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NUCLEAR REGULATORY COMMISSION

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HIGH ENERGY ARCING FAULT LARGE-SCALE TEST PLAN

COMMENT RESOLUTION

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WEDNESDAY,

MARCH 20, 2019

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ROCKVILLE, MARYLAND

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The public meeting was held in Room O-11B04, Nuclear Regulatory Commission, One White Flint North, 11555 Rockville Pike, at 1:00 p.m., Mike Cheok, Deputy Director, Division of Inspection and Regional Support, presiding.

NRC STAFF PRESENT:

MIKE CHEOK, Office of Research

TOM BOYCE, Generic Issues Program Manager, Office of Research

STAN GARDOCKI, Generic Issue Program, Office of Research

KENNETH HAMBURGER, Office of Research

NICK MELLY, Office of Research

BRIAN METZGER, NRR Fire Protection

KENN MILLER, Office of Research

MARK SALLEY, Office of Research

GABE TAYLOR, Office of Research

MARK THAGGARD, Office of Research

ALSO PRESENT:

VICTORIA ANDERSON, NEI

JANA BERGMAN

PAUL GUNTER, Beyond Nuclear

CHRIS LAFLEUR, Sandia National Laboratories*

CASEY LEJA

CHICO PELIZZARI*

TONY PURTORTI, NIST*

MARKO RANDELOVIC, EPRI

RONNIE REYNOLDS, Exelon

MIKE SHAIRER*

OZZIE VIDAL*

KELLI VOELSING, EPRI

*present by telephone

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

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

12:56 p.m.

MR. CHEOK: Thank you for coming today. As you know this is a series of -- one in a series of public meetings. We will -- we had and will continue to have -- talk about the aluminum HEAF generic issue. Again, these meetings that we have periodically -- in between meetings we will continue to work in the work group with EPRI on things like the testing procedures, comments on doing risk analysis, on doing frequency determinations, and we'll continue to have these public meetings to basically inform everybody else what we do on -- on what we're doing and to get comments in a public forum.

So today's meeting is mostly to hear any additional public comments we have. We intend to be mostly in a listening mode because I don't think -- we got some of the comments beforehand, but at this point I think we want to listen to what you all have. And we'll offer a second meeting to be able to come back and respond to any comments you may have.

And the one thing I want to say is we have to keep in mind that this generic issue process is about, right? So we would like to have a schedule or type of -- we would like to finish things in a certain

schedule. And also as part of the generic issue process it's not -- we don't intent for a lot of things to be research projects as such. And so we will listen to all the comments on doing testing. We will try to incorporate them without having to impact on our schedules by too much. Plus we don't want this generic issue to continue for a long time. We would like to get it finished in time that we will -- it's supposed to get finished by.

And so we will try to incorporate a lot of the comments as much as we can and we'll keep everybody involved. And we will keep you updated as to what our responses would be and we will get your feedback into our responses. So it will be a continuing feedback process.

So with that I'll just let --

MR. SALLEY: Okay. So I guess -- good, Mike. Thank you. I want to give -- just give you a quick overview of this, and the meeting is for you all, so we'll turn it over to you. We'll just do a little quick intro, or a quick overview of the project.

As we've been going through and doing the testing we've tried to be as transparent as possible in both the large and the small-scale test plans.

We've put those out in the *Federal Register* notice and we've asked for public comments. And you can just see just a sample there of some of the comments we have received. You'll notice the OECD ones there that we also have a follow-on project that we're doing internationally with 10 countries to further look at HEAFs in total.

Again, a lot of the comments we received a lot of interest, and it's a little bit of a hard problem because we don't have an easy test standard. We just can't pull a test standard off the shelf and here is the IEEE or NFPA how to test a HEAF and get all the information you need, much like a fire barrier or something simple, penetration seal. So we're having to put the test plan together and do it as we move along.

There's an IEEE standard on arc faults. I believe it's C37.20.7, and that's a good starting point and it helped us out with some of the things like the shorting wire, where to locate it, the size, the ASTM slug for the calorimetry, but we're also relying heavily on the National Institute of Standards and Technology, NIST. Their thing is measurement. They've got a whole fire measurement laboratory to work with us.

We're also reaching to Sandia to get some of the experience from Sandia to help us put this together. And most recently we've been working very closely with EPRI under the MOU to again bring additional talent to this to bring this together.

So that's a little bit by way of background and our transparency. And another step to the transparency is the comments that we've gone through. We actually made the dispositions in that and publicly released it. You can see the ML number there for that.

January we held a public meeting. Kenny did a very nice job of putting the package together. Again, the ML number is there. It's in the presentation and you can download everything from the public meeting. And one of the things we walked away from with the public meeting was that -- Victoria, you asked that we'd have more interaction, which is the purpose for today's meeting, to have additional interaction to discuss the testing.

Kelly?

MS. VOELSING: Mark, I was wondering if I could ask on the -- I realize we're talking about comments on testing on a test plan that already occurred and Mike mentioned -- you know, you mentioned

timeliness and transparency, but as far as I know we still haven't seen any data or results from a previous testing. So where are we on that?

MR. MELLY: We have put -- at least as far as the working group is concerned, we put a lot of the raw data associated with the temperature probes, the -- from NIST onto the Box sharing site that we're using collaboratively. There are certain aspects of the testing that occurred in September where -- that we have not fully processed all the data yet to put onto that Box site, primarily in terms of the conductivity sampling as to the carbon tape and the Aerogel probes.

A lot of that hasn't been done yet because we wanted to identify how it was going to be used in the modeling space before we do a lot of the resource-intensive legwork of actually processing all that data. We wanted to -- it to inform our modeling and before we figured how we're going to incorporate it in the modeling. We didn't want to just go batch and sample 200 or so sampling points because we used a lot of different locations to collect data. We want to make sure that we're using the smartest technique to process that data.

MS. VOELSING: But some of it's pretty

fundamental and easy material characterization testing that hasn't been done.

MR. MELLY: Some of it is.

MS. VOELSING: And it seems pretty important to informing future comments on future testing.

MR. MELLY: Yes, and we've done some preliminary work to putting it out, but it hasn't been processed in totality yet. So we haven't put it on the Box.

MS. VOELSING: Is there a timeline for that?

MR. MELLY: Gabe, is there a timeline?

MR. TAYLOR: No, like Nick said, the modeling is driving the analysis, so the preliminary stuff is on the Box, everything that we have.

MS. VOELSING: And what about the data that was lost or missing?

MR. TAYLOR: So there was data lost during one of the experiments due to human error, so we won't capture that data. There was an issue with the data acquisition.

MR. MELLY: And we have addressed that with the test laboratory as to how to prevent that moving forward. It happened in one out of the three

of -- or one out of four of the days. We -- essentially human error. Someone pressed the button twice to record the data and we did not record the data for the AASTM probes for that test.

We did have redundant data from the NIST thermocouples as well as tungsten slugs, however, that was on one of the test days with the largest energy release, so some of their data was lost due to damaging the instrumentation wire and things like that. So it was unfortunate that the NIST -- or that the KEMA data was also lost on that day. But we're dealing with all of that as it comes in and I believe the raw data from KEMA has been shared on the Box site as well.

MS. VOELSING: I think it would be very helpful if we could list all the types of data that you're expecting and whether or not you currently have plans to analyze it and when we expect results to be available. And then we could comment and say, well, we understand that modeling is driving it, but we think this one is really important to our future comments if -- and understand when there's a plan to have that information available.

MR. MELLY: Okay.

MR. TAYLOR: Kelli, I just got feedback

from people on the phone. They're having trouble hearing us --

MS. VOELSING: Oh, sorry.

MR. TAYLOR: -- so if we can move up closer.

MS. VOELSING: Might have trouble hearing me anyway.

MR. MELLY: Moving forward if we had comments from outside the room, I'll try and repeat them for the folks on the phone.

MR. SALLEY: Yes, and Kenny's going to keep a running tab here of what we get at the meeting as far as comments and such, so you'll see him going back and forth to screen.

