: Judgment. We're supposed to be experts.

MEMBER POWERS: Well, I'm just trying to understand how you got that judgment. I mean, how -- since I'm not an expert, how would I become an expert in judging the probability of control -- alternate shutdown panel failure? Or do I run 600 attempts with the panel, and if 60 of them fail then I know it's .1 or --

MR. NOWLEN: Yes. It's a real -- it's a tough issue. You know, again, you wouldn't ask if it weren't. But we just had to use our own judgment. You know, did we consider -- and, in particular, we took it in the context of the objectives of the IPEEE process. Virtually all of the licensees acknowledge, yes, the control room is important to us, and it's a dominant contributor to fire risk.

Well, in the context of the IPEEE, that was -- the primary objective is, you know, have they acknowledged that they know where their risk contributors come from? Whether they got exactly the right number we were less concerned with.

And, again, recognizing that this brings

in a number of state-of-the-art issues, we typically didn't pursue it to that level. We said, you know, the licensee has acknowledged that this is an important area. It shows up as one of their dominant contributors. We can all argue about the number, but that's the answer.

Now, the ones we tended to focus on were the ones where we thought they had taken an overly optimistic view of control room fire risk and used, for example, very, very low probabilities of conditional -- or conditional probabilities of abandonment given a fire, or who had taken very, very high reliability values for remote shutdown. Those were the ones that we tended to focus on and say, "Gee, guys, have you really thought hard about how important the control room might be to you?"

Is that satisfactory?

MEMBER POWERS: Well, it's the answer.

CHAIRMAN APOSTOLAKIS: If I look at Figure 3-5 on page 331, you have --

MR. NOWLEN: I'm sorry. Which page?

CHAIRMAN APOSTOLAKIS: Page 331. There is a simple -- there is a reporting of fire CDF versus the method of analysis employed. Does it tell us anything? It seems as if those which --

MR. NOWLEN: Yes, we're jumping a little ahead. I actually have --

CHAIRMAN APOSTOLAKIS: Oh, okay.

MR. NOWLEN: -- if you want to --

CHAIRMAN APOSTOLAKIS: We can talk about it. But this is speaking of the same -- it seems to me that the same approach is used, which is -- it seems to yield more conservative numbers. I don't know if that was --

MR. NOWLEN: Yes. We're --

MEMBER POWERS: Well, I mean, I really question --

MR. NOWLEN: This is the figure you're referring to?

MEMBER POWERS: -- whether you can draw that conclusion? Because if they --

CHAIRMAN APOSTOLAKIS: Well, that's why I'm asking the question here.

MR. NOWLEN: Exactly. Yes. Our own perspective is that these are largely a wash. You can see, for example, the FIVE studies, which we've called FIVE plus. There is actually a very, very small number of studies you can call true FIVEs, that just did FIVE and stopped. Everybody -- almost everybody did a little bit more.

But the FIVE studies tend to be a little bit higher. They are screening, so you would kind of expect that, that if they stop at screening -- people who sharpen their pencil tend to get lower numbers. But there is a lot of wash here.

It's difficult to say there is a true trend here. There is a lot of spread in the data, and they all overlap. And so, you know, it's difficult to conclude that there is any real trend here, and our conclusion was that there is no real trend here.

There are some reasons that you can say, yes, that some of these we expected higher numbers, but also one thing to recognize is that in general screening was at 10^{-6} for fire compartments. And once they had satisfied themselves that they were below that threshold it stops.

CHAIRMAN APOSTOLAKIS: So how did these guys handle the issue of control room abandonment?

MR. NOWLEN: A range of ways. Which one? The FIVE studies, in particular?

CHAIRMAN APOSTOLAKIS: The FIVE studies.

MR. NOWLEN: There was some analysis done that would typically begin with a fire frequency, and they would assign a conditional probability that given a fire they would abandon.

CHAIRMAN APOSTOLAKIS: That's a key here because that's doing a screening analysis.

MR. NOWLEN: That's a screening, yes.

CHAIRMAN APOSTOLAKIS: They're very conservative there. What kind of numbers do they use to be very conservative?

MR. NOWLEN: To be very conservative, it was about .1 was about the most conservative that -- so one in 10 fires would lead to control room abandonment with no screening of any of the events. So you start with about a 10^{-2} fire frequency in the control room, a .1 on abandonment, and a .1 on remote shutdown failure, and you're at 10^{-4} control room.

We had a number of people who stopped there and said, "Yes, our control room is important. We know that, and, you know, thank you." And so, as you'll see, I've got some other slides that show some of these areas that contribute. And there are, indeed, some 10^{-4} IPEEE estimated control rooms, and those tend to be that -- that's how you get 10^{-4} for a control room -- those three numbers multiplied together.

But, again, it varies. You know, some of the FIVE studies went much deeper into the main control room and dug a lot deeper. So it's really all

over the board.

CHAIRMAN APOSTOLAKIS: But there really is no basis for the .1. I mean, it's --

MR. NOWLEN: No. No, you're right. It's -- it doesn't have a good, strong, scientific basis. Again, you have to use your judgment. And, again, in the context of the IPEEE, the licensee says, "Yes, we know it's an important area. You know, what more do you want us to say?" And we said, "Okay. Thank you." And we kind of let them go at that point.

CHAIRMAN APOSTOLAKIS: Okay.

MR. NOWLEN: Okay?

CHAIRMAN APOSTOLAKIS: I don't think we should start with the perspectives now.

MR. NOWLEN: Okay. This is actually not a bad place to stop, so we can stop right there.

CHAIRMAN APOSTOLAKIS: Take an hour, Mike? Okay. 1:15.

(Whereupon, at 12:14 p.m., the proceedings in the foregoing matter went off the record for a lunch break.)

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

(1:15 p.m.)

CHAIRMAN APOSTOLAKIS: Okay. Steve, keep going.

MR. NOWLEN: Okay. Returning to the presentation, we're on slide 9, beginning the discussion of CDF perspectives at this point. The plot that we've shown here in this particular slide separates the plants in the BWRs and PWRs and shows the range of fire CDF results we got for those plants that did report CDF values. Not all did that, by the way.

Compared to the IPE values for the corresponding group, I'll note that you can't compare the squares to the squares. They don't plot that way. This is just a distribution of the range for the entire population.

And the conclusion here is that, by and large, the IPEEE fire CDF values are in the same range as the IPE internal events values. They are relatively comparable here.

MEMBER POWERS: Let me ask you a question about CDFs, not that I argue with your conclusion for this plot, but there are some -- how do we get these CDFs? You have some features that are, in fairness,

highlighted in the report but raise some questions in my mind.

It says, "Most licensees screened all scenarios involving propagation of a fire from one zone to another. The rest reported CDF contributions for fires ranging from one percent," which I'll admit sounds pretty insignificant, "to 30 percent," which is not.

MR. NOWLEN: Well, 30 percent of what, though? If it's already --

MEMBER POWERS: Of the overall fire-induced CDF.

MR. NOWLEN: Yes. But if the fire CDF is $1E^{-7}$, and 30 percent of that comes from the --

MEMBER POWERS: Yes. But what about $1E^{-4}$?

MR. NOWLEN: They didn't report 30 percent due to room to room, so --

MEMBER POWERS: What did they report room to room?

MR. NOWLEN: No one found room-to-room scenarios to be a dominant contributor to CDF.

MEMBER POWERS: Well, dominant -- three percent is not dominant, but it's not negligible either.

MR. NOWLEN: Yes. Okay. That was perhaps

misphrased. No one found room-to-room scenarios to be a high contributor to CDF. They were all finding relatively low numbers for room-to-room scenarios.

Now, in one particular case we did have a plant who found some room-to-room scenarios that turned out to be relatively important in comparison to other rooms.

But, again, that -- if I recall correctly, that particular case is a plant that has a low CDF to begin with. And so the room-to-room scenarios are also low. This is a relative contribution for that particular --

MEMBER POWERS: If I understand what's said here, you're making all of these conditional statements based on 20 percent of the submittals.

MR. NOWLEN: Yes. In the room to room that is true. There was a limited sampling of the submittals.

MEMBER POWERS: Okay. If I looked at the others, would it raise all of these numbers?

MR. NOWLEN: No. No, it wouldn't.

MEMBER POWERS: Well, it would at least by perhaps as much -- as little as one percent. In some cases 30 percent.

MR. NOWLEN: Well, I think I've lost you.

You know, the worst -- the most significant in a relative sense for any given plant that room-to-room scenarios was cited as was 30 percent of the total CDF came from room-to-room fire scenarios.

MEMBER POWERS: Right.

MR. NOWLEN: Again, that was a plant that had a very low fire CDF. So we have to take that number with a grain of salt.

MEMBER POWERS: Maybe you need to make these things clear, because otherwise --

MR. NOWLEN: Perhaps.

MEMBER POWERS: -- I think this is a very provocative statement, and it really raises questions about whether they found their dominant fire scenarios in the course of doing this work, because if they go through and assume there's no propagation in between things, except for a few who find it's a 30 percent contributor, then I would really question whether you have found the dominant contributors.

MR. NOWLEN: Yes. And then, again, you have to take these in the context of the absolute numbers. And you're right. In this case, we should clarify that in the report. You know, we didn't get 30 percent of a 10 to the minus -- you know, we didn't get -- Quad Cities wasn't 30 percent room to room.

These were plants that were in the -- probably as I -- I don't recall the details of this particular case. But typically in the, you know, high 10^{-7}, low 10^{-6} range, with numbers in the low 10^{-7} range coming from room-to-room scenarios --

MEMBER POWERS: It's a non-trivial consideration, because we spend an enormous amount of time and resources chasing around on these fire penetration barriers. And what we'd really like to do is look at the risk significant ones, and what you're really saying is that there aren't any risk significant ones.

MR. NOWLEN: The IPEEEs didn't identify any risk significant ones. That is correct.

MEMBER SHACK: Does that includes the ones where they just sort of gave up and combined things? That isn't counted as a room-to-room thing? They just gave up and assumed it was all one room?

MR. NOWLEN: No. If they, in the end, treated it as all one room, then that's one room. It would not be a room-to-room scenario anymore. And there were cases of that as well.

We saw cases going both ways, in fact, where they began with a large room, and at some point in the analysis they decided to cut it into smaller

pieces. We also saw cases where they initially cut things into smaller pieces and said, "It's unnecessary. We can recombine it, and it's still small, so why don't we do that." And so there were cases both ways.

Ultimately, the bottom line is if they cited it as a single room number, we cited it -- we treated it as a single room number. If they cited it as this is a room-to-room scenario, then we treated it that way.

But you're right, yes. And the answer is that room-to-room scenarios did not present high-risk scenarios for the IPEEEs. That's not where the higher CDF values were coming from. They were coming from other areas, individual areas.

MEMBER LEITCH: Steve, I know it's not really the point of that viewgraph, but I was wondering if those two very low CDFs for BWR fire and BWR internal events, are they the same plant?

MR. NOWLEN: Yes. Yes, they are. That's Susquehanna.

MEMBER POWERS: Yes. We've got to find out what Susquehanna's fire protection program is, and just put that in the NFPA 805 and let it go at that.

MR. NOWLEN: Well, again, there was

considerable attention paid to that particular number. They looked at it in the review process in pretty close detail. Ultimately, you know, the number is still very, very low in comparison to the other plants. Of course, we take it with a grain of salt, but in --

MEMBER SHACK: Is their performance during fire as good as it is for internal events?

MR. NOWLEN: I can't answer that question. I don't know. I would -- well, no, I don't want to speculate.

MR. RUBIN: Yes. I think that was one of the issues, yes, definitely.

MR. NOWLEN: It jumps out, yes.

MEMBER LEITCH: You're questioning the validity of the results without -- just on the face of it, I guess is what I'm saying.

MR. NOWLEN: But, again, this was a case where there was a Level II review, and so they went down to the plant and they had extensive discussions with them, and the review team satisfied themselves that this was a -- you know, that there weren't outstanding vulnerabilities to be identified here, that, you know, despite whether you agree with that number or not, it's not a 10^{-3} plant, for example.

And so, again, within the context of the IPEEE, that satisfied our objectives, and we moved on. In this case, we kind of agreed to disagree with the utility on that one.

MEMBER LEITCH: Yes, okay.

MR. NOWLEN: Another interesting thing is that if you start looking at them individually, and we did avoid this to a large extent in the report -- we didn't want to compare one plant's fire to one plant's IPE directly and present all of those results.

But if you do make such comparisons, you find that the vast majority of the submittals do report a CDF value that's within one order of magnitude, in fact, of the IPE internal events CDF for the same plant.

There is a small number of licensees who didn't report CDFs, and those, in particular, are the FIVE-only studies. They were small, they did FIVE, stopped, so you get a screening answer, and it's not a CDF. We didn't include those.

Another thing that we saw, or didn't see I should say, is any definitive trend of CDF with plant vintage. We did specifically look at this, and there is a plot in the report that shows it. You see this is -- the operating license is the value that we

chose to plot against, the date of the operating license. And, again, that's a shotgun blast. There is no tremendous trend there. It's very, very flat, in fact.

MEMBER POWERS: Did you do any kind of formal regression analysis to try to separate out factors in these -- this shotgun blast?

MR. NOWLEN: No, we didn't.

The other point that we looked for and didn't especially see -- and we actually talked about this already -- is that there was no real definitive trend based on the method applied. There are some weak trends that you can sort of anticipate, and you do see those.

But again, statistically, it's difficult to say that there's a real trend. The FIVE studies, again, tend to solve marginally higher CDFs. They tended to stop at a lower level of detail. Presumably, sharpening the pencil would further reduce those values. And other than that, they tended to yield nominally similar results.

What I want to go into now is where were the dominant fire CDF contributors? And I'm going to cover it -- talking about it by fire area or fire zone, and by the types of initiating events that were

analyzed and in terms of the fire sources that they postulated.

So in terms of the fire areas and zones, the main control room is the one that was most commonly identified as the dominant contributor, and it was -- the main control room analysis itself was typically dominated by the abandonment scenarios.

MEMBER KRESS: What was the criteria used for abandonment? If the --

MR. NOWLEN: There tended to be different criteria. The most commonly applied criteria is the criteria you find in the fire PRA implementation guide. It basically did an interpretation of testing done by Sandia under USNRC sponsorship in the 1980s.

They interpreted the time it took for the smoke layer to descend to eye level, which is one of the things we reported in those studies. And then, based on the conditional probability that you put the fire out within that same time period, failure to suppress would lead to abandonment.

So the typical number -- when you do that analysis according to the PRA guide, it comes out .07, I believe -- 007? 007, yes, $7E^{-3}$. So that was the most commonly applied number.

