Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title:	Informational Update on High Energy Arc Faults (HEAF) Involving Aluminum
Docket Number:	(n/a)
Location:	Rockville, Maryland
Date:	Wednesday, January 23, 2019

Work Order No.: NRC-0048 Pages 1-169

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NUCLEAR REGULATORY COMMISSION

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INFORMATIONAL UPDATE ON HIGH ENERGY ARC FAULTS

(HEAF) INVOLVING ALUMINUM

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WEDNESDAY,

JANUARY 23, 2019

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ROCKVILLE, MARYLAND

The public meeting convened in the Commissioners' Hearing Room at the Nuclear Regulatory Commission, One White Flint North, 11555 Rockville Pike, at 9:00 a.m., Ken Hamburger, Facilitator, presiding.

PRESENT:

KEN HAMBURGER, RES/DRA/FXHAB, Facilitator

MICHAEL CHEOK, RES/DRA

TOM BOYCE, RES/DE/RGGIB

MICHAEL FRANOVICH, NRR/DRA

STANLEY GARDOCKI, RES/DE/RGGIB

NICK MELLY, RES/DRA/FXHAB

KENN MILLER, RES/DE/ICEEB/EET

MARK HENRY SALLEY, RES/DRA/FXHAB

GABE TAYLOR, RES/DRA/FXHAB

C O N T E N T S

P R O C E E D I N G S

9:01 a.m.

MR. HAMBURGER: Good morning, everybody. It's nine o'clock, so we're going to get started.

My name is Ken Hamburger. I work in the Office of Nuclear Regulatory Research. I'm an NRC Facilitator, and I'm here today in that capacity.

Mostly just to keep us on time and on schedule. And make sure everybody has a chance to say what they came here to say.

A couple of logistical notes. For visitors, while you're here, please keep your visitor badges visible. Keep them on you. You shouldn't need an escort wherever you are today.

This room is fine. The hallway out here is fine. The cafeterias are fine. You don't need an escort for any of that.

If you need to access any of the other floors, please find an NRC staff member to escort you. The bathrooms are through this door, make a left. Women's bathrooms are on the left. Men's bathrooms are on the right. Again, don't need an escort.

The cafeteria is also open to you if you'd like to grab coffee or a snack. It's out that door to the left. Follow the hallway down, and the cafeteria

is on the left.

If there is any sort of fire or emergency, you have emergency exists in the rear of the room. And we have the two exits in the front of the room.

We are transcribing today's meetings. We have our Court Reporter in the back there. So, a couple of things for those in the room.

Please identify yourself when speaking. Use your name so he can capture that in the transcript.

Please speak into the microphones. He has an audio feed, so he can only hear what's said over the microphones.

And we have webinar participants. So they can only hear what's said into the microphones. So please don't forget.

I'll try to remind you. Even if you're right up here in the front and you're speaking to somebody over here, the webinar hears silence if you don't have one of the mics.

So, we have an aisle mic over here and over here. I have two wireless mics. If you have any trouble getting to the aisles, you can just raise your hand, I'll bring over a wireless mic to you.

And for those on the webinar, best way to

ask a question or make a comment is to use the raise hands' feature on the webinar. Or use the chat feature and you can ask Tom. Tom is manning our webinar.

And he will either relay the question to us. Or open up the phone lines. We do have a phone line in the room so you can ask the question yourself.

And we have you muted at the moment, but periodically we'll open up the phone lines. Anybody has a comment or question.

So I suggest that you keep yourself muted until you're ready to speak in case we open up the phone lines.

We have a public comment period scheduled for the last two hours of today. That's open for anybody to present or say anything they would like to say.

I do think we're pretty lightly loaded in terms of the agenda. I expect to have two hours plus for that public comment period.

But just so that we can get through all the items on the agenda and make sure that everyone has a chance to speak, I may ask you to hold certain comments or questions until that public comment period.

Just to make sure we get through everything we have to get through. Again, I expect more than enough time for that public comment period.

If anybody has any questions or issues with today's meeting or with the webinar, you can reach out to me, Ken Hamburger. I'll put my contact information up on the board during the breaks.

And with that, I would like to introduce our Division Director, Mr. Michael Cheok.