And, Kelli, that's a valid point. And again, we had human error with some of the operators that came on one of the biggest tests, which is -- it hurts us a bit as well as we lost I believe some of the NIST data, too, with -- we actually burned through our leads.

MR. MELLY: Yes.

MR. SALLEY: -- which anybody who made the RIC, if you saw the presentations from Sandia that Anthony made on using the video as data, that will be a third source of information. Hopefully we'll be

able to recover some of this from Sandia's video. So again, we're looking at it from multiple points.

MR. MELLY: But as part of the working group with EPRI we did identify a lot of action items that came out of our in-person meeting. That wasn't one of the primary ones, but maybe it's one that we need to add as to establishing a firm timeline for measurements taken and when data will be available on the Box web site.

MS. VOELSING: Yes, Marko and I were just talking about it this morning. And I understand this meeting we're really talking about comments that have already been provided and how those comments are dispositioned and are we all in alignment, but we were just kind of discussing -- we kind of have to reserve the right to say -- our comments are out there until we seen some of the test results that we haven't seen at all yet. So that was the reason for asking the question.

MR. MELLY: Right.

MR. CHEOK: Fair enough.

MR. TAYLOR: Can I ask a question?

MR. SALLEY: Sure, Gabe.

MR. TAYLOR: So is there any test data in particular that you're interested in?

MS. VOELSING: Material characterization.

MR. TAYLOR: Right. So what type of characterization are you looking for because if you look at the small-scale tests, I mean, there is probably six or seven different analysis techniques that they can do it and characterize various aspects of the particles. So maybe if we'd get some feedback on exactly what are you looking for and where, is it near-field, far-field, that might help us better prioritize getting certain data sets together. So if we could work on that.

MS. ANDERSON: I mean, I think chemical composition was the big one, right? Like the chemical composition we'd want both near-field and far-field. I mean --

MR. TAYLOR: Right, and there's different ways to analyze that. So if you said you wanted to use a scanning electron microscope or whatever the other approaches were, that would help us better prioritize. But I don't need an answer right now.

MS. ANDERSON: I don't know if we've gotten from -- I don't know if that's been presented to -- like I don't -- I mean, maybe that's presented in the working group, like here --

MR. MELLY: It was in the small scale.

Small scale tested it.

MS. ANDERSON: -- are the analysis techniques available.

MR. TAYLOR: It was in the small-scale test plan, but the methods have been available. So if you could get back to us on exactly what you're looking for: size, speed, species, whatever it is, we can kind of see how we'd move forward.

MR. SALLEY: So picking it back up, as we look at the operating experience on the HEAFs, again the root cause and what we've seen looking at different events, there's a number of different failures that can influence the test and how it is performed. Again, with our testing is we're trying to generate data to better understand the physics and the phenomena of the high energy arc fault which we're working with Sandia to hopefully have a model that we can dial in.

Right now the way we're doing it with 6850, Appendix M, it's the 2001 SONGS events, so it's a one-size-fits-all. We believe we can do a much better resolution with this if we get a good model and we inform it.

Again, with just these -- some of the failures; and you've seen these if you've looked at

the OpE, there's also a variation in electrical equipment, and that's something that we need to think about.

Next slide. Previously we talked a lot about duration, so I really don't want to dwell on that, but we did again look at the OpE and for the low and medium-voltage we can see that the duration is more than milliseconds in cycles, that the HEAF is unique because we are looking at some form of failure where it stays locked in.

Next slide. A question or a comment we had from some of the industry execs was to get the risk piece up front. And of course that starts looking at things like the frequency of the event. Again, working with EPRI; Kelli, you probably know more about this than I do, is getting this together with the frequency of it.

One way that we're trying to work a lot smarter than we did in 6850 was with Bin 15 was so inclusive of electrical enclosures that the HEAFs were trying to subdivide different things with that so that we can get a more defined resolution of the HEAF events.

Kelli?

MS. VOELSING: I was going to say that

would -- I think the working group has made good progress on this one. I've been hearing good discussions going on and good alignment. And we definitely think the frequency is a piece of it --

MR. SALLEY: Definitely.

MS. VOELSING: -- but the frequency is not going to allow us to evaluate risk without an appropriate zone of influence. So it's only one piece of it and we still have to have the zone of influence in order to evaluate the risk.

MR. SALLEY: We agree.

MR. CHEOK: So I think I agree with you all that the frequency is really important and the zone of influence is just as important. And what I said earlier was I think when we comment on the test schemes and things like that, I think we might want to focus on comments on the testing that would jive with the frequencies of the HEAFs.

So in other words, I know when I talk to Nick or Gabe and we're talking about some test parameters and I -- my question to them always has been, okay, so in the end -- or to guide us we still will need to get the risk out of this. So to get a risk out of this we need to have some frequency definitions to be consistent with the parameters of

the test.

So in other words, so let's do tests that are now consistent with how we are going to be defining the frequencies. I mean, that's kind of what I meant by let's focus our comments on getting the test parameters and the test characteristics so that we can match the frequency.

MS. VOELSING: The intention was considering -- start with the end in mind --

MR. CHEOK: Yes.

MS. VOELSING: -- and considering that up front. Absolutely I'm in agreement with that. I just was concerned when you said we got a -- an the executive for saying we need to calculate the risk up front. I was pointing out that we're still going to need the zone of influence.

MR. CHEOK: Yes.

MR. SALLEY: Next slide. And moving along, again with the testing, too, and we want to do the testing in the most realistic manner as possible. A couple things here that -- with our test program we're not trying to recreate any specific event. We're not trying to say, okay, SONGS 2001, let's recreate this failure and see if we can do that.

Now that's a little bit different than

what our colleagues in Japan are doing. We're working very close with our colleagues in Japan. And their thing of course is the Onagawa event. And they really want to understand that and they tend to really want to focus in on that one event.

Ours is a little more macroscopic rather than microscope, looking at a specific event, to look at a larger phenomenon of HEAF, but still we want to stay grounded that when we do our testing there's a form of realism to it, that it's a realistic test. And looking at some of the post-test photos we can see that we think we're achieving that.

Next slide, Kenny.

MS. ANDERSON: I mean, don't think you can necessarily just look at photos and say that the testing -- that that proves that the testing was realistic just because the visual end-state might kind of be similar. Maybe your eyeballs are better than mine, but I don't think you can discern that the inputs and the conditions were necessarily reflective of realism just because it looks the same.

MR. SALLEY: You're absolutely right, miss, and you can take a look at this next test for example when we get to bus ducts. There's no way the KEMA facility can generate the power that a nuclear

power plant can, so we can never achieve those types of events.

An important thing with the -- you can see the damage in the duct. And important thing too and what we learned with the Zion bus is we had copper buses and we thought, okay, we're good with the copper, but then it migrated to the aluminum. So we saw that phenomena there that brought that to the forefront.

Next slide. Again, the latest thing is; and we talked about this in January, was that we were teaming up under the MOU with EPRI to bring all the best people together to work on this. We have the group in place. In February they spent a week together and had a full week-long meeting. I think a lot of good stuff got accomplished; a lot of your frequency stuff, Kelli, as well as starting to look at the physical models of this. So that's working well.

And I want to close up just on a final note here and I guess compliment EPRI on a document that was released last week. It's EPRI Technical Update 3002015459. It's publicly available. It's titled The Critical Maintenance Insights on Preventing High Energy Arc Faults dated March 15th, 2019. And I see that as a very, very positive step moving forward.

And again, we've heard from a lot of the executives at different RIS meetings that prevention is very key. Really want to -- the real success of HEAF is you could possibly do a very good job preventing them. I believe this is a step in the right direction. And if you think back, when we had the last Fire Forum in Charlotte I believe in 2017, we talked about -- one of the things was a long-term solution to HEAF. And again, and the way we do business it's a defense-in-depth and I believe this comes into the first layer of prevention where we talk about things like safe work practices, maintenance and arc-proof cabinets, if needed, but that prevention element.

So again, Kelli, I think your folks did a really good job getting that out and it's very timely.

So that's kind of the 10,000-foot quick overview. And again, this is your meeting, so with that I will turn it -- Marko, I believe you have some stuff on the working group?