There was considerable discussion of that

approach. It became one of the areas that was discussed with EPRI with regard to the fire PRA implementation guide. Our ultimate resolution there was that so long as they did not screen those scenarios on that basis, the probability of abandonment.

And that they continued and provided an analysis of remote shutdown, we accepted the number for the purposes of the IPEEE. But, yes, that was the most common. There were some others. Some people took conservative numbers; some took more optimistic numbers.

CHAIRMAN APOSTOLAKIS: Again, I'll repeat the comment I made earlier for the seismic analysis. You state in the report -- and I think you just said it again -- that the human error probabilities varied widely. There is no really strong technical basis, and so on.

And yet when it comes to discussing fire methodology perspectives, there's no mention of human error. Again, when we say fire methodology, we mean fire growth and suppression, or you also mean the scenario. So it seems to me that there should be some discussion of that, because this is one of the most important elements.

MR. NOWLEN: Yes. I'm surprised. There is a discussion of human reliability or human factors --

CHAIRMAN APOSTOLAKIS: There is a discussion separately?

MR. NOWLEN: Yes.

CHAIRMAN APOSTOLAKIS: In the section that says Fire Methodology Perspectives, there is no mention of it.

MR. NOWLEN: I see.

CHAIRMAN APOSTOLAKIS: You know, if I were to decide --

MR. NOWLEN: Yes, we culled it out as a separate section of the report --

CHAIRMAN APOSTOLAKIS: Right.

MR. NOWLEN: -- but it's -- it is a part of the methodology. But, yes, it was culled out as a separate section. But there is a fairly considerable discussion.

We did see something a bit different in the fire area than we saw in some of the other areas. Fire tended to be more binary. Typically, they began by crediting what's in the IPE, and then it was more commonly a binary. Either we're going to credit that action or we're not going to credit that action.

Relatively few people use performance shaping factors, for example.

CHAIRMAN APOSTOLAKIS: Yes, and there were between five and 10, as you state in your --

MR. NOWLEN: Right. Yes.

CHAIRMAN APOSTOLAKIS: And those -- you know, sometimes, especially in a field where we don't know much, people are dying to find somebody's report. I found out after 10 phone calls that a number that I was trying to track down a few years ago originated from me.

(Laughter.)

I'm serious.

MR. NOWLEN: It's disconcerting, isn't it?

CHAIRMAN APOSTOLAKIS: Not 10 calls, but four or five. I said, "No, this guy told me, this guy told me," and then finally the guy says, "Well, you told me."

(Laughter.)

So here we have an EPRI document which was used by people who found that the suppression of fire within 15 minutes or non-suppression is 3.4 10^{-3}. I mean, that's a very low number.

MR. NOWLEN: Oh, that's the correct number, yes.

CHAIRMAN APOSTOLAKIS: But if it comes from a document from a major organization, I guess it has some weight. But I'm sure it's just judgment, somebody's judgment.

MR. NOWLEN: No. It was actually based on an analysis.

CHAIRMAN APOSTOLAKIS: Based on actual fires?

MR. NOWLEN: Yes. They did an analysis of the events in the fire event database, developed a --

CHAIRMAN APOSTOLAKIS: 10^{-3} as a time? As a function of time?

MR. NOWLEN: I'm sorry? Nathan?

MR. SIU: This is Nathan Siu, Office of Research. The -3 number, basically what it comes from is a very small number of control room fires. I think it was four. And they had the times to extinguishment for those, which were pretty much clustered -- very short times.

They assumed that the time to suppress was log normally distributed, so they basically fit the curve to that, and then read off the tail to say, "Okay. Look at 15 minutes or whatever the appropriate number was." So there is some development there, but, again, you can obviously question the basis. And

that's why we had a lot of discussions on that subject.

CHAIRMAN APOSTOLAKIS: It's a lot of judgment. I'm not blaming you for -- I mean, I'm just stating that the -- you know, there are some numbers that are pretty low, and the performance shaping factors of five and 10 -- that is all judgmental. It's the same in the seismic area, and I think this report should make a big deal out of it.

MEMBER KRESS: It seems like an insight, doesn't it?

CHAIRMAN APOSTOLAKIS: It is a major insight, yes, a major insight. And, again, if we come to GSI 172, I don't know if there is a fire example that you guys can show us of these 61 units that supplied sufficient information to resolve the issue, because 172 is not limited to seismic. Is it? It includes fires. It's multiple system responses program.

MR. NOWLEN: Yes. There are fire --

CHAIRMAN APOSTOLAKIS: I'd like to see fire, too, to -- just to learn what was considered adequate.

MR. NOWLEN: Okay.

CHAIRMAN APOSTOLAKIS: Another unique

issue with the fires, it seems to me, Steve -- and we have not discussed it very much, if at all -- is not just the human error but the severity factors.

MR. NOWLEN: Oh, absolutely. Yes.

CHAIRMAN APOSTOLAKIS: It seems to me that the severity factors is destined -- are destined to be there forever, because I don't see how we can get data to -- to tell us what percentage of fires is large fires, and so on. Does everyone know what severity factors are?

MR. NOWLEN: I do have a discussion on this in a couple of slides. But --

CHAIRMAN APOSTOLAKIS: Okay.

MR. NOWLEN: -- and Nathan may choose to jump in at that point as well.

CHAIRMAN APOSTOLAKIS: Fine. We'll revisit them then.

MR. NOWLEN: Yes.

CHAIRMAN APOSTOLAKIS: But it's a major issue with fires.

MR. NOWLEN: It is.

CHAIRMAN APOSTOLAKIS: It's not an issue. It is an issue, I guess.

MR. NOWLEN: Yes.

CHAIRMAN APOSTOLAKIS: But it's a very

essential part of the analysis, and it has to be judgmental, because, you know --

MR. NOWLEN: Yes. And it did become a considerable point of focus, but --

CHAIRMAN APOSTOLAKIS: But that brings down the frequencies by two or three orders of magnitude, does it not?

MR. NOWLEN: Depending on how they're applied. We typically saw one, but we did see cases of three or four, yes.

CHAIRMAN APOSTOLAKIS: All right.

MR. NOWLEN: Okay? Let's see. Okay. Dominant fire areas -- again, another area -- switch gear rooms, the emergency switch gear rooms in particular, and the scenarios here tended to be panel fires leading to damaged overhead cables. These showed up a lot. Again, that's pretty consistent with what we've seen in past PRAs.

The third area here is turbine buildings. We've already discussed turbine buildings a couple of times. Often times these were large oil fires that led to the large contributions in the turbine hall, and there were a fair number of licensees who reported their turbine halls as high contributors in their IPEEEs.

A little bit of a surprise compared to past PRAs. The past PRAs have tended to be at plants that just didn't turn out to be much of an issue. In this case, we had a fair number of licensees who did identify that.

Other areas that we often wonder about in fire PRA - cable spreading rooms. In this particular case, the answer tended to be driven by how many cable spreading rooms there are. Again, not incredibly surprising. If there were more than one cable spreading room separated with train segregation, then they tended not to be important.

The other factor was the type and nature of the fire sources that were in the room. If it was strictly a room full of cables, they tended not to be important -- fire frequency very, very low for self-ignited cable fires. Whereas if they had panels in the room, then the fire frequency pumped up. You had a higher contribution in general. Again, not too surprising, fairly consistent with what we've seen in the past.

We also saw various types of electrical equipment rooms in certain plants that have a lot of the control room equipment that gets relocated to a -- what you would normally expect to find in the control

room gets relocated to an electrical -- auxiliary electrical equipment room. Those areas tended to show up as very important as well. So those were real common, fairly typical of what we see, perhaps with the exception of turbine buildings, so far.

Others -- diesel generator rooms. These were often associated with loss of offsite power scenarios, not too surprisingly. Although, again, we don't typically see those diesel generator rooms showing up as dominant in past fire PRAs, so that's -- for some plants that turned out to be important.

Cable vault and tunnel areas -- again, something we see in past PRAs has been found important. Kind of a mixed bag in the IPEEEs. It depended a bit on how they treated their transient combustibles. Many of the submittals took substantial credit for administrative controls on transient combustibles in such areas, argued that they weren't to access during normal operation, and argued very low frequencies, so they tended to go away.

But, again, if there were other ignition sources, that brought them back. In a number of cases we did ask licensees about their treatment of transient combustibles, and they would come back and say, "Well, okay. If we do that, here's a new

number." So this is another area where we've tended to question the results and often got a somewhat higher number with the response.

And then another one that tended to be very plant-specific -- a few cases -- battery/charger rooms popped up as important contributors. And, again, these were typically due to plant-specific factors. There happened to be some cables routed through that area that turned out to be very important.

Moving on to the accident sequences, this was a really tough area for us to try and glean insights. The information that we got in the submittals was typically fairly sparse in this area. We would generally get a description of what accident sequences were considered in the analysis.

But then when it came down to quantification and saying this particular scenario is associated with this sequence, we typically didn't get that level of detail. Licensees weren't asked to provide that level of detail, and we didn't get it.

We didn't generally pursue that as an RAI issue unless we felt it was important, that we really wanted to know what was going on here. Then we would ask licensees to tell us about what the scenarios

were. If they had provided us with no information at all about what sequences had been modeled, we would ask that question.

But where we do have information, the general plant transients tended to dominate. It may not be especially a robust conclusion -- again, because of the sparsity information. It's based on relatively few submittals that gave us that level of detail.

There were also cases that we saw of transient-induced LOCAs, stuck open PORV valves, some limited cases involving spurious operations, valve operations typically, and then the RCP seal LOCAs for the Westinghouse PWRs -- we saw a few of those crop up as important for those plants.

And that's about all we have to say about those. Again, a relatively sparse area in terms of the documentation we got.

When you look at the contributors in terms of the fire sources, in general there was a lot of attention paid to the electrical panel fires in the IPEEEs themselves. The licensees spent a lot of time looking at panel fires. They did dominate the analysis for a variety of areas -- the main control room, cable spreading rooms that had panels in them,

switch gear rooms obviously, and these electrical equipment rooms. Those all tended to involve panel fires.

The potential for damage to overhead cables and how that was treated was often a critical factor in what their contribution ultimately was, and that was dependent in part on the fire size that they assumed. These tended to be point estimates. There was a most likely fire size assumed. That was propagated through the analysis, and a zone of influence was assessed, and they would look at what -- within that zone of influence.

So, again, the electrical panel fires were the most typical contributing source. The other most commonly cited one was large oil fires. Again, this was often -- turbine halls would also, in certain other pump areas where you have large oil sources, they would typically crop up as important.

Transient fires rarely were found to be the important fire sources. In some cases, this is due to treatment, in fact, because typically if a licensee went in and said, "Well, I've got all of these fixed fire sources, and they're doing all the damage anyway. So I'm going to lump my transient fire frequency in with the fixed sources and I've bounded

the problem." That was not at all uncommon. Quite a few licensees did that.

So you tend not to get a separate split out of, what did the transient fires actually contribute? Unless you want to do the ratio of how much of the fire frequencies --

CHAIRMAN APOSTOLAKIS: In how many cases, though, did they argue that there is not enough -- there are not enough combustibles in the room? So we'll screen it out. That's when the transient combustibles become --

MR. NOWLEN: Yes. We did get a lot of --

MEMBER KRESS: And transients I think are more likely during shutdown conditions. And I don't know if this included shutdown conditions at all.

MR. NOWLEN: It did not include the shutdown conditions. And that observation has been made by -- before.

In this case, back to George's question, the areas that we tended to focus on for transient combustibles in the review process were exactly those ones you cite -- the areas where there weren't other fix sources present, and those areas where they were screened out based, for example, on administrative controls.

We generally did not accept that as an argument in and of itself to screen an area -- say, well, I've got administrative controls, therefore, I consider them so unlikely that I don't even have to do any more evaluation.

We questioned those whenever we ran into them and asked them to provide an explicit treatment of transient combustibles for those areas. And in response the licensees would come back with a reanalysis that would give us a revised estimate.

And, again, even then the answers tended to be relatively low contributions by the time you take a fire frequency and a partitioning factor for location and then you propagate it through the fire modeling and credit suppression and things of that nature. In some cases, severity factors would be applied.

Let's see. Self-ignited cable fires was an area where most of the licensees screen these as fire sources. In particular, all of the newer plants that had the newer style cable followed the FIVE methodology guidance that said these fires apply only to the older, unqualified cables. So if you have all qualified cables, you can screen them.

So the newer plants did that. And even

for the older plants, the pre-1975 plants in particular, most of them cited that they had back-qualified their cables in the Appendix R days to the flammability criteria of IPEEE 383. So they screened them as well.

There were relatively few plants that did include them explicitly and treated them. And, again, for those cases they tended not to be very dominant. They tended to be low contributions.

Okay. Jumping ahead -- getting into methods and modeling issues. Again, I've mentioned that we grouped these submittals in different ways or into different groups. The FIVE -- in this case, the FIVE plus the fire PRA guide studies, the ones that began with FIVE and then moved into the PRA guide, the ones who began with FIVE and then moved into other types of PRA analysis not specifically referencing the PRA guide, and those who jumped straight in to doing a PRA from the get-go.

The selected -- again, I've covered this. It didn't seem to have a big impact on the CDF. There are some trends, but it's really hard to pull anything specific out of it. And one point to make here is that as with the other aspects of the IPEEE there is one or more minor weaknesses that exists in virtually

all of the submittals.

For example, most of the submittals did not include a detailed human factors analysis. And we considered that to be a weakness of those submittals. The most common exception was the MCR abandonment scenarios. We did get a number of licensees who did human factors analyses for those.

And we typically saw that they were crediting the recovery actions that were modeled in the IPE. In those cases, we typically looked to ensure that they had considered whether those modeled actions were reasonable given the context of the fire. And in some cases, plants would go back and reexamine their credited actions and would eliminate those that were associated with, for example, actions within the fire area that you're analyzing and would take those out.

Our biggest concern here was some guidance in the fire PRA implementation guide that had suggested that you could do screening using the IPE event trees directly. And since those included those human actions, you're potentially screening by crediting human actions that may not be possible. We focused in particular on those and asked licensees to go back and reexamine their screening if they didn't

credit those types of human actions.

MEMBER POWERS: Is there a database, so that I can -- if I hypothesize a fire of a particular time at a particular location, I can estimate the rate of smoke generation?

MR. NOWLEN: A database? There are models that do that kind of thing. They tend not to be the models that are applied in this context. But there are simulation models that do that kind of thing.

MEMBER POWERS: I guess what I'm asking is, when you ask the licensees to consider, I hope you ask them to consider the effect of fire and not the affect of fire.

MR. NOWLEN: Yes.