MR. CHEOK: So thank you Ken. And good morning. Welcome. And thank you for participating in this public meeting on the Pre-Generic Issue on High Energy Arching Faults involving aluminum.

Again, my name is Mike Cheok. I am the Director for the Division of Risk Assessment in the Office of Nuclear Regulatory Research.

Today we will provide a brief status of where we are in the generic issue. We will also talk about our proposed next steps.

But most importantly, we would like to hear your comments, questions, or feedback on the process.

As Ken said, I would like to welcome those on the Webinar. And I would like to say that we would also love to hear from you. For those of -- for those

people who are not available today, this meeting is being transcribed.

So, today you will hear two main teams throughout the meeting. First, you know, we will follow the GI Process, the Generic Issue Process, which has several well-defined steps.

The first step that you'll hear about is the screening process. And you will hear about the results of that screening process.

We are now in the assessment phase of the process. And you know you will again hear about what we have done so far and where we plan to go.

We will have a methodical process. We will be methodical in getting to the most realistic and the most applicable offering experienced data and information.

We will also have to be methodical in terms of defining our tests going forward. We will have to have realistic and applicable tests to get the best information on how we can characterize the HEAF phenomenon.

We will -- we will have to do this so that, you know, when they come up with our recommendation, the recommendation will be robust. It will be supportable. And it will be defendable.

Also, you know, I would like to say that not all HEAFs are the same. We have to characterize the different classifications or categories of HEAFs correctly.

We have to determine the corresponding frequencies of these classes of HEAFs correctly. We have to model the effects of these HEAFs on plants correctly.

Also, not all plants are the same. Not all plants have aluminum. Plant configurations and plant equipment are different.

Plant procedures and plant practices are different. So, you know, we have to get this right in terms of the generic issue.

A single solution for all plants may not be applicable. We may have to have solutions that maybe different for different plants.

So the second thing you will hear today is that we will need to continue to improve on our communications. We will need to involve all the public stakeholders throughout the process, early and often.

We plan to hold as many public meetings as needed. And we hope that you will show up and provide us with the feedback.

So with that, I would like to go ahead and turn the meeting over to Mark Salley for his -- bringing us through the Agenda.

MR. SALLEY: Thanks Mike. To pick up where Mike left off there, this is about communications today.

And as a part of the Generic Issue, the Generic Safety Issue process, there is a requirement that they have periodic updates.

And this fulfills the periodic update. But more importantly, when we talk to Tom Boyce and Stan, there was additional information that we wanted to share today. So, we wanted to share as much information as possible.

You know, also with communications, good communications are very important. We've done a lot of internal briefings inside the NRC through the Commissioner assistants, up through the DEDOs.

And it's surprising some of the questions and information we hear that's floating around in the industry.

Without getting into that, we'd like to take the high road here and to answer any questions you have. And to communicate anything we can with you.

Also, with good communications is a two-way street. We need dialog. So, at the request of the stakeholders and industry, we've allowed two hours this afternoon as Kenny said, for any open discussion.

So again, we want to hear from you. So today is about communication.

I want to give you a quick overview of what we're going to try to accomplish today. And then we'll get right into it.

Again, this is part of the Generic Issue Program. We're doing this update. We've also performed some testing in September.

And we'll refer to this as confirmatory testing. If you remember the first phase of testing we did with the Internationals, the OECD NEA Program, we had two tests, Test 23 and Test 26 that kind of stuck out a little bit.

And we had some ideas and some thoughts that aluminum could be the issue. But we wanted to be -- we don't want to cycle industry.

We want to be sure. We want to be thoughtful in how we move forward. And we wanted to do some confirmatory testing.

We did some in September. We did the medium voltage. It's basically broken up into three

pieces, medium voltage, low voltage, and the bus ducts.

We did four tests with the medium voltage. Frank Cielo is here from KEMA. If anyone has any questions about the testing lab, you can grab Frank at a break and talk with him.

But we did the confirmatory testing, and Nick's going to give a presentation. And we're going to share some of the insights.

There's a lot of data. And it's going to take time for us to analyze the data and go through it.

But I think at this point we can share some observations and let you know what we see. Again, it's about giving you the information and sharing what we have.

We'll also be moving into the next series of tests. We hope to run the low voltage and the bus ducts this summer.