MR. RANDELOVIC: Yes. So my name is Marko Randelovic. I am senior technical leader for EPRI.

MR. CHEOK: Mr. Marko, would you please go on -- can we go around the room and just identify everybody for -- since we didn't do that? We did

it --

MR. HAMBURGER: Sure.

MR. CHEOK: -- for the phone people, but not the room people.

MR. HAMBURGER: Sure. We'll go around the room and everybody will please state their name and what organization who you're here representing. Start with the outside.

MS. VOELSING: Kelli Voelsing with EPRI.

MS. BERGMAN: Jana Bergman.

MR. LEJA: Casey Leja, electrical for Exelon.

MR. THAGGARD: Mark Thaggard, NRC, Office of Research.

MR. BOYCE: Tom Boyce, NRC, Office of Research, Generic Issues Program Manager.

MR. GARDOCKI: Stan Gardocki, Generic Issues Program.

MR. METZGER: Brian Metzger, NRR Fire Protection.

MR. GUNTER: Paul Gunter, Beyond Nuclear.

MR. MILLER: Kenn Miller, NRC, Office of Research, Electrical Engineering.

MR. TAYLOR: Gabe Taylor, Office of Research.

MR. CHEOK: Mike Cheok, Office of Research.

MR. MELLY: Nick Melly, Office of Research.

MR. SALLEY: Mark Henry Salley, Office of Research.

MR. HAMBURGER: Kenny Hamburger, Office of Research.

MR. REYNOLDS: Ron Reynolds, Exelon.

MR. RANDELOVIC: Marko Randelovic, EPRI, Risk and Safety Management.

MS. ANDERSON: Victoria Anderson, NEI.

MR. HAMBURGER: Okay. So, Marko, back to you.

MR. RANDELOVIC: Okay. So I prepared couple of slides to go through the status of the resolution of EPRI's comments that we have been working on with the NRC Research for the last couple of months. And since the effort kind of required significant collaboration between EPRI and NRC, I welcome Nick jumping in the presentation and provide some additional details as we are discussing different items.

So we initially had 29 comments and 25 out of 29 comments were addressed and resolved. There

were four comments that were left and needed additional discussions between us. Since the initial review EPRI has done additional research on the HEAF events in the U.S. and with that growing state of knowledge we had some additional recommendations and suggestions for the next round of testing.

So with the old comments and the new suggestions we decided to schedule a workshop in February. We had colleagues from the NRC Research, EPRI, industry experts, electrical, fire PRAs. We had Sandia. And we worked for four days on different topics including heat frequency and the testing. And overall the meeting was very productive. I was -- I personally liked the dynamics between members and we ended up following the meeting assigning the action items and we are making good progress regarding the testing setup and the next testing.

MR. MELLY: Yes, and these -- the working group meeting, the in-person meeting did go very well and there were a lot of issues that needed to be discussed kind of on a technical level in a lot more detail than can be done in a simple -- here's our comment to the test plan, here's a response to the test plan. So we went over each of these four comments that were previously on that comment

resolution sheet in a lot of detail. We discussed working group consensus moving forward and we discussed kind of how we're addressing those comments either explaining what NRC Research is doing, how it relates to the test plan or ways that we can answer those questions.

So we will be making that discussion and the elaborate -- or elaboration of those issues publicly available post-this type of meeting once we have NEI's issues also more well-understood.

So we can move on.

MR. RADELOVIC: To go to the next slide, yes.

So here are the four comments that required additional discussions where we actually brought more technical research and findings. So the first one was EPRI's position -- initially EPRI's position was that -- measuring the end-state of the combustion cloud may not be sufficient to really characterize the electrical properties of the fine particles as they travel. And we suggested that we perform the dynamic conductivity measurement.

So in the same time while we were looking into this the NRC Research, the Testing Team has already been looking into that. So when we met at the

workshop the Testing Team had already had a design in mind and we discussed the performance of the conductivity probes, the issues that we might be facing and how to interpret the results.

So, Nick, if you want to provide some updates and --

MR. MELLY: Yes, this gets back to an issue we were discussing earlier as to what are the material properties of the ejecta that we're seeing on these carbon tape samples or the Aerogel samples, or is there a better way to measure the conductivity of the cloud, of the ejected material from one of these events and to figure out if it's going to have an impact on other electrical systems within the room, either energized or relay cards or things like that.

So we were trying to enhance the way that we're doing our measurement techniques in terms of gaining conductivity results either in a delta format or static or dynamic, or what are better ways that we can assess the condition if we had a conductive environment.

So on the screen here we say that we do have a need for dynamic conductivity measurements. We've been talking with NIST and other -- and Sandia and we're trying to work out the kinks of how we can

do that. We have presented some ways that we can move the conductivity measurement forward. And EPRI also volunteered a conductivity type of approach for an alternate power supply that they'll be discussing later in the presentation which we think could be valuable to getting more information as to the environment in a HEAF event.

So we'll dive into that a little bit later, but it's something we are actively moving forward and we're enhancing the test plan to focus on this area.

MR. SALLEY: You know, one thing, if I could add to it, the dynamic measurement is going to be very difficult. The after-test measure is a lot more doable, and again it's a lot more cost-effective. We've reached out in the past week or so to our electrical colleagues. Kenn Miller is here and Tom Koshy who have a lot of experience with this and they have some ideas and some suggestions on how we could analyze this for conductivity. We're trying to get that together with Tom; he's in an IEEE meeting in Germany, when he gets back. And we're going to work with Sandia to just try some proof of concept, if you will.

Again, this is an area where not a lot has

been done. So we're trying that and when we find that out, we'll be sharing it with the working group.

MR. RANDELOVIC: So, yes, because of that lack of experience regarding the conductivity probes, how they perform, how to read the results, how to make sense of the results, we kind of took an option to design a mock switchgear. I actually have a slide on this, to be more representative of what we are seeing in the plant. And we -- I will explain a little bit later.

The second comment was regarding the methodologies for the evaluation of the zone of influence and the fragility assessment for cable trays, cables and electrical components. We -- the working group has not seen at that point the methodology, how we are going to use the test data to establish this. So we wanted to have a little bit more input from the NRC Research and Sandia on how the data will be used. And so, Sandia had a presentation and NRC Research presented the overall methodology, which sounded reasonable.

Nick, if you want to --

MR. MELLY: Yes, this gets down to linking the data that we received from the modeling in terms of our heat flux that we're receiving at our

measurement devices to a fragility or a target fragility, which was ranked high in the PIRT assessment as to I have a heat flux from my measured test. How do I link that with am I going to damage a cable?

We know there are thermal response times to damaging cable in and of itself, and we're talking about a quick temperature rise, a quick influx of heat. So we're going to be working with Sandia to link the data that we're receiving from testing to fragility assessment stages either using their solar tower facility or other techniques that Sandia has available to them to do more of a small-scale testing approach to link the data that we receive from actual testing to fragility values.

We're currently in the contractual phase, right, Gabe --

MR. TAYLOR: Yes.

MR. MELLY: -- to get this out the door and we're going to be sharing all that information with EPRI and the working group as we move it forward.

MS. VOELSING: Will that information on the front end include a V&V plan for how this model is going to be validated?

MR. MELLY: Do we have a V&V plan right

now?

MR. TAYLOR: We don't even have their proposal yet on the models, how they're going to be modified. I mean, the models that they currently have do give V&V, so until we have their proposal we can't really answer your question.

MS. VOELSING: Okay. But I would think as part of planning this that there would need to be a plan for how V&V those models for the specific application that you're planning to use it for.

MR. TAYLOR: Right.

MS. VOELSING: And you need to know what that looks like so that you collect the right data to support that. So I'm just saying V&V has got to be considered on the front end.

MR. MELLY: Yes, absolutely. And this is actually an item that came up during the working group. We wanted to make sure that we did have a V&V approach in there.

And, Chris, I don't know if you're -- you want to elaborate a little bit on this as to the V&V that is publicly available on the models that we were discussing using.