MEMBER POWERS: Heat, smoke, and stress. Do they have a good estimate of what the smoking rate is?

MR. NOWLEN: No. No. They don't go to that level. Typically, it's a judgmental assessment of whether or not smoke is likely to build up in a particular area. And, again, the typical response was if it's the area that has the fire in it, you just don't credit the actions. And that -- in fact, based on other work, you know, that may be somewhat conservative.

The other specific example that we ran into was the control room. Typically, in the control room they said things happening in the control room are not impacted by fires occurring outside the control room. That may be a little optimistic.

But, again, it was very typical. We didn't argue that point especially. You know, again, this is an area where there is still challenges for PRA.

MEMBER LEITCH: There's a discussion in Appendix B concerning heat loss factors.

MR. NOWLEN: Yes.

MEMBER LEITCH: -- gas layer modeling. And it left me a little confused. Apparently, a classical number has been .7, and there was some other information that perhaps .95 could be used, and that turned out to be not -- that turned out to be non-conservative. And I guess was that number -- my question is: was that number actually used any place, or did everybody go with the .7 number? Or how did that work out?

MR. NOWLEN: Okay. Ultimately, all of the licensees used one of two numbers -- either .7 or .85. Okay? And there were -- there was guidance that was developed by EPRI, in cooperation with NRC. We worked

with them to develop the guidance.

A little background -- let me back up one step. The heat loss factor is a simplified way of treating heat losses to the walls and the ceiling during a fire event. Most fire models treat that directly. They do heat transfer and the walls absorb heat and it goes away.

But under the FIVE methodology, there's a simplified correlation for estimating how hot the hot gas layer will get based on how much heat comes into the room. But since a fraction of that heat goes into the walls and is no longer available to heat the air, we take away part of the heat.

Well, the heat loss factor is that fraction of the heat that we take away. So .7 says you're taking away 70 percent of the heat. You've got 30 percent left to heat the air. It's a simplified, back-of-the-envelope kind of approach.

When the original methodology FIVE was developed by EPRI, the recommendation was use .7, it seems to work well, and it seemed relatively consistent with the data that was out there. The fire PRA implementation guide came out with new guidance that said, well, in some cases it might be as high as .97, .95, .85, and so they recommended new guidance to

use a new number.

And there was considerable discussion of that. We did some comparison with -- of the correlation to test data using the different numbers. And as you say, the numbers tended to come out -- the new numbers were non-conservative for the vast majority of cases.

Again, now back to your question, we ultimately settled on the two numbers -- .7 and .85. And the difference here was another aspect of the EPRI methodology. And this aspect was the virtual height of the fire. Where am I putting the fire? Do I put it on the floor? Do I put it on the top of an electrical panel, for example?

Do I put it at the location of -- typically, under the FIVE methodology, if you put the fire on top of a panel, then you assume the hot layer would only descend to that level, the level of the fire, and wouldn't go any further. So you would use only the volume of the room above that point.

If you put it on the floor, you use the entire volume of the room. Okay? What we came down to is that if you had the fire source elevated well above the floor, there was a criteria developed. If you put it up high above the floor, then you could use

the higher heat loss factor. If you modeled the fire on the floor, you used the .7.

And there are cancelling effects. Because you've reduced the volume you end up with the same temperature, which is really what we expect given the same fire, whether it's up there or down here.

MEMBER LEITCH: Okay.

MR. NOWLEN: So that's how that got ironed out.

MEMBER LEITCH: So no one actually used the .97.

MR. NOWLEN: Not in the end, no. They all went back and reexamined and applied the new numbers.

MEMBER LEITCH: Thanks.

MR. NOWLEN: Okay. Let's see, have I covered this one? Yes, I think so.

MEMBER POWERS: I don't know whether this is the point to discuss fire growth modeling, or are you going to come to that?

MR. NOWLEN: I didn't really present anything here on fire growth modeling. There is a lot of detail in the methods, and I was selective on how much of that I have covered. If you want to go there, I'm prepared.

MEMBER POWERS: Well, one of the things

that continues to bother me about how you model these fires is taking probabilities, applying them together, on things that are not transparently independent. For instance --

MR. NOWLEN: Sure.

MEMBER POWERS: -- you have an area with a geometric factor, and you take some probability of the fire -- where the fire is located, and then you take some probability of the severity factor, and you multiply them together to get the amount.

Do you see a lot of that kind of stacking of probabilities on things that are not transparently independent quantities?

MR. NOWLEN: We saw some of that and attacked it where we saw it. The most common area was severity factors overlapping other aspects of the analysis. For example, if you're going to do a severity factor that credits most fires are small, and don't cause any damage, which was not at all uncommon, then when you go to the detection suppression analysis you need to base that on the fact that I'm now, by definition, treating a large fire, because I've eliminated all of the small ones.

We did see a bit of that, and we did attack it fairly vigorously when we saw it. And the

typical response was a revised estimate that would eliminate the double counting factors.

For example, a lot of people use severity factors in lieu of a detection suppression analysis. They said, you know, "Look, only one in 10 fires is going to cause any damage, so I'll take a .1 and move on. And I'm going to skip detection suppression analysis."

We weren't entirely happy about those. It tends to drive you towards a generic answer rather than a plant-specific, case-specific answer. But so long as we felt it was within the bounds of what we would get from a detection suppression analysis, we accepted it and said, "Well, again, within the context of the IPEEE identifying vulnerabilities, okay."

But, you know, we did see various cases of that. And, again, we did attack it when we saw it.

MEMBER POWERS: The COMPBRN code gets used a lot in these analyses.

MR. NOWLEN: If I can correct -- the COMPBRN code wasn't used a lot in the IPEEEs. A lot of people used the FIVE modeling worksheets. That was by far the most common. Relatively few actually went to COMPBRN and IPEEE. But, yes, when they used codes, COMPBRN was the code of choice.

MEMBER POWERS: The question comes up -- COMPBRN was written with a set of assumptions and hypotheses. At least I tend to have seen people use COMPBRN fairly indiscriminately. Did people tell you about when they applied COMPBRN and when they did not?

MR. NOWLEN: I would say yes, because the people who used COMPBRN tended to be the PRA studies, the folks who jumped straight into PRA. And those were typically done by people who were well versed in fire PRA, and they used them in the way that they have traditionally been used in fire PRA.

So with the people who did COMPBRN studies, we had occasional issues about it, but it was typically choice of parameters. For example, what did you use for your ignition temperature? What did you use for the damage temperature? Things of that nature. Rather than fundamental abuse of the model. Again, far more common in the IPEEEs was use of the FIVE spreadsheet approach.

MEMBER POWERS: And certainly you highlight the indiscriminate use of the glamorous fire for every cable-to-cable transition known to man.

MR. NOWLEN: Yes. That was another one of the fire PRA implementation guide issues, the fact that a single fire test -- it was a USNRC test at

Sandia, 1975. That was used to develop guidance for how fires would propagate from tray to tray.

And, yes, we had considerable difficulty with the concept that you could extrapolate that to all conditions. And, ultimately, those were typically purged from the final answers. When questioned, most licensees went back and just simply got rid of it and said, "Okay. We'll do it a different way."

So you -- I think you will have a very hard time finding any of the final analyses where that really played any role at all. Yes. And we did -- again, that was one of the generic RAIs that was addressed with EPRI.

MEMBER POWERS: Do you have a set of documents for each of the submissions that you are doing?

MR. NOWLEN: Yes. For each of the submittals there is typically a technical evaluation report written by the reviewers, and there is a staff evaluation report. There is also a collection of RAIs -- one, two, perhaps three rounds of RAIs, and, in a more limited number of cases, site audits.

MEMBER POWERS: If I wanted to get those documents, could I?

MR. NOWLEN: Alan Rubin?

MR. RUBIN: Yes, you can, in ADAMS.

(Laughter.)

Pardon me. That --

MEMBER POWERS: The question was quite different and quite explicit. I asked if I could get those documents.

(Laughter.)

MR. RUBIN: Yes. They are publicly available.

MEMBER POWERS: It would be interesting to see the one for Waterford.

CHAIRMAN APOSTOLAKIS: Steve, would you say that detection and suppression are areas that were not modeled very well?

MR. NOWLEN: There was a range of treatment there. Again, you know, some people did very well. Some people took a shortcut. For example, a lot of the submittals used severity factors in lieu of detection suppression analysis.

CHAIRMAN APOSTOLAKIS: Or just the probability that comes from questionable sources. Somehow this area never received serious -- as serious an analysis as the growth factor. Is it because there are things -- the detectors are so reliable that we don't even worry about them?

MR. NOWLEN: Oh, no. No. I don't think that was the case. It was simply that this was a common area where a simplified approach was used -- again, severity factors.

For those who did do a more traditional detection suppression analysis, it was typically based on the fire PRA implementation guide -- again, had developed a series of probability of suppression versus time for different classes of fire. The alternative approach was basing the analysis on fire brigade response times.

They say, "We can get to -- we've done drills. We can get to this area within 10 minutes." We're going to assume that the probability that a fire lasts longer than that is very low. In some cases, they said, "No fires will last more than 10 minutes," and we would typically say, "Please go back and reconsider the possibility of a long duration fire."

But, again, there is a very wide range. There are some very excellent analyses done based on fairly traditional PRA approaches, and there are some very shortcut approaches based on severity factors, and sort of everything in between.

Again, we -- in the context of these reviews, we wanted to achieve a comfort level that

they had identified the vulnerabilities, and at least were in -- we're identifying the correct areas that were dominant contributors. And in this particular case, what you find is you usually don't get to the detection suppression analysis until you're already dealing with your dominant contributors.

So for us as a review team it perhaps was a lower priority than some of the other things. For example, screening -- we paid a lot of attention to, did they get the right screening results in the first place? And when we got down to actual quantification of what survived in the dominant contributors, we tended to not focus quite as much on the details of exactly what number they were using.

How they got there was certainly a criteria. You know, gee, did you guys use a reasonable approach? Does it at least seem reasonable to us? Again, you're typically dealing with the dominant areas by that point.

MEMBER POWERS: You use the word "reasonable" a lot in this area. And it's troublesome because you don't give me any idea of how your reasoning satisfied them.

MR. NOWLEN: It's very difficult to quantify the judgment of a panel of individuals

that --

MEMBER POWERS: Is it consistent with experience? Consistent with databases? Consistent with models? Those things I understand. "Reasonable" is not a word I understand very well.

MR. NOWLEN: I shall reexamine every use of the word.

MEMBER POWERS: And as Dr. Kress has pointed out, I'm inherently unreasonable.

MR. NOWLEN: No comment.

(Laughter.)

CHAIRMAN APOSTOLAKIS: Coming back to the screening --

MR. NOWLEN: Yes.

CHAIRMAN APOSTOLAKIS: -- there was no need to assume probabilities for the detection and suppression screening scenarios?

MR. NOWLEN: They typically did not in screening. Typically, screening was limited to likelihood of the fire, likelihood of -- or, I'm sorry, likelihood of the fire, conditional core damage probability given the postulated damage state of the plants.

In a few cases we had people bring in additional factors. For example, we would see

severity factors apply in a screening analysis that did, in effect, bring in a detection suppression credit. But, again, you know, that's that simplified approach that I -- I wouldn't really call it detection suppression analysis.

And, again, we often questioned the factors that went into screening. If we saw too many things going into screening, then they weren't willing to declare that they were doing detailed analysis. We would often say, "Hey, look guys, you're going into the realm of detailed analysis, and we'd like to hear more about that" -- was typically our approach to that.

Anything else? Let's see, how am I doing on this slide?

I think we've talked about the PRA implementation guide. It was used quite widely by licensees by the way. There were these 17 generic RAIs, and ultimately revised guidance was provided to resolve those RAIs within the context of the IPEEE. Some of these still remain open in the broader context of PRA, but within the context of IPEEE we resolved them.

I think we covered the severity factor approach. Again, widespread use by licensees of

severities, severity factors. About half of the submittals used them in some form or another. And various factors -- again, the fire PRA implementation guide was a common source.

We were especially concerned when we saw multiple severity factors being applied to the same scenario, and those really raised a red flag in our mind and we would chase those down, typically got responses that would back off on the second and third number that were applied and give us a new answer.

And, again, in my own view and what we've cited in the report is that this severity factor, the widespread use, tended to drive the answers towards generic CDF estimates as opposed to plant-specific estimates. And so long as you're satisfied that the situation is not too far off from the norm, okay. If we get situations where it appeared like you've got something unusual here that might warrant further review, we would question those.

Okay. Getting close.

MEMBER POWERS: In the end, coming up with an answer -- how do we know when they do the severity factors that they're getting a good answer?

MR. NOWLEN: In the broad context, that is an extremely difficult question. In the context of

the IPEEE, again, we went back to the -- to the team having a comfort level that the licensee didn't miss a vulnerability, they've got the right dominant areas, they've got the right scenarios. Maybe we don't like the number, but, you know, the bigger picture --

MEMBER POWERS: They were developing plausibility there.

MR. NOWLEN: I think so, yes, in a sense. We tried not to get overly focused on the final numbers, until you got something like $5E^{-3}$. Then, you know -- that's an interesting number.

MEMBER POWERS: How about $5E^{-9}$?

MR. NOWLEN: Yes, that one was an interesting number as well.

(Laughter.)

Okay. Again, I mentioned that, you know, of these issues there are a number that do remain open to debate I think in the broader context of PRA, the panel fire issues, severity factors. Barrier reliability was another one that I think still -- and gets to the issue of the room to room.

Firefighting, how we credit firefighting is still an open issue. Effectiveness of fixed detection and suppression. And these are all things that are -- insights that are being transferred to the

research program, so, you know, you've seen other presentations on the research program, I'm sure, and so you should see a lot of parallelity between this list and what's going on in the research program.

MEMBER POWERS: When you say "non-code compliant," you're speaking NFPA code for --

MR. NOWLEN: Yes. Yes. There was a particular question raised in our reviews regarding code compliance. A lot of the nuclear powerplants had retrofitted fire protection systems, and in a retrofit situation it's sometimes difficult or impossible to meet code. So there are various code non-compliance issues that you'll run into.

In this particular context, what we typically did is we asked the licensee, are your systems code compliant? Yes or no. We did not, then, ask them to go back and, if the answer is no, use some other number. We simply tried to use it as a flag to say here are cases where the generic reliability values may not be directly applicable because of these non-compliance issues.

But this is another area where, you know, is there a basis for adjusting the numbers? Absolutely not.

So we didn't ask the licensees to advance

the state of the art and give us some alternative number. We simply tried to use it as a flag that would flag that for future attention that, gee, there are non-compliance issues for a particular plant and --

MEMBER POWERS: What other compliances are -- non-compliances are --

MR. NOWLEN: Yes. A lot of them can be nits. Some are not nits. And we didn't go to that level. For the purposes of the review, again, we -- we flagged it that the TER typically will say the licensee was asked, and they have said no, this might be an area for attention in the future if these values are used elsewhere, for example.

MEMBER POWERS: Elevations.

MR. NOWLEN: Elevations, yes. Whether, you know, the detectors are 10 feet apart or nine and a half feet apart or, you know -- you can get some -- you have a very minor -- or minor non-compliance issues. In some cases, they are not minor, though. And, again, we didn't try and --

MEMBER POWERS: It's very important.

MR. NOWLEN: It can be, yes.

MEMBER POWERS: But sometimes the non-compliance is not very important.

MR. NOWLEN: Exactly. And we did not -- without going onsite and inspecting the system, you can't make that kind of a judgment. And so we didn't attempt to. We simply tried to flag them.

And, again, how we deal with that in the future -- good question. You know, PRA still has challenges here, and that's one.

So, conclusions. In a lot of ways a lot of things we thought we know seemed to have been confirmed. You know, again, we're seeing the fire CDFs that are coming in on the same order as the internal events values. You can argue how conservative some of those numbers are.

That's been the wide perception, that --

MEMBER POWERS: We have Appendix R. We end up with a system that, as Nathan will point out to me pretty quickly, has not a great deal of redundancy in it. Why wouldn't you think that it would even have a higher CDF than --

MR. NOWLEN: This perception is based on past PRAs, and past PRAs have gotten that answer. That's where our perception derives -- 1150. Even the early studies that came out of UCLA, Indian Point, they have consistently come up with an answer that's on the same order as the internal events, and that's

what we saw here as well.

So, you know, is the answer conservative? Is it not? Well, all those debates remain. But, you know, again, the IPEEEs are pretty consistent with what we've seen in past PRAs in that regard.

Again, main control rooms -- they were found to be important. IPEEEs, we've seen that before. Emergency switchgear, the insight regarding multiple cable spreading rooms, those are all consistent. And also, plant-specific configuration issues having so much to do with the fire risk. We saw that here as well.

There were various things that would make an individual plant -- a room in an individual very important, whereas other plants you wouldn't expect to see that -- the battery/charger rooms. You wouldn't normally expect those to show up generically, but for particular plants they turned out to be important. We've seen that in the past as well.

MEMBER POWERS: Your significance determination process -- why is it based on generic?

MR. NOWLEN: Well, PRA is based on a lot of generic stuff, too. I mean, we use generic flyer frequencies. We use generic reliability of suppression systems. You know, there's a lot of

generic things that go into any fire PRA. So, you know, you don't have enough data to get plant-specific on every single item.

You know, fires happen, but they don't happen every day. So at some level we have to be satisfied with that, and, you know, judge the results accordingly.

MEMBER KRESS: Let me ask you a question about your first bullet again.

MR. NOWLEN: Sure.

MEMBER KRESS: I let it get by me before I caught it. The fire CDFs are normally the same as the IPE. That's an average number. Did you have any correlation between if it had a high CDF and IPE value, did it also have a high fire? Or was there any correlation between those things?

MR. NOWLEN: This is a slide that I skipped because it -- it's hard to figure out what it means to us. But I'll go back and show it, if I can find it.

MEMBER POWERS: I'll just comment while he's looking. Tom, I did plot them, and I had a hard time coming to that conclusion, that there was a tight correlation.

MR. NOWLEN: What you have here is this is

the ratio of fire to internal events versus fire CDF. So, you know, we have cases where fire was, you know, 10 times or more. So you do tend to see that the ones with the higher fire CDFs tend to have the higher ratios as well. Exactly what that means -- difficult to say.

You know, you can come up with a lot of explanations for why that might be so. Maybe there's more uniformity in IPE, more variability in fire. But you look across the board, that doesn't seem to be borne out.

MEMBER KRESS: That's sure an interesting plot, I'll have to admit.

MEMBER POWERS: Take out the top two points and the bottom three. You'll see what the problem is.

MR. NOWLEN: Yes, it's largely a shotgun blast. You've got a -- well, there's our 10^{-8} plant again.

MEMBER KRESS: Except the BWRs do seem to have a correlation.

MR. NOWLEN: Well, they both seem to trend a bit. You know, you can -- you know, the desire to draw a straight line through there is almost irresistible. But, again, how do you interpret it?

We originally did this as trying to show the ratio of internal to fire, and we said, "Well, we need to spread it somehow." Well, let's spread it by fire, and this is what we found. And it -- we've scratched our heads ever since, and we've come up with at least six explanations for why that might be true.

So in the end, we -- this particular plot is not in the report, because there are so many potential explanations that you can come up with for why that might be so, and it -- you know, you could make a career of exploring those I think.

MEMBER KRESS: Well, it's probably because if you have a high CDF plant, it's vulnerable to failures and the fires create the same sort of failures.

The point I wanted to make, though, is if I were thinking defense in depth, and I had CDFs due to fire that were -- you know, if I were trying to control my CDF and I had one of these high CDF plants that I wanted to control, I'd put a lot more attention on the fire, even though it's comparable, because there is such a big uncertainty in it, and that's what the defense in depth is. It's supposed to deal with uncertainty. It seems to me like that's --

MEMBER POWERS: Only when you're a

rationalist. When you're a structuralist --

MEMBER KRESS: When you're a structuralist, you don't care. Right.

MEMBER POWERS: -- it deals with the fact that you're probably wrong about all of these analyses.

(Laughter.)

MEMBER KRESS: Yes. I just wanted to get my defense in depth --

(Laughter.)

MEMBER POWERS: I mean, but you raise another point. That you have this number that often times is comparable, and yet you are putting far more attention on each little nit in the operational incidences. And we have -- I mean, this is like having one scenario in a CDF that's big. And the question is: is fire getting its fair --

MEMBER KRESS: Due attention. That's exactly my point.

MEMBER POWERS: And before I'm willing to trudge off and do a lot of things on fire, I think I want to look a lot harder at these CDF calculational techniques, because there's lots of judgmental components to it.

I mean, it's a lot of metaphysical things

that we're never going to be able to compare them against them. I think you want to look at them fairly closely before you jump too much on this, but it looks like it's worth jumping on.

MEMBER KRESS: Yes.

MR. NOWLEN: Okay. We -- I'm sorry?

MEMBER POWERS: Fire is the only place in the regulations where defense in depth is defined.

CHAIRMAN APOSTOLAKIS: Not anymore. Well, the white paper I guess is not a regulation.

MEMBER POWERS: The white paper is not a regulation. 1.174, contrary to what you may think, is not a regulation.

CHAIRMAN APOSTOLAKIS: It carries a lot of weight, though.

(Laughter.)

MEMBER POWERS: Only with you.

(Laughter.)

CHAIRMAN APOSTOLAKIS: In fires you have a lot of --

MR. NOWLEN: It's true. Fire is -- you know, as a discipline, fire has treated defense in depth for --

MEMBER POWERS: Let's not congratulate ourselves too much here. Fire may well cull out

defense in depth, and it may have a prescription for defense in depth. It has not been -- fire protection has not done as vigorous a job in the area of diversity and redundancy.

CHAIRMAN APOSTOLAKIS: That's right.

MR. NOWLEN: Defense in depth is more on the phenomenological side.

MEMBER POWERS: It is the classic structural approach to defense in depth, which, of course, is the appropriate approach to take.

(Laughter.)

MR. NOWLEN: Okay. Returning to the conclusions, again, I've mentioned we had a few surprises. The turbine hall showing up in as many plants as they did show up I think was a bit of a surprise. You know, in the diesel generator battery room kinds of areas showing up -- again, those are plant-specific features.

MEMBER POWERS: Do you wonder if turbine fires show up because people spend a lot of time looking at them after things like Narora, and what not?

MR. NOWLEN: I think there is an element of that, sure. But from a more traditional perspective of fire protection, the turbine hall is

where all of our worst fire hazards are. So if we're going to have bad fires, it's the most likely place to have bad fires.

The risk comes in when you combine that potential for a bad fire with collocation of important equipment and cables. And that's where these cropped up, and I guess we were a bit surprised to see as many plants that had that much safety equipment in turbine halls. You normally consider that secondary site power generation. You might have offsite power.

But when you start finding emergency switchgear and cables routing through the turbine hall to get to the reactor building, things like that, that's what cropped up here. And we had -- again, in comparison to what had been done in earlier PRAs, you don't see those kinds of areas showing up.

MEMBER POWERS: I think that's -- the words that you just appended on, why it was a surprise to -- they need to appear a little more strongly maybe in your executive summary.

MR. NOWLEN: Okay.

MEMBER POWERS: I mean, it's just something -- go back and look and make sure that it's really reflecting what you've learned out of this.

MR. NOWLEN: Okay.

MEMBER LEITCH: Do you know if any of the licensee corrective actions included the use of synthetic fire retardant lubricants in the turbine blue boil system?

MR. NOWLEN: Well, I don't remember seeing that in any of the plant improvements. That's something that has happened for other reasons. You know, in a lot of pumps, in fact, we use high fire point oils and things like that. I don't remember seeing any cases where that was cited as an improvement.

MEMBER LEITCH: I think it's fairly commonly used in the electro-hydraulic control system but not in --

MR. NOWLEN: Okay.

MEMBER LEITCH: -- the lubricant system, that I'm aware of. I was just --

MR. NOWLEN: I'm not qualified to answer that. I'm afraid I don't know the answer.

Let's see. Again, I've mentioned the point that, you know, we did have a lot of debates on methodology as a part of the review process. We've resolved those to our satisfaction in the IPEEE context, but a number of those still do remain open. And, again, they're being addressed through the other

research programs.

I think overall we have concluded that all of the licensees did meet the intent of the IPEEE process with regard to fire. We did have two licensees that at some stage of the analysis cited that vulnerabilities existed and took actions to address those. And we have most of the licensees identifying at least one improvement, and often several improvements.

Sixty-four percent of all the submittals cited at least one improvement, and I think, again, that's a good news story.

And with that, unless there are other questions, I'm done. Thank you very much.

CHAIRMAN APOSTOLAKIS: Okay. Our next one is by Brad Hardin.

MEMBER POWERS: Brad has an easy topic. Everything else, right?

(Laughter.)

MR. HARDIN: Good afternoon. I'm Brad Hardin, and I'm going to talk to you about high winds, floods, and other external events. Sometimes we refer to them as HFO events.

And I'd like to acknowledge the other members of our team here, because I didn't do the HFO

reviews for all of the plants. Alan assigned each of the team members a certain number of plants, and for each of those plants that we were assigned the staff member did the individual review.

And some of those people are here today. There's Ed Chow and John Ridgely; Art Buslik; and Uril Chelia, who is no longer in our area but he did some of those I think earlier; John Chen, who is retired; and Bob Kornasiewicz, who is retired also, acted as an advisor to us in this area.

MEMBER POWERS: Is there cause and effect here?

(Laughter.)

MR. HARDIN: Maybe. And Mike Bohn from Sandia also was very helpful in the SRB meetings.

MEMBER POWERS: And he has left the area.

(Laughter.)

MR. HARDIN: All of the staff people that did the HFO reviews were involved in all of the SRB meetings as well and prepared RAIs. We had a number of RAIs in this area, maybe not as many as for seismic and for fire, but we did have a fair number of them.

The areas that I'm going to cover -- and I'll try to do this quickly so we have time to do the other things as well -- types of events that are

included in HFO, the type of screening methodologies that were used by the licensees, and a summary of results, methodologies. We can break up the results into qualitative and quantitative results, talk about each of those. And then plant improvements, which there were quite a few of, and so that's an important area to talk about, and then conclusions.

As Dana said, this area covers just about everything that's left I guess. And that would be high winds, including tornadoes, tornado missiles and hurricanes, external floods, including intense rainfall, flooding from nearby bodies of water, such as lakes, the ocean, rivers, including wave run-up and postulated dam failures, both upstream and downstream, transportation accidents --

MEMBER POWERS: What is a downstream dam failure? Loss of water? Is that --

MR. HARDIN: Yes.

MEMBER POWERS: Yes.

MR. HARDIN: Yes, that would be more like a loss of water in that case.

Transportation accidents from highway, aircraft, train, and barge. And then accidents at nearby industrial and military facilities. And then one that's kind of close and related to that would be

there are other types of external events -- some of the type of industrial equipment that they might have on the plant itself, like nearby pipeline accidents, release of hazardous materials from onsite storage, like chlorine and various chemicals, hydrogen, fuels, effects of temperature extremes, blockage of drains, and intakes by debris.

MEMBER POWERS: You say effects of temperature extremes. Does that include the frazzle ice kind of phenomena?

MR. HARDIN: I'm sorry, Dana.

MEMBER POWERS: Frazzle ice?

MR. HARDIN: Yes. Perhaps breakdowns of equipment due to low temperatures, but I guess typically.

And then any plant-unique hazards, anything particular to a plant because of its unique design. I don't think we found many things like that, but those were included as well.

The licensees were given a number of -- I'm sorry, I forgot to put one of the viewgraphs up. They had a number of options they could use in reviewing HFO. All of the licensees -- first of all, they had to review their plant-specific hazard data and the licensing basis for the plant compared to the

FSAR. They had to identify any significant changes that might have taken place since the operating license review.

At that point, if they wanted to make a comparison of the plant with the 1975 standard review plan criteria, if they decided that they could satisfy all of those criteria they were pretty much home-free, and they could just document that.

They had a choice. In addition to doing that, they could also do a PRA, or they could look at the hazard frequency for various things like wind events or flooding. And if they determined that that was significantly low frequency they would be all right also.

And so I think we'll see that there's a combination of all of these different approaches that were used. Sometimes plants combined SRP criteria review along with some of the quantitative approaches, such as the hazard frequency or the PRA.

And the PRAs were done with this different level. Some of them were fairly complete PRAs. Maybe they used one that they had in existence already. In other cases, they did a partial PRA just for the subject that they were interested in.

And this slide indicates the choices that

were made by most of the licensees. Many of them, most of them, like 80 percent, decided to do the qualitative screening approach using a comparison with a standard review plan. About 15 percent performed a PRA, which was either a full PRA, partial, might have used more conservative bounding parameters or could have been best estimate.

Less than five percent of the licensees chose to use a hazard frequency approach, so that wasn't as popular with them.

And a summary of the results -- there were no vulnerabilities identified. However, there were quite a few improvements made. So even though they didn't identify anything as a vulnerability, they did choose to make quite a few changes and improvements to their plans.