MS. LAFLEUR: Yes, this is Chris. Yes, our Aria programmer has told me that he'll be sending

me publicly available V&V documentation. And I'll forward that to the working group and put it on that Box so that it's available to everyone.

MR. SALLEY: There's also another data point, too, as an alternative to this. We've talked with NIST. If you remember Kevin McGrattan and the Carroll Fire Program created the THIEF model that we use for cable fragility for the standard fire dynamics. We've met with Kevin and we've asked him to look at the process that he developed THIEF with, if there's something he could do similar to HEAF -- for HEAF. So again, NIST as an alternative is also looking at this.

MR. RANDELOVIC: So the overall outline on how we are using -- going to use the data to what the codes should do and how they would perform as I said is reasonable. Now the work has to be done and we have to see how these codes are working, how they are benchmarked, and that is an important step and that would be under the purview of the working group who would be following each step as the process goes.

The next comment was regarding the extrapolation of the low-voltage test results to medium-voltage switchgear testing. Our comment was that because the energy levels are different between

medium-voltage and high-voltage. The geometry. The load center is in the switchgears are not exactly the same and we were just -- we want more discussion and details on how -- what this approach looks like and so that we can judge if it's feasible or not.

Nick and the NRC provided a high-level approach.

Nick, if you want to explain a little bit?

MR. MELLY: Yes, we just kind of just at the working group meeting discussed how we were planning on using the eight-second low-voltage test to -- as a data point to inform the medium-voltage longer duration test because KEMA doesn't have the ability to test at longer duration for medium-voltage. It's not something that we can do as a one-to-one evaluation because there are a lot of things to take into consideration: the differences in power levels, the differences in the arc voltage itself.

So this isn't a simple approach and it's something that we're going to be relying on the working group to evaluate the data to see if this is even feasible or possible once we have the data.

So we do understand the hesitation with saying that this longer-duration, low-voltage test]KC be directly comparable to a medium-voltage test and we're not recommending that that's how we look at

things. We're going to be getting the data from this test and making the decision can this be used at all in an extrapolation method?

Some of the other interesting things that came out of the working group was that we had a lot of discussion that these low-duration -- or I'm sorry, these low-voltage, longer-duration events are relatively rare or not feasible, but from looking at the operating experience we actually did find several events. The Fort Calhoun event lasted 42 seconds. And there was also a -- I believe it was -- was it Robinson? No, it wasn't Robinson. The River Bend event we identified a low-voltage event that had been previously missed, classified as a medium-voltage event that actually did last for 12 seconds.

So we are seeing that this eight seconds for low-voltage may be appropriate. And one of the other action items we were taking into account is let's look at the realistic current value that we can expect if we have a stuck-in, low-voltage event. So we're trying to take that into account when performing the testing. It may be at a lower current and it could be based on the set points of the breaker themselves. So that actually gets to the next point.

MR. RANDELOVIC: That does get to the next point.

MR. MELLY: Yes.

MR. RANDELOVIC: So that we are investing currently those events and if the current is low, we agree that the next round of tests we'll basically replicate what we are seeing in the OE. So it should be fairly prototypical.

MR. MELLY: Yes.

MR. RANDELOVIC: Next slide.

MR. MELLY: And so those are the easy comments. Those the ones that were previously --

(Simultaneous speaking.)

MR. RANDELOVIC: Those are the previous ones.

MR. MELLY: Now there's a whole new set of new ones that we'll address. This was a very productive meeting. It was four full days of discussion.

MR. RANDELOVIC: As I said, as we -- EPRI was investigating and digging deeper into the operating experience and the HEAF events in the U.S., we actually learned a lot and formed the technical basis for some recommendations regarding the test changes and regarding the use of the additional

instrumentation. So we -- during the workshop we brought the technical basis with us and we discussed with the team the proposed changes for the medium-voltage test configuration and fault location; and I have a slide on this, and the low-voltage load center test design.

And as I said, the conductivity probes, we have low state of knowledge on how they perform and what kind of data we can gather from them. So EPRI took a lead on designing the representative energized mock switchgear that would be used for the measurement of the conductivity in the combustion cloud. So we are providing the support for design and for the technical specification. And as I said, the working group acknowledge the need and the value for such a device.

Next slide, please. So research on the medium-voltage switchgear suggests that the majority of the medium-voltage switchgear events occurred in the supply switchgear configuration and the majority of the faults occurred at the supply breaker stabs and the main bus bars. So you can see on the figure -- I'm sorry for those on the phone. So we have the arrows where it shows that the -- where the majority of the faults occurred.

So our recommendations to the Testing Team is to perform at least one test with the arc wire on the main bus bars in order to replicate the majority of those events and to be able to understand the difference in geometry in the arc itself and the importance of the cubicle where the arc is located because currently we have the tests with the arc wire and the main bus bars on the -- the bus bars over here. What we're suggesting is to raise the arc wire over here to perform a test and to see the differences. Is there any difference in the zone of influence or the arc behaviors, arc dynamics?

MR. MELLY: Yes, so this one is kind of on the cutting room floor. We identified this at this workshop and we put some more work into looking into this. And the NRC is looking right now at the feasibility of doing a confirmatory test to see is this a primary impact driver for what the zone of influence or the resultant energy release could be?

So we are looking into how we can reconfigure one of the cabinets that we tested in September. In a future test in a confirmatory manner see is this really going to drive a difference in the energy release? It's kind of flipping where we put the power from our test facility into the cabinet

itself and then switching the arc location. So we are going to look into is this possible in terms of how much money we have to do testing, timeline of testing, availability, knowing that there's a limited number of tests we can do. There's limited budget. And what are our primary interests in testings?

One thing we're not talking about here is we also have already said that our spare tests and the test matrix were going to be used to evaluate the decrement curve approach. So right now we're looking into that decrement curve and the additional tests that we've already budgeted for is do we need four decrement curve tests? Can we do two decrement curve tests and maybe do two confirmatory tests? Or what other tests in our current budget can be used in a confirmatory nature when issues like this come up?

MR. RANDELOVIC: At the end we will have to do the tests that satisfy and then remove any uncertainties in how the data could be used in the actual replication.

MR. MELLY: Yes.

MR. RANDELOVIC: If we can justify technically that not doing a test -- not to do the test because we have a strong technical justification, then the working group will decide and we can proceed.

But if we feel that we don't have enough knowledge to explain the differences, then again we will have to evaluate at the working group level and how to proceed.

MR. CHEOK: So, Marko, thank you for that. I think when you heard Nick say confirmatory test, that's kind of what I was alluding to. I don't think we can afford money-wise or time-wise to replicate all our previous tests moving the location of the arc. I think we -- let's do one confirmatory test, too --

MR. MELLY: Yes.

MR. CHEOK: -- to see if this is going to have an effect before we move forward. For now the working group suggests only one confirmatory test on the main bus bar location. And then I think from there we can look at the differences between these two locations and we can determine if there is a big difference. If there is no big difference, then it's -- could be okay.

MR. TAYLOR: Do we know how common it is for those main buses to be aluminum versus copper? Because that might also influence whether we test with the OECD Program or the ones we're sponsoring.

MS. ANDERSON: I thought it was pretty uncommon.

MR. RANDELOVIC: So you have two. So you have the aluminum and you have copper. I just can't tell you how --

MR. TAYLOR: That's -- I just --

MR. RANDELOVIC: -- how many plants have the bus bars, aluminum or copper. I don't have that information yet.

MR. TAYLOR: I mean, if we could get that information, I think --

PARTICIPANT: We didn't do a study?

MS. ANDERSON: Yes, I thought it wasn't that many.

PARTICIPANT: It wasn't that many.

MR. REYNOLDS: No, there should be no copper on a main bus bar.

MS. VOELSING: Yes, on the supply side it was mostly all copper and some on the right side had aluminum bus bars. There are a few but copper is still predominant. But that doesn't mean --

MR. TAYLOR: I mean, it would help us just to determine what tests we should do that, one with the copper and one versus -- sorry, one with the aluminum, because when we were looking at procuring the low-voltage stuff, we had a piece of gear that -- it was a split. It was half copper and half aluminum.

And from the vendor they said that's a pretty common design. Now this was low-volt. It was not medium-volt. So I mean, it would help us out if we could --

MR. RANDELOVIC: We can bring this at the working group level and we would investigate.

MR. MELLY: Yes, it could also help our understanding of is this an issue that we want to handle in testing configuration space or is this something that we think we can handle in the modeling space? So can we account for the fact that will I have copper in -- on the supply side or look at a cabinet configuration-wise and I will only have copper on my breaker? So maybe the aluminum --

MS. VOELSING: But aren't you tuning the model for accurate testing?

MR. MELLY: No, because if we tune the model to say that I have only copper in the breaker stabs -- so the data that's -- I'm gathering from aluminum, if I look at my cabinet in a different aspect, I don't want to apply aluminum-type zone of influence to my breaker cubicle itself if I know I don't have aluminum there.

MS. VOELSING: You're going to need a copper zone of influence, too.

MR. MELLY: And we think that we have data

from the Test Series 1 to inform the model for copper-initiated arcs.

MS. VOELSING: Then why haven't we already validated the model and verified that this all work before we move forward with testing?

MR. MELLY: It's being done as we speak.

MS. VOELSING: But you don't have a V&V test plan.

MR. MELLY: All of it is -- this is ally running in parallel right now.

MR. SALLEY: I'll caution you, too, to mixing the different materials up and go back and look at Test 26 from the first phase, the Zion bus duct, because that was one that caught us looking where we had copper conductors, if we had the aluminum enclosure, and we saw the interaction between the copper and the aluminum. So the answer may not be obvious.

MR. REYNOLDS: What's the weight of actual location of the arc as opposed -- like you're showing? What weight is put on that in respect to testing?

MR. MELLY: As a parameter of interest when we look at this the aspect of the PIRT it wasn't a very important factor. The breakers locked in in testing, so whether we come in from the rear or the

front of a cabinet, in my opinion I don't think it will have a very large impact. It will affect the directionality of the arc itself, however, until it's tested there's no way to say it's going to be a one to one ratio versus a -- or if it has a bigger impact that I'm not anticipating.

MR. REYNOLDS: Is that the intent of the testing for that is --

MR. MELLY: Yes.

MR. REYNOLDS: -- also to determine where that --

MR. MELLY: Right.

MR. REYNOLDS: -- impact of the location is?

MR. MELLY: Yes.

MR. RANDELOVIC: Right, so if you look at the bus bars here, the arc -- these are the horizontal bus bars, so the arc is horizontal. When you look at this one, so those are the three bus bars, because you see the arc. There is a difference in geometry in the arc. Cubicle itself is not the same. Space, the location of the arc. The other side, you have the differences in geometry in the arc itself and the cubicles where the arc is. So how -- what is the difference between those two, I don't know and I don't

think that anyone can say with 95 percent confidence level they are the same.

MR. REYNOLDS: Without testing.

MR. RANDELOVIC: Without testing. So that is why we were suggesting if we performed this one test with the arc location there and the previous OECD tests I think you guys had placed the arc wire, the breaker stabs. And we are looking to -- gathering the data from the first round of tests, if feasible.

MR. TAYLOR; So this is just me personally speaking. I think there's a valid and reasonable comment in the feedback on the material types that would probably help us better inform what we want to do moving forward. So I don't think we can say, yes, we're going to do it, but we're definitely considering how we can adjust the test plan to move forward.

The other thing I just want to point out on this is that those main bus configuration is a little different from like other vendors, most of the other vendors for medium-voltage. Now these are out in the field, but a lot of the other vendors have three in the same plane, three phases in the same plane.

MR. RANDELOVIC: But I mean, so you still have --

MR. TAYLOR: Well, these are kind of -- you got two in one plane and then --

MR. RANDELOVIC: Right, right.

MR. TAYLOR: -- two in the other plane. So it's a triangle. So there's just some configurations, I think, and in the end it does probably impact on the severity of the hazard. Yes, we'll look into that.

MR. RANDELOVIC: Next slide. For the low-voltage events our research shows that all low-voltage events occurred in the load center supply cubicle and the all faults were initiated at supply breaker stabs. So our recommendation for the Testing Team is to supply -- to procure actually the load center supply cubicles to maintain the prototypical geometry and to place the arc at the same location. That's what we are seeing in the operating experience. And I think NRC Research is working on the procurement activities right now and is considering EPRI's comment.

MR. MELLY: Yes, we're currently working through procurement for -- of the equipment and we're working closely to make sure that we'll have a realistic set of equipment to test.

MR. SALLEY: If industry has anything they'd to donate as far as equipment, we'll always

welcome that.

MR. RANDELOVIC: And the last suggestion was the use of the mock switchgear test unit because as we already discussed the conductivity probes, the issues with performance and the test data. So we have designed a mock switchgear unit and the purpose is to see if there is a certain amount of particle -- fine particles that could actually create a secondary fault in the medium-voltage switchgear.

So this is still in preliminary design of the device. It's a small box: 36 by 30 by 10. You have five different ventilation panels. This is the bus bar, 8 kilovolts, that will be maintained with two insulators. And so as the dust cloud moves in through the ventilation panels, the idea is to see if the cloud itself could actually provoke a Phase II ground fault. Or you have -- you collected sufficient material on this -- on the insulator to create a low-resistance path for the Phase II ground fault.

MR. SALLEY: Will that be natural ventilation or forced?

MR. RANDELOVIC: Natural. We will just place -- the placement is going to be a point of discussion. We may need to look at some videos from the previous round of tests and located the device

somewhere where it's far from the molten ejecta because we don't -- that's not the purpose of the test. We were just looking at what's in the cloud itself. But we are going to have the screens here anyway on these ventilation panels to prevent any entrance of the molten ejecta. And so this -- the bus bar is going to be located a little bit further up, so you actually get a cloud going in. And then we will see if the cloud is conducting or you have the sufficient material collecting on the internal lean surface.

MR. MELLY: Yes, so the initial discussion that we had at the working group -- this -- place this at the -- behind the six-foot instrumentation rack in the path of the ejecta.

MR. SALLEY: Okay. But did you have screens or louvers up? Would it be more common or more representative to have louvers?

MR. MELLY: It would be. And like we said this is a -- this came -- yesterday this came together.

MR. RANDELOVIC: It's a big room, so having small louvers you may actually not be able to get any cloud inside. So we are trying to get the cloud inside the box. So we think we can actually

measure it. If we have the small louvers, then -- in a sort of big space where you actually -- with the device, you may not collect --

MR. MILLER: Not going to simulate the actual equipment as opposed to actually exposing the cloud to the voltage to see if that produces a fault?

MR. RANDELOVIC: Yes.

MR. MILLER: Okay. So said that's going to be eight kV?

MR. RANDELOVIC: Eight, yes. Which was calculated because in the plans the most typical faults are phase to phase and with 13.8 kV, if you divide by the square root of three --

MR. MILLER: Right.

MR. RANDELOVIC: -- you actually get 8,000 kilovolt for Phase II ground fault. So that's -- 8,000 is equivalent to 13.8 in the plan. The currents that we have is -- there are about 30 milliamps, so very small. If you have a fault -- we have a -- I think the spec requires like 5,000 kilohertz frequency, so you're going to be able to get probably 5,000 data points in a second. And if you have a flashover, then we would be able to see the current going from 0 to 30 milliamps, which is the maximum current for this transfer.

MR. MILLER: So you're just doing like an accelerograph measurement of leakage current?

MR. RANDELOVIC: Right. Yes.

MR. MELLY: Yes, and this is -- we will have discussions on this at the working group as to criteria, how we're going to measure, whether we want it fused or things like that. So it's still on the table right now, but this is the idea, to get another data point as to the potential impact of the cloud itself.

MR. MILLER: In parallel with the dynamic conductivity measurements, of that's possible?

MR. MELLY: Yes, we also plan on putting black carbon tape or Aerogel inside of this measurement device, non -- hopefully not affecting anything that we're of primary interest to, any of the spacing or distance to the ground to see if we can get a comparison data point, if we do see faulting or if we don't see faulting.