Most of the submittals did not define what constituted a vulnerability. I think you heard a little bit of discussion earlier about vulnerabilities, and that in many cases they did not define what they were. They indicated to us that they did not find a vulnerability.

About half of the plants reviewed -- 34 submittals -- reported plant improvements. And in the same cases as were reported for seismic and fire, many

of these were not reported as having been completed yet, but they had been identified. Some of them were still being evaluated, and we did not know if they had actually completed all of those.

MEMBER UHRIG: These were not required improvements.

MR. HARDIN: No. We did not require any improvements.

MEMBER UHRIG: It was their own self-improvement.

MR. HARDIN: That's right.

Of the 34 submittals, there were a total of about 64 improvements. So, obviously, some of the plants made more than one improvement. And of these improvements, they were about half procedural and half hardware-related.

MEMBER LEITCH: I can't find the reference here, but I seem to recall reading that Turkey Point had more improvements than anyone else.

MR. HARDIN: That's right.

MEMBER LEITCH: Like five.

MR. HARDIN: Yes, that's --

MEMBER LEITCH: Okay. Yes, okay, there it is right there. And I guess -- does that say that they had -- based on their experience with Hurricane

Andrew they perhaps recognized some things that the rest of the industry did not?

MEMBER UHRIG: They also have determined that it leaves a lot of things --

MEMBER LEITCH: Yes. Yes.

MR. HARDIN: I guess that's possible. I don't know.

MEMBER LEITCH: I mean, it would seem to me that -- you know, that they were there, and they perhaps have a better understanding of these kinds of issues than some of the other ones. Maybe they got religion and the others didn't. I mean, I just -- I just wonder if the kind of things they did are applicable to the rest of the industry.

MR. HARDIN: That could be true. I don't remember if there were other plants that made reference to Andrew. I think there might have been. There may have been other plants that referred to lessons they learned from that. I'm not sure.

MEMBER POWERS: So there's been a -- following Andrew, there was a lot of attempts to publicize -- I mean, people were forever making talks about what was learned at Turkey Point in connection with Hurricane Andrew. So it's not like it's hidden information. But whether they got religion or not, I

don't know.

(Laughter.)

Andrew was a big earthquake. I mean, a big hurricane, but it wasn't the biggest that you could hypothesize. And, in fact, what I understand is we're headed into periods of time when we'll have bigger ones.

MEMBER UHRIG: Andrew was a very unusual hurricane because it did not have a storm surge. It had -- most of the damage was wind. Very, very high velocity winds -- 170, 180 miles per hour.

MR. HARDIN: I'm thinking a little bit more about your question. I think my opinion is that probably there were not too many plants that might have missed opportunities to make similar improvements, because a little bit later -- and I'll show you what some of those improvements were -- and quite a few of the plants did similar things in this area for flooding.

MEMBER LEITCH: Okay.

MEMBER POWERS: Do we still require plants to shut down if a hurricane is imminent?

MR. HARDIN: I can't answer that. I don't know.

MR. RUBIN: Dana, yes, that's correct.

That's still part of the procedures for station blackout.

MEMBER POWERS: But we have this incredible low probability of damage.

MR. RUBIN: This is defense in depth.

MEMBER POWERS: Good man.

(Laughter.)

CHAIRMAN APOSTOLAKIS: When in doubt --

MEMBER POWERS: But we're not in doubt. We've done the analysis.

CHAIRMAN APOSTOLAKIS: Often wrong but never in doubt.

(Laughter.)

MR. HARDIN: I know that some plants have criteria that shut down if a flood level reaches a certain -- a certain level to where they don't feel they have enough margin anymore.

MEMBER POWERS: Well, I mean, of course the difference is that if -- I mean, the situation is that if a flood level is very high, or the hurricane is imminent, now it's a conditional probability. Whereas these numbers are annual probabilities.

MR. HARDIN: Okay. Just go through quickly on the remainder of this one. Flooding accounted for the largest percentage of improvements

-- about 50 percent of those. High winds was next with 27 percent. Transportation or nearby facility accidents was about eight percent. And then other external events was about 15 percent.

There were some improvements that were cited that were of interest to us because they were related to HFO areas, but these were done independent of the HFO review, the IPEEE review. And there were 36 plants that reported that based on their review they concluded that there were no improvements necessary.

MEMBER POWERS: Let me ask a question about questions of timing on these. We have -- the IPEEE was asked for like in '91, some early time. And now -- and in between the two we had a flooding event at WMP II. Was that recognized in this -- in these responses?

MR. HARDIN: I don't recall that it was.

MR. RUBIN: What are you referring to?

MEMBER POWERS: Where at WMP they had -- the fire system --

MR. RUBIN: The internal flooding.

MEMBER POWERS: Yes.

MR. RUBIN: That would come under the IPE, the internal flooding, rather than -- this is,

remember, an external flooding assessment.

MEMBER POWERS: Okay.

MR. RUBIN: That's what I thought you were referring to.

MEMBER POWERS: Yes.

MR. HARDIN: Some more results. All of the licensees screened out accidents involving transportation and nearby facilities, meaning they tried to quantify that area. They concluded that the core damage frequency contribution was less than 10^{-6}, or else through their standard review plan review they screened it out in that way.

And the same thing with plant-unique hazards. Those also turned out to be pretty low on the importance. I don't recall actually that any of those were identified. Most licensees indicated that some form of walkdown had been performed during the HFO review.

Sometimes it wasn't specifically stated, but I think when they indicated that they had followed the standard review plan review approach that would require that they do a walkdown in conjunction with it, so I assume that they did use walkdowns. And I think it's clear from the improvements they made that walkdowns are very important to them in this area,

too.

None of the 70 submittals determined that there were any particular containment performance issues that were unique to external events. Similar issues, as with an IPEEE, were the ones that showed up in IPEEE.

Some examples of plant improvements -- protection against high winds, there were procedures, sheltering plans, protection of diesel generator exhaust system from tornadoes. There were missile shields in some cases, strengthening of exhaust stacks of a nearby fossil plant to protect against collateral damage. That's an interesting one.

Protection against external floods, and, again, procedurals, increased inspection of roof drains, improved emergency procedures in the event of dam failure.

MEMBER LEITCH: That exhaust stack in nearby fossil plants, is that Turkey Point, do you know?

MEMBER UHRIG: Yes.

MEMBER LEITCH: Because I know that --

MEMBER UHRIG: One of the stacks actually went down, and the other one was damaged. I don't know whether they took it down to rebuild it or not.

MEMBER LEITCH: I think Waterford has some adjacent fossil units, too. It's an interesting thing to see. I don't know how adjacent is adjacent, but --

MEMBER UHRIG: Well, Turkey Point was close enough that it could create problems, not on the reactor but on the turbine deck.

MEMBER LEITCH: Yes.

MR. HARDIN: Some more improvement examples for external floods. The addition of scuppers in the roof parapet walls to aid drainage and reduce roof loading during heavy rainfall. That was probably the most common improvement that was made by a number of plants.

It kind of goes along in line with the other one of improved -- increased monitoring to make sure that debris doesn't clog the drains in the roofs. Upgrading flood-resistant doors. Improved penetration seals between the service and auxiliary buildings was done at Salem, and that was very significant for them.

They had calculated a contribution to core damage about the order of 10^{-4}, and by improving the penetration seals they were able to show a reduction down to about 10^{-7}. And the reason for that was, on that particular plant, in that area all three emergency trains had cables that were not separated,

and they could all have been flooded and could have shut down all of their emergency service.

Protection against accidents involving transportation or nearby facilities, plant guidelines, excluding all flights over plants. This would be not just overflights by commercial companies, but in one case I guess company pilots had not been restricted before, and so they were given guidelines to prevent them from flying over the plant itself. Prevention of barge shipping of explosives in nearby shipping channel.

Protection against accidents involving transportation or nearby facilities continued. Addition of backup cooling water intake structure to protect against barge accidents. Addition of concrete barriers surrounding propane tank near the diesel generators to protect against possible vehicle impact.

Protection against external events included guidance regarding onsite storage and transportation of hazardous materials, review of control room habitability as affected by onsite storage of hazardous materials such as chlorine. And modifications to prevent ice formation on diesel generator service water pumps.

Some more -- addition of screens on drains

to prevent foreign material intrusion into safety-related equipment spaces. Modifications to ventilation exhaust systems to protect against potential combustible gas explosions. And modifications to plant intake structure to prevent blockage from debris.

Now we go into a summary of quantitative results. We did have some quantitative results for the HFO areas. On the range of the estimates of contributions to core damage frequency for high winds and tornadoes, they range from about two times 10^{-7} to six times 10^{-5} per year. For floods, they range from two times 10^{-8} to about seven times 10^{-6}. And I mentioned before the improvement that Salem had.

Transportation and nearby facility accidents -- we didn't have any values reported other than that they were all screened out. They were less than the criterion of one times 10^{-6} per year. The same thing with the plant-unique events.

MEMBER POWERS: That transportation and nearby facility accidents -- that just reflects the fact that that's something that's covered by a standard review plan, gets examined in fair detail?

MR. HARDIN: I would think so. I can't remember. Volume 2 lists a summary of each of the

areas of review for HFO and whether there was a PRA done. And I don't recall if any of the plants actually calculated something. I think you're probably right.

MEMBER POWERS: I mean, we've just basically put out a revised standard review plan in regard to this stuff. People look at it fairly closely.

MR. HARDIN: I think you're probably right on that.

Some more external event quantitative results. Haddam Neck reported for lightning about eight times 10^{-6} per year.

MEMBER POWERS: It says that in the document, and it doesn't come back and say, "And other people reported much lower values for lightning." Is it the case that only Haddam Neck looked at lightning or --

MR. HARDIN: I think there were other people that used PRAs to look at this, and they got values that were much lower than that. Haddam Neck had the highest values, and that's why we're reporting those.

MEMBER UHRIG: That area is not the highest incidence of lightning in the country. It's

much more severe in southwestern Florida.

MR. HARDIN: Yes.

VICE CHAIRMAN BONACA: Some people have evaluated it.

MEMBER POWERS: Well, they do evaluate it through these peculiarities of how you do the probabilistics. They draw an area, and say, okay, well, the frequency of the lightning strikes is so much here, so the chance of hitting this little tiny vulnerable component that happens to be a spike on the top of the loop is --

MEMBER KRESS: Is the ratio of the areas.

MEMBER POWERS: -- is the ratio of the areas instead of --

MEMBER KRESS: Strange thing.

MEMBER POWERS: The probabilistics are often very strange.

VICE CHAIRMAN BONACA: I know something about the snow, for example. You know, that was just simply discovered in that -- the roof of the building, the auxiliary building that contains a lot of safeguards, too, is designed to sustain as much as six inches of snow. I mean, it's a tin roof.

Yes. So that procedures to clear the roof -- fortunately, of course, we have a high temperature

inside that building. That will keep the area melted to some degree. But if you get to low enough temperatures you have accumulation of ice.

So, I mean, there was, you know, insight there that leads you then to have some procedures to clear the roof to make sure you are aware of that. So, but --

MR. HARDIN: I think, unfortunately, we really don't have much reported information on lightning from the plants. Haddam Neck reported it. There were other plants that reported that they used a PRA to do the HFO review, but they didn't tell us specifically for the different areas. So we just don't have information on it.

And South Texas reported about eight times 10^{-6} per year for chemical release. And, again, I think there were other plants that reported chemical releases, but that was the largest one.

MEMBER KRESS: Is that close to the oil refinery or what?

MR. HARDIN: I'm sorry?

MEMBER KRESS: Is that an oil refinery or close to --

MR. HARDIN: I kind of think so down there, but I don't recall what the specific facility

was.

MEMBER KRESS: It's being expanded in South Texas.

MR. HARDIN: I'm not going to --

CHAIRMAN APOSTOLAKIS: We have a whole presentation on unresolved safety issues.

MR. HARDIN: Yes. So I'm just flashing this up here. This is just to indicate that in the HFO area there are some generic issues that had to do with these topics. And John Ridgely will go into those in more depth.

Conclusions -- there were no HFO-related vulnerabilities. About 50 percent of the plants made HFO-related improvements. And relative to the other external event challenges, HFO contributed significantly less to overall plant core damage frequency.

Based on the extent of the documentation by the licensees, and the discussions that they gave us on this area, it would seem that they actually had done quite a bit of work, and they probably learned quite a bit about their individual plants, so that hopefully if they were to have an event like this they would be better prepared to take care of it.

MEMBER POWERS: It really is the

overwhelming sense that you get in that section, that they did a lot more than I would have thought they would have done.

MR. HARDIN: There was quite a bit of material submitted to us. I think it did leave you feeling that they had done a fair amount of work there, and they responded to a number of RAIs in that area, and there were quite a few improvements, obviously, that they made.

MEMBER POWERS: Good.

MR. HARDIN: These next slides I don't think you need to see them unless you want. Just as an example of what they were, this was just to show you what some of the quantitative results were, so --

CHAIRMAN APOSTOLAKIS: We should reserve some time for the next speaker, I think. Any other questions for this particular -- on this particular subject?

Thank you, Brad.

MR. HARDIN: Thank you.

CHAIRMAN APOSTOLAKIS: What time do the members disappear?

MEMBER POWERS: 4:00.

CHAIRMAN APOSTOLAKIS: Okay. Tom?

MEMBER KRESS: 4:00.

CHAIRMAN APOSTOLAKIS: So it looks like at 4:00 we should -- well, we still -- we will take a 10-minute break. So we'll start at 3:00.

(Whereupon, the proceedings in the foregoing matter went off the record at 2:50 p.m. and went back on the record at 3:00 p.m.)

CHAIRMAN APOSTOLAKIS: Back in session.

Now, you are threatening us with 47 viewgraphs here.

MR. RIDGELY: Not actually. I've added two.

(Laughter.)

VICE CHAIRMAN BONACA: Originally, he had seven.

(Laughter.)

CHAIRMAN APOSTOLAKIS: Before we adjourn, I would like to go around the table and get the members' views regarding, first, whether we want to write a letter, and, second, general comments. So we don't even have an hour for this subject.

MR. RIDGELY: Right. Which is why I'm not going to focus on what the issues are, because these issues have been discussed with the ACRS previously.

CHAIRMAN APOSTOLAKIS: Okay.

MR. RIDGELY: And so there is no discussion of that. It's only on the materials presented. And I guess I should apologize. My name is John Ridgely, for the recorder.

CHAIRMAN APOSTOLAKIS: Okay.

MR. RIDGELY: And I do hope to go rapidly through this. But I do hope to get to your questions also on there.

CHAIRMAN APOSTOLAKIS: Okay. You have half an hour.

MR. RIDGELY: All right. This is what I propose to do -- list the issues, talk at them -- about them one at a time, talk a little bit about the review process, provide a summary of each of the issues with a description -- short description, findings, related improvements -- and then come up with conclusions.

The licensees were explicitly requested to address these particular issues -- USI A-45, Generic Issue 103, 131, and 57, and the Sandia fire risk scoping study issues. They were not explicitly requested to look at these issues -- GSI-147, 148, 156, and 172.

However, during the IPEEE process it was concluded that if the licensees had made an adequate

submittal that we could also most likely resolve some of these issues.

The importance of this slide is to show that what we have here is an interrelationship between not only the issues -- multiple issues -- but they appear across also multiple generic issues. So these are very highly interrelated.

On the review process, the licensees' IPEEE hopefully is complete with regard to these issues. The licensees' assessment was to demonstrate an indepth knowledge of the external events as they related to these generic issues. And the licensees' assessments results are reasonable, given the design, location, features, and operating history of the plant.

An issue is, thus, considered resolved if no potential vulnerabilities associated with its related concerns were identified in the submittal or plant-specific improvements to eliminate or reduce the significance of the potentially identified vulnerabilities were implemented at the plant.

Most submittals contained information that addressed most of the generic issues. If information on an issue was incomplete, then that was taken up with the Senior Review Board and the reviewers to

determine whether the missing information would lead to an important finding or would lead to a potentially significant vulnerability that might have been overlooked.

In these cases, requests for additional information were sent out to the licensees and we proceeded from there. If not, then the potential vulnerability -- if a potential vulnerability was not missed, then the SER listed the missing information as a weakness. In such a case, the submittal would still meet the intent of the Generic Letter. And for those where the generic issue or sub-issue is not closed, the staff will determine separately from the IPEEE program if there is any need to do any further work to close those particular issues.

USI A-45, Shutdown Decay Heat Removal Requirements, the objective was to determine if the decay heat removal function is adequate, and whether cost-effective improvements could be identified. In reviewing the submittals, we found that adequate information was provided in the submittals to resolve this issue.

The decay heat removal equipment was included in seismic and fire PRAs. The equipment was included, and seismic margin analysis in the form of

a safe shutdown equipment list. For the seismic margin analysis, each component's high confidence of low probability of failure value was determined.

We've concluded that all plants have adequately addressed USI A-45. All plants have identified at least one method of removing decay heat and no vulnerabilities were identified.

Generic Issue 57 --

MEMBER LEITCH: Can I ask I guess just a process question? If you have concluded that all of the plants meet USI A-45, then will ACRS be getting a look at that for closure? Is that the way that's going to work?

MR. RIDGELY: I believe this is it. This issue has been brought to the ACRS previously, and the ACRS has written letters I think on some of these, and they've identified that they're going into the IPEEE program for resolution. Some of them they've dealt separately with.

MEMBER LEITCH: Okay. Okay. Thanks.

MR. RIDGELY: You're welcome.

GSI-57 is the effects of fire protection system actuation on safety-related equipment. They were to evaluate the risks that possibly a seismic event could induce a fire and induce suppression

diversion so that you don't have a fire suppression system where you need it. And the other issue is that it could actuate the fire protection system and cause damage.

In reviewing the submittals, we found that the plant's fire protection system was frequently designed to the seismic Category II/I criteria. Most plants had the pre-action types which requires two independent conditions -- for example, smoke to valve and then heat to fail the fuse in the sprinkler head.

There were a few that had deluge type, which relies then in this case on spatial relationships between the fire protection system and the safety-related equipment seals and drainage systems to keep from flooding.

Carbon dioxide Halon systems were reviewed for the potential to have adverse effects on personnel in the control room and on equipment, predominantly there the diesel generator.

Our conclusions on this generic issue is that the licensees have concluded that the impact of this activation is negligibly small, no plant vulnerabilities were identified, and all but four plants have adequately addressed this issue.

CHAIRMAN APOSTOLAKIS: So that's in a

generic safety issue as a result -- for specific plants. Is that what --

MR. RIDGELY: For all the plants except for four.

CHAIRMAN APOSTOLAKIS: In this case.

MR. RIDGELY: In this case.

CHAIRMAN APOSTOLAKIS: In other cases, it's --

MR. RIDGELY: We'll go through each one, and I'll tell you what's missing here.

Generic Issue 103, the Design for the Probable Maximum Precipitation -- in this case the objective is to evaluate the potential effects of revised PMP criteria on site flooding and roof ponding. Physically, roofs can withstand the additional loads because of the excess rainfall overflows, the roof parapets. In some cases, scuppers were installed in the parapets.

To credit roof drains, licensees referred to procedures to periodically inspect for roof drainage system blockage. And typically the site flooding from the PMP effects on nearby rivers and streams -- this is dam failures, for example -- did not adversely affect the plant.

If flooding could adversely affect a

plant, plant changes were usually made -- timely shutdown, sand bags, that kind of thing. Site drainage adequately removed very local intensive precipitation or there was insignificant water accumulation. Or if there was significant water accumulation, no adverse effects on components or the components were designed to operate submerged.

Confirmatory walkdowns were used to identify doors and penetrations vulnerable to moisture intrusion, and the ability of drainage systems and the site drainage.

The conclusion for this generic issue is that the original design and construction of the plants included sufficient margin to allow for the variations of up to two to three times the original design basis PMP without adversely impacting safe operation of the plant. No plant vulnerabilities were identified.

One plant -- Salem -- installed new penetration seals between the service and auxiliary water buildings, and reduced the core damage frequency from 10^{-4} to 10^{-7} per year. All but three plants resolved all aspects of this generic issue.

Generic Issue 131 is applicable only to Westinghouse plants.

VICE CHAIRMAN BONACA: I have a question regarding the statement that you have.

MR. RIDGELY: Yes.

VICE CHAIRMAN BONACA: Those three plants, are they committed to resolving those? Is that --

MR. RIDGELY: There are no commitments from anybody to resolve these open issues that I'm aware of. These open issues would now go to some other organization -- I believe Generic Issue Branch -- and they will determine whether it is worthwhile to pursue getting closure on these issues.

VICE CHAIRMAN BONACA: Because, I mean, they are not generic anymore. By the time you go from 100 plants to three, they're very specific to those licensees. And so I guess it's hard to understand how the process works.

MEMBER KRESS: You have to go to a backfit analysis, then.

VICE CHAIRMAN BONACA: All right. I understand. Thank you.

MR. RIDGELY: You're welcome.

MEMBER LEITCH: In a few cases, this table in the report that addresses each particular plant and whether they have resolved the issue or partially resolved the issue, there is a couple of places where

there are blanks.

MR. RIDGELY: That's because when we were in the process of printing this all of the SERs had not been written at that time.

MEMBER LEITCH: Okay.

MR. RIDGELY: The next version will have them all filled in.

MEMBER LEITCH: Okay. Thanks.

MR. RIDGELY: This particular issue is dealing with a failure of the in-core flux monitoring system and in a seismic event with a possibility that its movement could cause a small break LOCA.

This was applicable to all but three Westinghouse plants with those that have an immobile flux monitoring cart. This issue had already been resolved by 19 plants, and for six plants the as-found condition was adequate. Adequate restraints were added by four plants, and this was mainly installation of angle iron welded to the seal table to bolt to the transfer table in place.

Administrative controls were implemented at one plant to restrain a chain from falling onto it, and walkdowns were performed to verify the installation of previously-installed improvements.

Our conclusions on this generic issue is

that no plant vulnerabilities were identified, and all plants have satisfactorily resolved this generic issue.

Generic Issue 147, Fire-Induced Alternate Shutdown and Control Room Panel Interactions -- this issue -- the objective of this is a fire in the main control room might lead to a loss of control or power to alternate systems before the transfer could take place, or the total loss of system function or spurious operation leading to a LOCA, and alternate shutdown systems needed to be electrically independent.

Our finding on this is that many relied, in part, on the compliance with Appendix R requirements and meeting those regulations. Alternate shutdown locations varied from one place in a plant to some -- up to 14 different locations. And these were found to be electrically independent of the control room. No unrecoverable LOCAs would be identified. Spurious hot shorts were considered, anywhere from one to six at a time. And no total loss of system function was identified.

Our conclusion on this one is that no plant vulnerabilities were identified, and 94 percent of all of the plants resolved this issue

satisfactorily.

Generic Issue 148 is Smoke Control and Manual Fire-Fighting Effectiveness. The issue here is that the buildup of smoke could hamper efforts of the fire brigade and operators, potentially damage equipment, and lead to misdirected fire suppression, or inadvertently initiate fire suppression systems.

We found that 65 percent of the manual fire -- 65 percent of the submittals credited manual fire-fighting actions, 15 percent did not explicitly discuss this issue, but it could still be evaluated because this issue is related to one of the fire risk scoping study issues covering the same topic. And so we could look at that portion of the submittal to resolve this issue. Twenty percent of them took no credit for manual fire-fighting activities.

While this is a conservative assumption from a PRA standpoint, it has its problems. First of all, it does not consider the potential effects of misdirected spray. And if they did not consider this, then this is one of the reasons why this issue would remain open and not fully closed.

Even though they take no credit -- took no credit for manual fire-fighting activities, many of them did discuss fire brigade training, simulation

exercises, equipment, and timing aspects. Because of insufficient data to evaluate equipment damage from smoke, this aspect of Generic Issue 148 was not addressed. This would be basically beyond current state of the art, and that's not what the IPEEEs were for.

Our conclusions were that no plant vulnerabilities were identified. It was completely resolved for 71 percent of the plants, partially resolved for 25 percent of the plants, and not resolved for four percent of the plants.

Generic Issue 156 is --

CHAIRMAN APOSTOLAKIS: But you said that insufficient data to evaluate equipment damage from smoke -- this aspect has not been addressed. So how can you say that it has been resolved for 71 percent of the plants?

MR. RIDGELY: For the IPEEEs, their challenge was not to advance the state of the art, but to use the information and techniques that are currently available. There is very limited experience with smoke damage to equipment, and so there really isn't any particular basis to derive any kind of a conclusion about what smoke would do.

Those that did address it said that smoke-

induced damage to equipment would be a, relatively speaking, long-term event, and that that would be taken care of by regular maintenance and be something that would occur after the fire was put out.

CHAIRMAN APOSTOLAKIS: Yes. Okay. I won't consider that as resolved, but consider it still open until sufficient information is available. I just --

MR. RUBIN: Let me just add to this. In the report itself, in discussing the issues, some of the issues are fully resolved by the IPEEE. The plant-specific reviews, some are partially resolved. This issue 148 is partially addressed in the IPEEE program. So that aspect -- this is a discussion I had one day with the -- in a subcommittee meeting, just on Generic Issue 148 to clarify that point.

CHAIRMAN APOSTOLAKIS: Okay.

MEMBER UHRIG: Since the time these were written there has been a good deal of work done jointly with Sandia and Oak Ridge National Laboratory on the damage of fire to particularly the electrical systems.

MR. RUBIN: There are research activities going on, particularly with the effect of smoke on digital I&C systems, as you're aware of. And that's

going on under a separate program. That's why it was not considered to be part of the IPEEE review for that issue.

MR. RIDGELY: The SEP program was to review 31 plants that were licensed prior to issuance of the 1975 edition of the standard review plan, which those plants did not explicitly address the information in that SRP. These are the nine issues that are -- were to be addressed, and we will take those issues as we go through.

Findings on this is that we are -- no improvements specifically identified for this generic issue were made. Other improvements were made for other reasons that would affect this generic issue. External flooding resolved the hydrological issues. These are issues on the other page of 1, 4, and 6. Seismic evaluation resolved the seismic design issues, which would be 5, 7, and 8.

The HFO evaluation would resolve the wind and other issues, which is 2, 3, and 4. And resolution of USI A-45 also resolved the shutdown issue, which is number 9.

Our conclusion is that no plant vulnerabilities were identified, and all 31 plants have resolved this generic issue.

Generic Issue 172 is a Multiple System Response Program. This was to address 11 IPEEE-related MSRP concerns raised by the ACRS regarding safety issues that might exist and which might not be addressed by the NRC's existing generic safety issues. The first one of these is the effects of fire suppression system actuation on safety- and non-safety-related issues.

This issue overlaps Generic Issue 57, and it was resolved in part by seismic -- part of the seismic walkdowns. It was also addressed as an impact on safe shutdown equipment or safety-related equipment.

Most of the licensees considered non-safety-related equipment unnecessary for safe shutdown or drains adequate to prevent unacceptable flooding. This aspect of this issue was resolved for all but two plants.

Seismically-induced fire suppression system actuation is also addressed by Generic Issue 57. It was addressed in part by the seismic walkdown. Sixty-six submittals evaluated the potential effects of inadvertent actuation. Many did not include seismically-induced loss of fire protection system.

Some included evaluation of the potential effects of fire protection system component failures. Plant improvements in this area included replacing relays and switches, strengthening component anchorages, and implementing procedures to properly secure transient fire protection equipment. This aspect of this generic issue was resolved for all but three of the plants.

Seismically-induced fires is related to the Sandia fire risk scoping study, and a few plants -- licensees performed PRAs for initiating events. Most addressed the issue as part of the seismic walkdown, and most evaluations limited the impact on -- to safe shutdown equipment.

Some included pipes and tanks containing flammable materials. Plant improvements in this area mainly were restraining gas cylinders. This aspect of this generic issue was resolved for all but three plants.

The fourth issue is the effects on hydrogen line ruptures. Hydrogen line ruptures did not contribute significantly to the core damage frequency. Typically, addressed with walkdowns following EPRI's FIVE methodology. This was resolved for all but five plants, but two licensees addressed

hydrogen lines but not tanks. The other three did not address either of the issues.

The fifth aspect of this generic issue is non-safety-related control system and safety-related protection system dependencies. This is related to the Generic Issue 147 and a fire risk scoping study issue. Safe shutdown can be performed at the main control room or the auxiliary shutdown panels with only safety-related equipment. Non-safety-related equipment failures would not inhibit shutdown. This was the position that was taken by most licensees.

All but four licensees provided adequate information to close this issue. One did not address hot shorts, and three did not discuss the issue at all.

The next aspect of this issue is the aspect of flooding or moisture intrusion on non-safety and safety-related equipment. The HFO portion of the IPEEE resolves the flooding aspect for these components. Moisture intrusion is evaluating the potential effects of seismically-induced failure/activation of fire protection system and misdirected spray from manual firefighting activities. This was resolved for all but three plants.

The next issue is seismically-induced

spatial and functional interactions. This was addressed by -- in part by seismic walkdown. Most submittals limited this to direct impact on safe shutdown equipment. Plant improvements related to this were strengthening of component anchorages, anchoring cabinets together, procedures to secure transient fire protection equipment. This aspect was resolved for all but two of the plants.