MR. RANDELOVIC: That is basically all I have for now.

MR. HAMBURGER: Okay. Any questions for Marko or Nick on some of these items that were discussed in the current status of 150?

(No audible response.)

MR. HAMBURGER: So we are now going to open up the meeting. The rest of the afternoon is reserved to solicit input and feedback from those in attendance. And I think NEI sent us a list of flagged comments that they wanted to discuss. Would you like me to pull up the flagged comments and --

MS. ANDERSON: I mean, I think they essentially boil down to two specific concerns, if you look at them. I mean, so the first concern is that the testing is realistic in the sense that all the inputs match up with each other with respect to the OE. So we're not taking the worst case duration that we've seen in OE and the worst case voltages we've seen in OE and the worst case material that we've seen in OE, because they don't all necessarily go together. So, and it sounds like the working group has worked on looking at the OE more carefully and matching it up a little bit better.

So like one of the comments we flagged was with respect to the Robinson event. I think that was our comment No. 20. And so it sounded like there was some overstatement of the zone of influence that was attributed there and that event is being -- was being used to justify some of the testing parameters, but it seems like there's some insight that maybe should be

considered with that specific event that would lead you to not really support those test parameters. So I think that's -- some of the work that the working group has done really alleviates a lot of our comments.

The other aspect, the other sort of flavor of our comments is this testing plan is supposed to be supporting the pre-generic issue on the impact of aluminum, and sometimes it's not clear how we're specifically teasing out that impact. And we talked earlier about needing to do material characterization, but I think it seems like maybe we can work on getting some more input to you via the working group on specifically where we see aluminum and what kind of configurations we see it in.

And maybe the tests can be better configured to help tease out those effects versus just doing HEAF experiments and make sure that if we do see any impact on the zone of influence, that it's uniquely attributed to aluminum if that's what the true purpose of the pre-generic issue is. We definitely want to see realism in our PRAs and fully account for all the potential hazards, but that being said, we need to make sure that if we're saying that there's an -- if we do decide there's a potential

increase in zone of influence due to aluminum, that that's based on sound testing that teases out the individual effects of aluminum. It is not just due to testing factors. We need to make sure that we're really carefully looking at what the unique of aluminum is.

So it sounds like both of those are going to be -- have been or are going to be addressed in future tests via the working group.

MR. MELLY: Hopefully, yes. On the Robinson event which parameters specifically were we overestimating --

(Simultaneous speaking.)

MS. ANDERSON: So if you look at that comment in the resolution, I think there was a comment that the damage and the sort of the zone of influence that was being assumed there were not actually reflective of the OE. It sounded like perhaps the vertical distance between the cabinet assumed in 6850 doesn't really correspond with the actual OE. So I think they're saying that they noted that some of the cable just three inches from the cabinet were undamaged, yet we're relying on data that -- or we're relying on a model from 6850 that assumes a larger zone of influence.

MR. MELLY: Yes. And I think the comment resolution that I provided there was more so to say that we did do a comparison -- we did get cables from Robinson and were able to look at those for damage states, however, the cables that we received, there was no way to actually map those cables to the location in the plant where the cables were received. So it made it a little bit murky in saying that -- there was nothing we could do to make a determination that, yes, the 6850 model was correct or, no, the 6850 model overestimated the risk without having that mapping ability.

So and I think that was in the report that we issued on the Robinson event.

PARTICIPANT: I think -- I mean, we can get that information.

MS. ANDERSON: Yes, so I mean, I think -- I understand why you did what you did because you didn't have specific information, but we can work with the licensee to get that information and improve the realism there. We're happy to -- through the working group or if you need to go through NEI, we can do that. But --

MR. MELLY: Well, we also wanted to make sure that we're not -- we're trying to be better than

the SONGS event in saying that all HEAFs are this model.

MS. ANDERSON: Right.

MR. MELLY: So there is some benefit of looking at the operating experience, however, what we're seeing from the high energy arcing fault event testing is if I direct my energy, I know that I'm going to direct it all horizontally away from the cabinet based on the configuration of where the arc is initiated and based on where the energy is going. I can run 15 tests in that orientation and I'll never damage potentially cables in a vertical orientation, however, if I just move the arc initiation point or move the configuration of the cabinet, I will.

So we can gain insights from OpE, but the testing is trying to get a generic approach for the potential of an arc occurring in all locations within the cabinet so we can try and take that into account.

So while we do have some anecdotal information from the OpE from the Robinson event, there's very little we can do to say this happened at the Robinson event, therefore all potential HEAFs are going to be this.

MS. ANDERSON: Right. And that's what we just cautioned against before.

MR. MELLY: Yes.

MS. VOELSING: But I guess could you elaborate on how -- I understand you want testing to represent all possible --

MR. MELLY: Yes.

MS. VOELSING: -- configurations. How would you propose putting that distribution into the PRA, because assuming the worst is not the right answer either.

MR. MELLY: So we don't plan on assuming the worst. That's definitely not what the working group is trying to establish when we're creating this model. We have a skeleton outline that's on our working group agenda to describe how we plan on bringing the OpE data that we have, bringing the test data together in a format that can facilitate a more dynamic zone of influence. So we can take into account things like your plant design, your circuit protection design, where your arc would be occurring in the plant to try and inform potentially how many layers of circuit protection I have, how long the arc duration will last, and then how we link that with an energy release that can tie to a zone of influence. That's the current thought.

We're also going to try and take things

into account like where the arc is initiated in your cabinet, the configuration of your cabinet. It's lofty goals, but that's what the working group is striving towards accomplishing.

MR. RANDELOVIC: So if the plant doesn't have the aluminum, then you are going to have a zone of influence without the aluminum.

MS. VOELSING: Right, but I guess there's still multiple places that an arc could be initiated --

MR. MELLY: Right.

MS. VOELSING: -- in a configuration.

MR. MELLY: Yes.

MS. VOELSING: So how are you going to represent that?

MR. MELLY: Through the evaluation of how much energy is potentially released timed back to duration hopefully. And it may not be a three-foot, five-foot zone of influence. It's going to try and look probabilistically of what the energy release is in your cabinet to more of a -- I don't want to assume anything, but a spherical zone of influence based on energy release, and then trying to use engineering judgment to take into account things like where in the cubicle -- or where in the cabinet itself the arc is

being initiated to potentially putting factors on that.

MR. RANDELOVIC: I think this is where the confirmatory test is crucial because now you're going to relocate the wire --

MR. MELLY: Right.

MR. RANDELOVIC: -- on the main bus bars and then you can compare the energy levels and behaviors and zone of influence and other variables.

MR. CHEOK: So let me kind of restate what you just said, I think, so that I understand it better, right?

We will have enough tests hopefully to replicate different cabinet and plant configurations. We will not take the worst case and apply it to everybody. We will -- we understand that HEAFs and the risks from HEAFs is really plant and configuration-specific. We will -- given the different configurations that we are testing under we will only apply the test for a certain configuration to the plant if that configuration is applicable to that plant.

MR. MELLY: Yes, and for instance, that's the reason we're trying to isolate single parameters. So that's the reason why I'm testing at two seconds

and four seconds. I'm not going to -- the goal is not to link every single plant's zone of influence to the most bounding test case of this is what I saw from my four-second duration testing, so now this is the zone of influence. The plan is to say this is the data that I've obtained at two seconds, four seconds and here's what it potentially could look like at eight seconds, and then trying to link that with in my plant configuration I will most likely have a 3.5, 4-second, 5-second arc. And then I can tie that energy release to a more realistic energy output from the event itself.

MR. SALLEY: You know one of the things I guess is direction that I gave to our side on the working group was that 6850, Appendix M, that information is almost 20 years old now and that three-foot, five-foot box was a nice convenient screening tool for PRA that they came up with back in the 2000 time frame to not limit themselves to a square three-foot, five-foot box. But I know Gabe has done some looking at some IEEE standards and what they're showing is more of a sphere or a different geometric configuration that more accurately realistically represents the HEAF. So again, that's some of the stuff that I've asked them to look at.