The eighth issue is seismically-induced flooding. A few licensees evaluated this using a PRA. Most used a seismic walkdown. Most evaluations limited their scope to safe shutdown equipment. Plant improvements in this area include adding seals to waterproof electrical cabinets, enhanced drain inspection procedures. This was resolved for all but six of the plants.

The ninth issue is related to seismically-induced relay chatter. A few plants had low ruggedness relays in the IPEEE success paths that were not redundant to those in the USI A-46 evaluation. Twenty-seven licensees performed seismic PRAs. Fourteen included relays in their PRA. Recovery actions were not modeled. Forty-two licensees performed separate evaluations.

Low ruggedness relays found in alarm

circuitry, negligible consequences, or operators could provide effective reset for those relays. In a few cases there was a plant improvement, and the improvement was replacement of the low ruggedness relays. All licensees resolved this issue.

Now, item 10.

CHAIRMAN APOSTOLAKIS: Yes.

MR. RIDGELY: I was wondering if you were going to get back in time for this.

CHAIRMAN APOSTOLAKIS: I made sure I did.

(Laughter.)

MR. RIDGELY: The IPEEE issue focused on human errors involving operator recovery following the occurrence of an external event, namely fire and earthquake. Errors modeled in PRAs were done by using the IPE model, modifying the IPE model using judgmental scaling factors, or simplified operator error fragilities.

In seismic margin analysis, reliance is placed on most familiar success paths and most reliable equipment and qualitative discussion on operator reliability.

In fire evaluations, the licensees used the IPE model or the IPE model with a performance shaping factor, expert judgment to determine a factor

for each action, a conservative screening factor of, for example, .1, or some reevaluated or requantified all error rates. And this we consider resolved for all but eight plants.

Now, for two slides you do not have. The question was asked as to what is the -- give us some examples of what was done for plants that -- where we found these acceptable. Well, one -- and I just grabbed some off the shelf. Okay? These --

CHAIRMAN APOSTOLAKIS: So it's a random example.

MR. RIDGELY: More or less random example, yes.

One plant went back and relied on NUREG-4826, the screening approach for a single train and multi-train system. This approach was found acceptable and identified so in NUREG-1407.

Another plant for the fire -- the human error probabilities were increased by roughly a factor of 10 over the IPE values, but no credit was taken in any sequence for recovery actions, and this included the restoration of the loss of offsite power. In the -- excuse me, that was the seismic area.

In the fire area for this particular plant, only one recovery action was credited, and that

was aligning alternate power to the reactor protection system motor generator sets. Another plant -- they used the IPE human error probabilities until they got to a ground acceleration of .5 g. And then they set the error rate to one.

(Laughter.)

They did a sensitivity and --

CHAIRMAN APOSTOLAKIS: At .5 g, it becomes one? Really?

MR. RIDGELY: Yes.

MEMBER POWERS: You wouldn't agree with that number?

(Laughter.)

CHAIRMAN APOSTOLAKIS: Sensitivity performance to --

MR. RIDGELY: Right, to .35 g, and this changed the core damage frequency by about 50 percent.

CHAIRMAN APOSTOLAKIS: Mean perform sensitivity -- that means it was an error of probability of one down to .35 g? Is that what that means?

MR. RIDGELY: When they changed that to .35 g, that's when it crossed over and made it one. They are failure rates.

CHAIRMAN APOSTOLAKIS: Right. But then

sensitivity performed to .35 g, what does that mean? That you put the error equal to one at .35 g?

MR. RIDGELY: What they did was they had a -- they used -- the IPE value, whatever the error rate was --

CHAIRMAN APOSTOLAKIS: Right.

MR. RIDGELY: -- okay, up until they had an earthquake magnitude of .5 g.

CHAIRMAN APOSTOLAKIS: Correct.

MR. RIDGELY: Okay. Then they set it to one. Okay? Now, then they did a core damage frequency probability for this. All right?

Then there's a sensitivity. Instead of changing the error rate to one at .5 --

CHAIRMAN APOSTOLAKIS: Right.

MR. RIDGELY: -- they change it to .35. And then they -- that changed the core damage frequency by about 50 percent.

CHAIRMAN APOSTOLAKIS: Fifty percent from what?

MR. RIDGELY: From what it was when they did this evaluation. So it's not even a factor of two increase in core damage frequency, so it's not necessarily -- percentage-wise, it's not a big change. Now, that's what they did.

And as far as fire --

CHAIRMAN APOSTOLAKIS: Well, the real issue, though, is that the HEPs, it's not just the factors that were multiplied here, but it's also that they themselves -- it's basic human error probabilities. The ideas are of questionable validity.

MR. RIDGELY: I won't argue with that. It was intended that for the external events that hopefully the licensees would look at whatever values they start with, usually from the IPE, and say, "Well, under those circumstances I could expect the error rate maybe to be something higher based upon the ground moving or smoke coming in," or whatever.

MEMBER POWERS: I think you're wrong, Mario. We shouldn't put the operators and run a scenario with them on the shaker table. We should put the PRA analysts on the shaker table.

(Laughter.)

See if they think that a .35 g would --

VICE CHAIRMAN BONACA: But they would -- even .35 g seems to be a little bit incredible.

MR. RUBIN: But then, as you pointed out, they have time after the .5 g has settled down to get up and recover, maybe an hour or two --

(Laughter.)

-- take some operator actions.

CHAIRMAN APOSTOLAKIS: The problem is we are dealing with a basic set of numbers that are not based on -- don't have a strong technical basis, and we will --

MEMBER POWERS: Well, unless they come from THERP, and then they are totally reliable.

CHAIRMAN APOSTOLAKIS: Yes.

MR. RIDGELY: You were looking for examples where you found that they were not resolved. Well, here we have some here. The first one -- modifications to operator actions from an IPE were made from a fire, but they did not discuss what the effect would be of a seismic event. And that was left as an open issue.

Another case -- in fact, two other cases they did apparently a very good discussion of operator recovery actions for a seismic event, but very minimal for fire aspects. And then, for a partially resolved one, they did -- a detailed human error analysis was performed to evaluate operator actions that might be necessary for each fire area.

However, the seismic human actions discussed were -- the general discussion wasn't

specific to success paths, so that was a partial resolution.

The eleventh item on this list is evaluation of earthquakes magnitudes greater than safe shutdown earthquake. Well, that's the point of the IPEEE. And having done an acceptable seismic portion of it, they solved this problem and all of the people have resolved this issue.

Therefore, in our conclusions for Generic Issue 172 -- is that no plant vulnerabilities were identified, and 56 plants have resolved all 11 of the MSRP issues.

Now, to try to put this a little bit in perspective, this is what it looks like. This is the number of plants versus the number of issues that are open. You see there's one plant that has seven issues open, one five, but the majority have thrown those two out as outliers. We've had a pretty good success with those on a per plant basis.

If you want to look at it by an issue basis, these are the issues. Obviously, common cause is the biggest issue here, and this is the -- this is how it comes about issue by issue.

All right. Sandia Fire Risk Scoping Study. This is to evaluate risks of five previously

unaddressed fire risk issues that were identified in NUREG-0588. The first issue is seismic/fire interactions. We've heard a little bit about this before.

Fires might cause threats to the plant for different reasons, for complicating -- causing spurious actuation which could complicate operator response to the seismic event, cause actuation of fire suppression systems inadvertently, or could lead to flooding problems, habitability concerns, diversion of suppressions, suppressions to non-fire areas rendering them not available for the -- where the fire is, potential for overdumping of gas suppression, some pressurizations of the compartments, spraying important plant equipment.

I'll talk about the answers on this one. This was resolved partly with a seismic and fire walkdown. The evaluated induced failure and actuation of fire protection systems, plants improvements in this area, was to ensure existing procedures for securing cylinders were followed, and 66 plants provided adequate information to resolve this aspect of the generic -- this generic issue.

The second issue is the adequacy of fire barriers. The fire barrier issue is important because

it -- we're talking about protecting redundant equipment, potential for fire from one room to go to another room, also for retention of smoke. And what we found when we reviewed this is that this discussion -- the licensees discussed inspection, surveillance, and maintenance procedures for seals and doors, fire watches for welding activities.

Where they did multi-zone fires they found it was not a significant contributor to the core damage frequency, and smoke through the penetrations they found would be diluted and not inhibit firefighting activities.

MEMBER POWERS: Now, you say this is not a significant contributor, but we still have this 30 percent number. Thirty percent of CDF is not a non-trivial number.

MR. RIDGELY: Okay.

MR. NOWLEN: This is Steve Nowlen again. We discussed that -- you know, the idea that 30 percent of a small number is not significant in this context. For that plant to -- it's a visible contributor given their number, but --

MEMBER POWERS: I mean, you're the one that's telling me that it's 30 percent of a small number. I know it to be 30 percent of a number that

can range from one times 10^{-4} down to 10^{-8}.

MR. NOWLEN: We will be sure to clarify 30 percent of which number as we do the revision of the report.

MR. RIDGELY: And 66 of the plants resolved this aspect of the fire risk scoping study issues.

The third one is smoke control and manual firefighting. This issue became Generic Issue 148. Most submittals discussed consideration of smoke in their fire brigade training, and 55 licensees provided adequate information to resolve this issue. This issue, again, is for the possibility of hampering firefighting activities.

The fourth issue is dealing with equipment survivability. Again, this is potential for misdirected sprays, for sprays coming on spuriously and failing equipment. This issue is addressed by Generic Issue 57. And 65 licensees provided adequate information to resolve this aspect.

The fifth issue is fire-induced alternate shutdown/control room panel interactions -- a combination of fire-induced failures and spurious actuation, with a high probability of random equipment failures, were identified as potential contributors to

fire risk. This issue became Generic Issue 147.

The transfer control from the control room to alternate locations is in all the plants. The plants identified they were electrically independent, either from the power source or a fuse or breakers in the line. Spurious actuations were considered, and 67 licensees provided adequate information to resolve this issue.

Let's see. So our conclusion is 25 licensees used EPRI's FIVE methodology. No plant vulnerabilities were identified, and 53 licensees resolved all aspects of this generic issue. Graphically, this is the issue. This is how it looks.

Obviously, the one that spans out is the -- the LOCA effects, and this is primarily because, again, if we're talking about misdirected spray the common thing that wasn't considered in manual firefighting was not specifically -- not credited in 20 percent of the plants. So this is why that particular item is so large.

Looking at it a different way by number of plants, we see that the number of issues -- number of plants that have open issues -- again, it's either, you know, one or a very low number -- again, defining it as a success for closure to this issue.

Summary and conclusions. There were 31 IPEEE-related issues. There were unresolved safety issues and generic safety issues and sub-issues. Nine were explicitly discussed in the Generic Letter; 22 were not.

We considered a major achievement to resolve a large majority of these issues -- 44 licensees provided sufficient information to resolve all 31 of these issues; 25 submittals had one or more generic issues or sub-issues open or partially resolved.

Saying that a little differently, we have 100 percent closure on the first three -- A-45, Generic Issues 131 and 156; 95 percent on Generic Issues 57, 103, and 147; 80 percent on 172 and the fire risk scoping study; and 70 percent for 148.

For those issues that are not fully resolved, potential -- we don't believe the potential vulnerability was missed. They were identified as weaknesses in the plant SER. And any need for additional work on those would be addressed separately from this program.

Saying it a little bit differently, this is how it looks, so we consider this to be a success of the IPEEE program.

And I'm through all of my slides, and I didn't take an hour.

CHAIRMAN APOSTOLAKIS: Thank you. Thank you.

Alan, you have here some closing conclusions and remarks. I don't know that -- do you have anything that's new?

MR. RUBIN: The only thing that's new is the examples of the uses of IPEEE information.

CHAIRMAN APOSTOLAKIS: Maybe we could address that one.

MR. RUBIN: I think it's useful, because I think that --

CHAIRMAN APOSTOLAKIS: Sure.

MR. RUBIN: I can certainly get through this in two minutes.

CHAIRMAN APOSTOLAKIS: Okay. Good.

MR. RUBIN: Because I think you've heard the basic conclusions. Let me say that we think the IPEEE program has met the intent of the Generic Letters, and the licensees have met the four objectives that I discussed earlier today.

But let me put up the slide in this package on uses of IPEEE information. These are examples without going into much detail. First of

all, licensees have obviously, you've heard about, used the IPEEEs to make plant-specific improvements.

The second bullet -- the NRC has used these issues, as you just heard from John Ridgely, to resolve the external event related generic safety issues, a large number of them, a very large percentage of them.

The NRC, and particularly NRR, has used the results in the fire protection area to prioritize areas for plant inspection. That's both for the fire protection and the seismic areas. And you've also heard in some of the improvements areas licensees have used the results to prioritize areas for fire protection training in several cases.

Another use is that the results have provided insights to the risk importance of inspection findings. That has been used in a useful -- in the significance determination process for the reactor oversight program. Some of the results from the reviews and risk insights have been incorporated into NRC's Regulatory Guide, the comprehensive reg. guide and fire protection, Reg. Guide 1.189, and the industry's fire protection standard, NFPA 805.

MEMBER POWERS: I take it what you're saying in connection with NFPA 805 is because NRC

staff participated in the development of that and had some preliminary information on these that that somehow got folded in.

MR. RUBIN: That's correct.

MEMBER POWERS: There's no indication that having produced this report we're now going back and revise NFPA 805?

MR. RUBIN: No. It's just the insights as we went along, and particularly some of the -- you've heard the generic questions that we had on the fire protection and fire PRA implementation guide were carried out and factored into those -- that guidance document.

MR. NOWLEN: Yes. If I could elaborate a little further. This is Steve Nowlen again. The three of us who are on the Senior Review Board also participated in NFPA 805, so there was, you know, direct knowledge of what was going on from the IPEEEs, and we communicated that to the panel. And it did get incorporated, so, yes, there is a very -- very direct connection.

MR. RUBIN: And the last bullet on this page was that the results of the insights have been used to identify topics and to provide a basis to prioritize several areas of the fire risk research

program. An example is the importance of turbine building fires and some other areas that Steve Nowlen mentioned in his presentation.

One other area we had been asked by the Commission -- to look at what is the cumulative effect of exemptions to Appendix R on fire risk. The IPEEE was a basis to do that analysis, and a SECY paper was provided to the Commission in July 1999. That was SECY-99-182.

The results were also used to prioritize research needs for age-degraded structures and passive components using both insights from the IPEEE program as well as aging data from operating plants. And, finally, in the evaluation of severe accident mitigation alternatives, known as SAMAs, the IPEEE results are being used in part for that for the license renewal process.