Gabe, what was the standard you were looking at?

MR. TAYLOR: So it's our calculation it's 1584. But I think the point is whether it's a sphere or some other shape. It's geometry-dependent. It's cabinet configuration-dependent. So I think what we saw from the fall test as well as Phase I of the OECD Program that they're getting these directional energy output and they do breach the enclosure. And I think the model that we develop moving forward needs to capture that directionality in some form to realistically represent the energy release.

MR. MELLY: Yes, and one of the things that we have identified from looking at the OpE is we see a lot of these longer-duration high energy arcing fault events that make us the frequency either being generated or fed where they have no certain protection to limit the fault energy or places where you have circuit protection failures.

So our goal is to try and take into plant configuration where these faults can happen in your lineup at your specific plant into account very heavily to try and link that with what is the probability of having an extended-duration event versus having a very quick fault that will only last

potentially on the milliseconds or half-a-second-type approach.

So we're going to try and rely more heavily on plant configuration in terms of establishing the zone of influence as we move forward.

MR. CHEOK: And you're going to marry that with the potential frequency of those HEAFs on an OpE --

MR. MELLY: That's the plan.

MR. CHEOK: -- splitting fractions.

MR. MELLY: We'll see what we can do.

MS. ANDERSON: And the future test plans are still going to be used for public comment, correct?

MR. MELLY: Yes. The hesitation with -- so we've -- a lot of these have been incorporated into the test plan as it lives right now. The shift there is that the test plan in the format that it was in a few months ago was linked to the OECD Agreement, so we didn't want to have multiple versions of a test plan out there; one on agreement; one on non-agreement while we were in the signature process with our international members. Once that program is officially kicked off, we will again release the comments that we discussed with EPRI through the

working group as well as any insights from this meeting and an officially updated test plan as we move forward.

MR. HAMBURGER: Victoria, did you want to go through any of the comments since --

MS. ANDERSON: No.

MR. HAMBURGER: No? Okay. Can you -- would you mind just -- I'm trying to succinctly summarize everyone's concerns so that we have it on record and NRC can ask questions if they have any. Did I accurately capture your two comments in No. 3 and 4?

MS. ANDERSON: Well, it's the pre-GI. Yes, I think No. 3 is essentially more or less what I'm saying.

MS. VOELSING: Maybe If I could --

MR. HAMBURGER: Certainly.

MS. VOELSING: -- add one more based on what I'm hearing. I understand the intent and the marrying of right frequencies within appropriate zone of influence, but I also am hearing about this -- the Sandia model being utilized to develop those zones of influence. And so in order to accurately comment on the test plan I think it's really important for our stakeholders to be able to understand what feeds the

Sandia model, how is that Sandia model actually validated for this specific application and what outputs are expected from the Sandia model, because those things drive what we -- what data we need to get out of the testing. And so to move forward with testing without understanding that limits our ability to comment on that.

And I'm sorry for the voice.

MR. HAMBURGER: You want to get Chris to give an overview?

MR. TAYLOR: I can give high-level and then Chris jump in, if she wants to.

MS. VOELSING: And I'm just saying I don't know that this meeting is the right format, but --

MR. MELLY: No, I think --

MS. VOELSING: -- it needs to be published and it needs to be put out for public comment.

MR. MELLY: I think we anticipated doing all that and then holding an additional public meeting that was requested at the --

MR. TAYLOR: So from the meeting we had in January we committed; and I think it was Jennifer's comment, that we need more engagement with the stakeholders on what we're doing. So once we get everything ironed out in our proposal with the work

with Sandia, we're going to have that interface and interaction. And the things that you bring up we hopefully will be able to communicate at that time.

MS. VOELSING: But I was just saying that what we learn from that may influence --

MR. TAYLOR: Right.

MS. VOELSING: -- more comments that we need to provide on the test plan.

MR. TAYLOR: Understood.

MS. VOELSING: We kind of got to have that discussion first.

MR. TAYLOR: I agree.

MS. VOELSING: Okay.

MR. TAYLOR: And as I think talking to Chris a lot of the stuff that they need they're doing on a small scale basis. They're running a few preliminary small scale tests to look at how Aria is going to model the arc and a few other pieces. So they should have that --

MS. VOELSING: And I know you said they're already using it to model copper. It would be really helpful to lay out how they're doing that, how it's validated so that we understand the basis for the model.

MR. TAYLOR: Chris, did you get all of

that?

MS. LAFLEUR: Yes, absolutely.

MR. TAYLOR: Okay.

MS. LAFLEUR: I did send some documents that I was able to find that were -- one around the verification of the Aria model and it's like basic equations and the user manual that goes through in detail like how it calculates everything.

So I definitely hear we're definitely going to look at how it compares to this specific application, so that will be part of the whole model plan.

MR. TAYLOR: Okay. Sounds like a good starting point and we'll work towards what's being asked for. Thanks, Chris.

MS. LAFLEUR: Thank you.

MR. HAMBURGER: Kelli, would you mind just making sure I've captured the comment here in No. 5?

MS. VOELSING: I could be wrong, but I think it -- I thought it was more than just the Aria model. It was putting a couple of pieces together.

MR. TAYLOR: Just put modeling because there's a number of models.

MR. MELLY: Okay. Yes, our model will see a different model.

MS. VOELSING: And that's an appropriately validated tool.

MS. LAFLEUR: Yes, so the Aria model has confirmation of mass, species, momentum, energy. It also calculates current and voltage. And that will be used to model the arc itself, but then what we see happening is the arc then feeds this more sooty fire plume. And so that is more appropriately modeled with our Fuego model which isn't a mass and heat transport model. And so those will -- coupled together where the model of the arc will feed the development of this plume, sooty plume which radiates the energy completely differently than the arc, which is just -- it's just a different energy release.

MR. SALLEY: And, Chris, for those base models Sandia has done a lot of V&V work on those. It's correct, isn't it?

MS. LAFLEUR: Absolutely, yes. They are used and they were developed for modeling harsh environments that nuclear weapons are exposed to, the fires and lightning strikes and all types of things. And so I mean, our thermal test facility here was built specifically to validate all those models. And so, there's a lot of documentation I just have to get for the Fuego and I have to find the unlimited release

document, but that -- it's tested in minutiae detail for the NMSA.

MR. SALLEY: That would be great, Chris. If you could kind of put a literature thing together on what's publicly available for that to support the V&V --

MS. LAFLEUR: Yes.

MR. SALLEY: -- that would be good. Thank you.

MR. HAMBURGER: Do we have any other comments on any of the previously dispositioned test plan comments?

(No audible response.)

MR. CHEOK: Maybe go around the room for comments.

MR. HAMBURGER: Sure. If anybody in the room has comments on any of the previously dispositioned comments that were made available through the public meeting notice and that have been publicly available for some time now or if anyone on the phone has any comments on those, we'd be happy to take that input. And if anyone has any new comments?

(No audible response.)

MR. HAMBURGER: Okay. Well, I'll give everyone a minute to think about it. And just to

summarize what we have here for our action items and comments, the first was a request from EPRI that we list all the types of data collected from our fall series of testing and come up with a timeline for when it will be made available either in its preliminary or final forms. And there was a specific interest in the material characterization of that ejecta that we collected.

MR. MELLY: We gave an action item for them to potentially look at the Small Scale Test Program and determine which specific type of analysis --

MR. TAYLOR: Yes, we can probably work that through to the working group.

MR. MELLY: We could do that.

MS. ANDERSON: You want to do that, because I wasn't sure if you wanted to do that through the working group. I was going to ask if you wanted to do it through the working group or --

MR. MELLY: Let's put it on there.

MR. SALLEY: Well, we got a working group. Let's make it work.

MR. MELLY: And they can add it to the working group agenda.

We have an action item, and this hasn't

been assigned to anyone in particular, but to determine the prevalence or even the existence of the aluminum main bus bar where we're proposing the confirmatory test be parked. So --

MR. TAYLOR: You want to make it medium-voltage. I think we know those combinations for low-voltage.

MR. HAMBURGER: Okay. So determine the prevalence of main bus bar aluminum versus copper material in medium-voltage enclosures for our confirmatory test configuration.