So it's a pretty -- I think there are some uses that go beyond what we originally anticipated. But as we come to the risk-informed area we're in now for many activities these results are more useful than I probably would originally have thought when the IPEEE program was first undertaken.

CHAIRMAN APOSTOLAKIS: I'd like to go around the table, unless there is a specific question

for Alan. Thank you very much, Alan.

MR. RUBIN: Okay.

CHAIRMAN APOSTOLAKIS: There are I guess at least two questions. One is, shall we write a letter now or wait until the staff has received the public comments and responded to them? Or should we write a letter at all?

And the second is, what kind of things do we want the staff to present at the full committee meeting in July? Okay?

So shall we start with the big question. How about the letter? And then, I would also like to know, you know, if we are writing a letter what you guys think.

MEMBER POWERS: It seems to me, George, we've got to think in terms of two letters. I think in the end we're going to have to write a letter explicitly addressing the question of the Generic Safety Issues, because we have an obligation in that area. In some cases there are Generic Safety Issues.

And I don't think we can write that letter closing out the generic safety issues until the staff has got public comments back.

CHAIRMAN APOSTOLAKIS: Right.

MEMBER POWERS: Right now, I would say

that it appears to me that USI A-45, GSI-103, GSI-131, GSI-57, all can probably be declared closed, at least in a generic sense. There may be individual plants that need something.

I don't believe we can conclude that GSI-148 and 172 -- that's smoke control and multi-systems response -- can be declared closed. I think we need -- I at least need to examine more closely 147 -- that's shutdown control panel interactions, and GSI-146, that is the SEP, a little more to have an answer. But I think they will probably be declared closed with exceptions.

CHAIRMAN APOSTOLAKIS: Okay.

MEMBER POWERS: But, again, closing out those issues looks to me like that's a letter to come after the public comments have come back and been closed. And in that regard, I think that any presentation of the committee has to at least touch on a synopsis of what Mr. Ridgely presented to us very nicely. I mean, he's quick, but maybe he's a little too quick for the full committee.

But the synoptic nature of his presentation is quite fine. Just do more a status report on where they stand on those GSIs, but not --

MEMBER KRESS: Save the full presentation

for later after the public comments.

MEMBER POWERS: Yes.

MEMBER KRESS: So we'll have the --

MEMBER POWERS: Yes. But I think he -- I mean, I think you want to get --

MEMBER KRESS: We need a status report.

MEMBER POWERS: Yes. I think you need to keep the committee abreast on these GSIs, because, like I say, in some cases there are GSIs. So, you know, we raised them. We have an obligation to stay abreast of whether they're coming and what not.

I think it might be useful for us to write an interim letter at this point to the -- in connection with this study, if nothing else to help the staff highlight it as something that ought to be looked at carefully and made public comments on it, because there's no question this group of people have done a tough, tough, hard job.

I mean, I am quite impressed with what they've been able to pull together out of what could look like just a cacophony of unrelated results. And I think they've done a really nice job, produced a report -- as I call -- refreshingly frank in some of its language. They may want to refine some of that language to make sure that it really reflects what

they intended to say.

It may well be that the -- as they say that the licensees have fulfilled the objectives of the Generic Letter. I'm not sure that this is entirely demonstrable. And I call attention particularly to the simplified fragilities and the human reliability analyses that show up in the document.

Another thing I think that it's useful for us to point out in a letter is that the -- the IPEEE process really has not yielded what I would call usable risk information concerning fires and external events, usable in the sense of 1.179 determinations, and the like.

I think it highlights the diversity of the technologies available, the lack of standardization, the deficiencies of databases that afflict this general area simply because it has not received the kind of attention that it probably deserves in light of the results we're getting. And I guess that's the most overwhelming conclusion we come out of the IPEs.

Is the risk so far on the risk of external events comparable to normal operating events? They haven't received that kind of technological development that normal operating events -- and they

do highlight areas for priority research.

I think that's going to be one of the biggest values, as Mr. Rubin pointed out so nicely, that there's a lot to be mined here as far as defining what research should be done. And I think we can point -- we could help them highlight the needs that have emerged from having done this IPEEE study.

Similarly, I think, as you noted, it can highlight the challenges we face in the area of human reliability analysis and the remarkable absence of these topics in the human performance program plan, or whatever it's currently called, and what not.

But, again, I think we should offer our hardiest congratulations to the people involved in this work. I think they put in some substantial effort to pull things together as nicely as they have.

CHAIRMAN APOSTOLAKIS: Good. That's it for you.

MEMBER POWERS: That's all I can --

CHAIRMAN APOSTOLAKIS: Any other members have anything? Yes? Bill or Mario. Mario, go ahead.

VICE CHAIRMAN BONACA: I just -- I second very much the points that Dana has made regarding the GSIs and ISIs. I'm not sure about writing a letter on these documents right now before we have -- I would

rather wait for having the -- you know, the feedback from open comments.

In general, I also think that this is an amazing effort to pull together some insights from all of these massive IPEEEs which are a little bit obscure. I would like to make a couple of comments.

One is that I think the lessons learned from such a large program are somewhat limited, I mean, because the expectations of the programs were low to start with. I mean, and so there are two lessons there to me. One is that if you set somewhat lower expectations, you get, you know, a hodgepodge of information. It's hard to really get lessons out of it. And it's important -- I find some of the conclusions are speculative in my judgment.

For example, the one that -- risk for older plants and newer plants are similar I think is a reach. I mean, if you walk down most recent plants and old plants just it's hard to believe that that's true. And so some of the conclusions are speculative somewhat. I believe, however, that the text puts it in that perspective. It's clear you understand that it's a true statement.

I also believe that the value to the licensees may be somewhat overstated. I mean, when I

hear that 36 percent of submittals showed no plant improvements, and most of the others had maybe one or two, I really wonder -- and, again, it comes from the fact that the expectations set by the programs were somewhat low, and maybe we didn't get the benefit that we could have got if the expectations set were higher, like, for example, process and what you would want to see out of the program itself.

I do believe, again, that given what was submitted and developed, I think that this is a good summary, this report. But, again, I would just wait for the feedback from the industry before -- or comment before I write a letter.

CHAIRMAN APOSTOLAKIS: Bill?

MR. RUBIN: May I take 30 seconds just to clarify one point?

CHAIRMAN APOSTOLAKIS: Sure.

MR. RUBIN: I didn't get -- this is a slide that I had skipped. Overall, if you take into account the number of plants that made improvements, it was 95 percent of the plants made one improvement, either fire, seismic, or HFO area. So the number you were quoting was correct for the HFO portion, but --

CHAIRMAN APOSTOLAKIS: Well, I thought it was correct also for the fire.

MR. RUBIN: No. Fire was about 50 percent, also -- and seismic was 70 percent made improvement.

MR. NOWLEN: Individually, each area, but when you collect them all together as an IPEEE group, you know, you get like 95 percent cited at least one improvement across the board.

CHAIRMAN APOSTOLAKIS: Yes, right.

VICE CHAIRMAN BONACA: I understand. You might have an improvement that is a change, and I'm saying this is a significant program, and I just -- I don't know. I've been there, and I think that you would see much more than that. That's my judgment. Okay? And, again, I've been there, and I've seen it, and things -- so I am not impressed by the numbers.

CHAIRMAN APOSTOLAKIS: Bill?

MEMBER SHACK: Well, I'm always impressed -- you know, I like these integrated programs. You know, we have regulations one piece at a time. This is the one chance to sort of look at the whole impact of all the regulations on all the plants at least in this area.

And so I think, you know, it's kind of an integrated picture that you don't get any other way. So I think it's very important -- you know, I think

it's -- unlike Mario, I think, you know, it sort of made a fairly substantial contribution to managing risk. I mean, I got the impression that the plants learned a lot doing this. You know, they made some improvements.

I think even the quantification, with all of the problems that it has, it certainly gives you at least the picture that, you know, this is an area where we begin to prioritize, and we begin to put some emphasis on it. So I think that's an important result from it.

I think the notion of the letter -- I don't see why it can't wait until we get the public comment. But I take a much more positive spin on what was accomplished in the program.

CHAIRMAN APOSTOLAKIS: Other members? Comments? Grant? Yes.

MEMBER LEITCH: I guess my question about the improvements is I was left with the impression that not all of these improvements have been implemented. And if that is the case, I think some kind of a summary on the status of implementation would be helpful.

MEMBER POWERS: For the whole committee? Wouldn't that be kind of an arcane thing, for the

whole committee?

CHAIRMAN APOSTOLAKIS: Well, he'd like to see that sometime. That's I think what you're saying.

MR. NOWLEN: I could comment on that because it probably derived from my presentation. That is true. The status of the improvements is not always specified. In some cases we know that there were things that were under consideration, and by now may or may not have been implemented.

I think beyond what you have in the report it's going to be difficult to provide that. That would require a separate followup with the licensees to say, you know, "Gee, what did you do about these things?" And right now that's not a part of our insights work here. So it might be something for NRC to consider in the future but probably not here.

MEMBER LEITCH: And I think it also -- I think also a number of these improvements were made independent of the studies.

MR. NOWLEN: Yes. In some cases, it was difficult to be certain whether improvements they were citing were being made for other reasons and were simply being credited here by -- or whether they truly derived from the program. In some cases, people were explicit that, gee, these things we've done before

really made an impact here, but it was often difficult to tell. So, again, beyond what's in the report already, it's -- you can't say much more.

VICE CHAIRMAN BONACA: I would like to say one thing. I think I gave a message that has been interpreted as overly negative, and I really didn't intend to do that.

What I was trying to do is to say that in my judgment if some of the expectations had been a little bit stronger in the definition of the program -- for example, the way to conduct it in some respects and the expectations for what you would get out of it, I think there would have been a much higher payback than actually was possible given the definition of the program itself.

I believe that what has been produced meets the requirements and the objectives of the program. I believe that more could have been derived by a better-defined program. I'm criticizing probably what was written in the requirement for 10 years ago.

MEMBER KRESS: I think we ought to write a letter, and I see no good reason to wait until public comments. I think we can go ahead and write the letter now while the subject is hot. It's going to be tough to figure out how to squeeze all of this

into a couple-hour presentation, but I think now is the time to write a letter.

And I think it should be a relatively positive letter from the standpoint of the -- of the nice job they did. And I think I agree that it did meet most of the -- it did meet the requirements for the IPEEE.

I think there are lessons that could be learned that are in addition to the ones they already learned. Number one, I really like the slide that highlighted the research needs with respect to PRAs. And I think that's a good one.

But I -- one of the things that struck me that we didn't dwell on very much was the fact that the plant age in terms of when it was constructing the license didn't seem to make a damn bit of difference on the bottom line CDF. That was a surprise to me.

I worried for years that here we've got plants that are licensed under different requirements, and you have to tolerate that. They require each plant to be updated to all of their new requirements all the time, and I worried about the older plants being under different requirements, might not be the right -- not be up to par.

Well, this kind of puts -- this puts this

in terms of external events -- it went against my intuition. I would like to understand it more, and I wonder also if it's true for internal events. That it doesn't matter.

MEMBER POWERS: I think I would be more excited about the conclusion if some legitimate regression analysis had been done that -- you know, the similarity in the plots may be reflecting compensating errors or compensating differences. And it would be nice to see if you could do something --

MEMBER KRESS: I would like to see more done on that.

And the other thing that I was looking for and really didn't see was that when you have seismic for -- in particular, it bothers me that we think a CDF, for example, of equal magnitude to the internal events might be acceptable, because I suspect you're compromising emergency response at the same time.

And this is one set of sequences that it has high uncertainty to it, in my mind. And it worries me that we don't feel a little -- I worry more about those kind of things, especially when I see it of equal magnitude. So that didn't give me a lot of comfort that it was just of equal magnitude. I would like to have seen it much lower.

And I don't know -- you know, I don't know if -- these are just thoughts. I don't know if they're worth bringing up. You know, I would have expected to see a lot more defense in depth associated with things like that.

CHAIRMAN APOSTOLAKIS: No. But, I mean, if you wanted to talk about these sequences, these are usually very strong earthquakes. And the fact that perhaps the surrounding communities will not exist anymore is also a fact.

MEMBER POWERS: Well --

CHAIRMAN APOSTOLAKIS: I mean, even though we regulate on -- I mean, it's a fact that if you go to .5 g, there will be nobody to evacuate.

MEMBER POWERS: Well, I'd caution you that there is not a surrounding community. The nearest town can't exceed a population of 25,000. So it's not like these plants are out in an empty field.

MEMBER KRESS: Except for one and two plants, you're right.

And last but not least, I think it's worth pointing out that I don't really think these results are highly useful for risk-informing the regulations, although there are some things you could -- some insights you can draw, but I don't think they're

highly useful.

MEMBER POWERS: I think the only thing they tell you is that to risk inform them we're going to have to look farther than just the normal operating.

MEMBER KRESS: I think that's what you learned mostly for it.

CHAIRMAN APOSTOLAKIS: Okay. Graham, you didn't have a chance to tell us whether you want a letter or not.

MEMBER KRESS: Oh, I'm sorry, Graham.

MEMBER LEITCH: Oh, the letter? I don't see any problem with writing the letter now. I mean, I have no problem with writing the letter now.

CHAIRMAN APOSTOLAKIS: I'd rather have it at the end, but -- when is the end of the public comment period?

MR. RUBIN: July 31st is the end of the public comment period.

CHAIRMAN APOSTOLAKIS: So we will have to write it in September, then, if --

MEMBER POWERS: Well, they'll get the public comments, and they'll have to resolve it.

CHAIRMAN APOSTOLAKIS: Oh, they have to resolve them.

MR. RUBIN: We have to resolve them.

MEMBER POWERS: I mean, if we -- it seems to me that if we've got things that we want them to take into account when they do the resolution we ought to write something.

CHAIRMAN APOSTOLAKIS: Are we then commenting just as a public stakeholder planning to influence the final report? Or are we commenting on the overall project/program?

MEMBER POWERS: No. I think we want to comment on the -- we want to give them the sort of stuff that they might want to address as they go looking at it and revising it.

CHAIRMAN APOSTOLAKIS: Well, that's certainly one point of view. And I think that would be arguing for writing a letter now.

Okay. So anything else?

Okay. Thank you very much, gentlemen. It was a very good effort -- seven presentations.

Thank you, members, for being here, and we will see you again in a couple of weeks.

(Whereupon, at 4:04 p.m., the proceedings in the foregoing matter were adjourned.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Reactor Safeguards - Subcommittee on Reliability and Probabilistic Risk Assessment

Docket Number: n/a

Location: Rockville, Maryland

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Rebecca Davis
Official Reporter
Neal R. Gross & Co., Inc.