And then we have NEI's two overarching comments.

MR. SALLEY: So No. 2; backing up, who has the action on that one, Kenny?

MR. HAMBURGER: We can -- want to work that through the working group as well?

MR. SALLEY: Or is that something you could do a survey, Victoria, and help us on like you've done in the past before when we were looking for aluminum?

MS. ANDERSON: It's not as easy as it sounds, but I think we've -- I think we have some of that data sitting around. So we -- yes.

MR. RANDELOVIC: Yes, 50 plants and I

don't know the level of details for the main bus bars. I'd have to look.

MS. ANDERSON: Yes. I'm not sure how --

MR. RANDELOVIC: We can just --

MR. MELLY: I know from the surveys that we at least saw I wouldn't be able to pull that type of information out of them, but you may have more that I don't know about.

MS. ANDERSON: Yes. Well, we know which -- who -- which each of the plants are, so we can query them --

MR. MELLY: Right.

MS. ANDERSON: -- more deeply.

MR. MELLY: So think this would be an -- I don't know if it's really appropriate for the working group because we wouldn't -- the NRC side wouldn't be able to help with this action item.

MR. SALLEY: No, this I think has to come on your side.

MR. HAMBURGER: I can -- how about we put this down as something that NRC will work with NEI to see if we can query the fleet for.

MR. MELLY: I think it would just be an NEI action item.

MR. SALLEY: You could, Victoria, because

I mean, we want to get into 5054(f) letters and that kind of thing.

MS. ANDERSON: Yes.

MR. SALLEY: Yes. No.

MS. ANDERSON: NEI won't be able to get you the full fleet.

MR. SALLEY: Could you get something representative like you did last time?

MS. ANDERSON: I can do best we can, but --

MR. SALLEY: Okay. Yes, I think that's kind of what we're -- Gabe, that's what we're looking for as far as details?

MR. TAYLOR: Yes, I mean, it's -- we don't have to know the exact number, but if there's aluminum out there, then it would probably make sense to test aluminum. If there's only copper, then it makes sense only to test copper. That's kind of what I need to -- I don't need to know 48 percent as this versus the other half.

MR. SALLEY: Nick, is it worth reaching out to our international folks to see if we can get data from them on that?

MR. CHEOK: Again, how important is this information, because if you were going to be doing it

as -- going to be --it only applies to a certain configuration. If you have data for both configurations, you're only apply the pertinent data to the correct configuration.

MS. VOELSING: But it also needs to be -- what we're trying to understand, does it matter? Right? And so as long as you do apples to apples, it doesn't really matter what you do. If you're comparing -- if you test aluminum, compare it to the aluminum. And the other like just --

MR. TAYLOR: Right. I think we need to understand whether there are even any little amount there on the main buses. If there are, then it makes sense to do it like you said and do the comparison, but if there aren't, then we're testing something that's not out there. So that's kind of what -- at least I'm --

MR. HAMBURGER: I think what Gabe is saying is that the apples to apples would best be done with copper if the aluminum configuration doesn't even exist.

MR. LEJA: So copper on the main bus bars and the aluminum on that? Okay.

MR. TAYLOR: Or the aluminum on the main and aluminum on the secondary.

MR. LEJA: Yes, I don't think you want to separate much on medium-voltage. Aluminum wears a lot faster than copper. Just to -- putting the breaker in and out, that would wear it out. And also the --

MS. VOELSING: I thought it was pretty clear that the looping side was mostly all copper.

MR. LEJA: It is mostly all copper.

MR. RANDELOVIC: Yes, but I also talked to Kenn and he was saying that he knows the existence of the main bus bars are aluminum. So what I am saying, that you just need to --

(Simultaneous speaking.)

MS. VOELSING: I think it gets impossible, but predominantly it's copper.

(Simultaneous speaking.)

MR. LEJA: The other thing is aluminum contracts and expands, so that it's also not a good application for it. In fact, you wear it out even faster. So you guys can verify. I'm pretty sure you're not going to find very many applications.

MR. HAMBURGER: Okay. We have NEI's two more general comments, and I think the first one we've -- the NRC has committed not to doing this and the working group is proceeding to everyone's satisfaction.

No. 2 is the -- I guess just the idea that these tests need to be designed to isolate the impact of aluminum if that is the goal of the pre-GI. Do you have anything to add or change?

(No audible response.)

MR. HAMBURGER: And then the last comment was regarding the modeling effort that it's important that we understand and that we make sure that the working group has access to the modeling approach and the fragility determination for targets. Is that what you meant by fragility determination? Targets? Potential targets?

MS. VOELSING: The zone of influence is where the fragility is going to be affected, too, so --

MR. HAMBURGER: Okay. I want to make sure I'm understanding what you mean there. And the model's validation inputs and outputs to make sure that they are appropriate tools and that they're properly validated for what we intend to apply it to in terms of zone of influence calculations. And EPRI has reserved the right to submit further comments after looking at the details of the modeling approach.

Any other comments from anyone in the room or on the phone?

MS. VOELSING: I guess I'll just say briefly obviously I've learned way more on this than I wanted to and it -- I give credit to the team and the working group. This is really -- this is not simple and it's really new science. It's not stuff that's out there. So I think they've done an admirable job and identified a lot of issues that need to be investigated, I think doing a great job working together and working through the issues. I just want to make sure that we don't get ahead of answering some questions we need to answer in the interest of moving forward on testing if we're not ready for it.

MR. HAMBURGER: Okay. Hand it back over to our division director. Do you have any --

MR. CHEOK: Actually just thank you for coming. Thank you for your interest. And I think Mark wants to say something.

MR. THAGGARD: Well, I just wanted to say we don't want to try to set a time frame for when we want to have the next meeting. Are we going to just figure out what works best?

MR. MELLY: So that's something I can touch on at least in terms of the working group at our level. Like we said, we discussed here a lot of the discussions that we held at the last in-person

meeting. We did discuss and think that it would be very valuable to hold another possibly shorter in-person meeting prior to the low-voltage and bus stop testing that will be done in the late summer months.

So we do plan on meeting again once the equipment for low-voltage has been procured, once the instrumentation has been developed, once these devices have been built and just so we can have everyone's alignment on what we plan on doing, what we plan on testing, what we plan on measuring, the new devices that we've built and used. So we will be as a working group meeting prior to testing. And there has even been discussions of having it be in Pennsylvania to actually see the equipment that we'll be tested.

The working group members will also be invited to the testing itself. It's not easy testing; there's a lot of setup that goes into it. So we do foresee the NRC NIST Sandia Working Team potentially spending a month at KEMA, so there will be plenty of opportunities for interaction and visits.

MS. VOELSING: So do you think we can have a public meeting on that No. 5 here sooner than later?

MR. TAYLOR: So that's what I was going to say is I think once we get prepared for No. 5, we can probably just have one public meeting that covers the

modeling and the fragility and these other items as well. That seems reasonable. I don't have a date yet for when that will happen though.

MR. SALLEY: And to understand the timing and how we're trying to schedule and bring this together, remember we have timeliness for the pre-GI to support that program. And we all agreed that the more data, the more information we have, the more realistic we can do the analysis for the pre-GI.

Scheduling that with the test lab, we're trying to look at the what, August, September time frame as when we want to be in there. And we kind of got that blocked with KEMA. Again, they've got a lot of clients. We need to kind of get in there and say this is our time frame and we'll be ready. So that's the target we're working to. There is a little time, but there's not years. It's months. Okay? So that's kind of what we're up against. And again, supporting the Generic Issue Program.

MR. CHEOK: So we'll meet again. We will discuss the follow-up discussion on several of these items, notably No. 5. And I thank you for coming out and thank you for your interest.

MR. SALLEY: Mike, it would probably be good if had the model and any final comment resolution

at the same meeting. We could do that, put it together like that.

MS. VOELSING: I don't think we can do that until we know about the model. I can then provide some comments.

MR. SALLEY: We can get the model stuff.

(Whereupon, the above-entitled matter went off the record at 2:22 p.m.)