So again, we'll talk about that. If you remember the meeting back in April, we had two and a half days, very good discussion with everyone. We're moving along with that matrix and some of the testing there.

And finally, the last thing that we'll

talk about after lunch is, NRC has an MOU with EPRI to work on technical matters in a number of areas. One of them is fire risk.

Under the fire risk we've put together a working group and a charter with EPRI that we'll look at the data and do some of the technical analysis. We'll discuss that this afternoon.

So that's the basic overview of what we're going to have today. Again, this afternoon I want to emphasize that we've got a two-hour slot for any of your questions and open discussion.

I see that Victoria, you've got a presentation from NEI, which we'll put up first. And Kelly, I believe you have one too that we'll have.

So, with that, I'll turn it back to you Kenny and get started.

MR. GARDOCKI: Well good morning. My name is Stan Gardocki. I work with the Generic Issues Program in the Department of Research here at the NRC.

If you have any questions dealing with the generic issue process, you can always give me a call anytime. Or send me an email.

I want to first step back a little bit for those people that weren't here at the last public meeting, and introduce the Generic Issues Program and

how it -- the generic issue processes through the program.

It basically has three stages, as you can see on the slide there. Now the first time we see the GI, it comes into what they call the screening stage.

And we take a first cut at it to see if it meets the seven criteria. If it does not meet all seven criteria, it doesn't proceed forward.

We spend as much time on this screening stage as necessary to make a good evaluation. Because we don't want to waste, you know, resources, time and personnel doing something that's not necessary.

So, we've revamped the program several years ago and came up with these seven criteria. And we think it's a pretty good screen to go to the next stage.

After it goes through the screening stage, we go to what they call the assessment stage. And we spend about one to two, maybe possibly, you know, two years on the issue to determine the risk and the safety significance of the issue.

This is important for us here to determine whether it goes to the next stage, call the Regulatory Office of Mutation Stage. Which, you know, we have the applicable NRC office that's working on the issue.

This particular issue would go like to NRR. So we don't want to waste NRR's time. So, we do what they call an assessment.

We do the testing up front. We do the modeling up front. And we do what they call an assessment report at the very final part of it.

And we put it out to the public. We have meetings with ACRS and we discuss what they call the regulatory analysis. We'll get into that a little bit later on.

And then if it passes the screen -- the assessment stage, it goes into a regulatory office stage. And this is where the regulatory office here would be like NRR.

It develops generic communications. They might send out generic letters, bulletins, INs. They meet with the industry. Develop an action plan if there's any necessary actions that industry has to take.

That process could take several years. Once you get into a regulatory office, depending on how quickly the industry reacts.

And we stay in the regulatory office stage until all actions have been implemented for all plants affected. And that the NRC has verified that all

actions have been taken.

The next slide here is a generic process overview. It's a very encompassing slide. But it captures everything from the screening to the regulatory office.

And it shows who's responsible. Who's working on it. And at the bottom you can see all the notices and the public involvement and ACRS involvement.

So it's a pretty good slide. It gives you an overview of the entire process.

Where we are now, is we went through the screening process. And we're in the assessment stage. You can see there the drop downs that we put out the necessary reports.

And during the assessment stage, you can see the research still has the issue. So we're still in charge of the research office.

And we have what they call an assessment team working on it. These personnel are just, you know, working on it.

And they go back and report to the generic issues, you know, group. And put out an assessment report at the end. Okay. Next side.

Specifically where we are on this generic

issue is, when we first get the generic issue into the NRC, we screen it out to see if it's an immediate safety concern. We ask the regulatory office to document that.

And we don't want to procrastinate through a process if there's an immediate safety concern in the plants.

NRR has the LIC-504. And I don't know if anyone's been introduced to that process. But it's pretty quick.

You know, they can say, you now, we have a problem with a valve, or a valve stem or whatever it is. And the plants need to go out there and replace immediately.

But, if the NRR comes back with immediate safety concerns and says it's not an immediate safety concern, we don't know how much of a safety concern it is, so put it in the generic issues process.

Do the entire process. The in depth development and the assessments. And see how much risk and safety importance it has.

So they've done that. You can see that back in March 2016. In May 2016 we put it in the program.

You can see the mark -- the ML numbers at

the end there. If you ever want to go into the ADAMS, and you can see all these documents.

We also have a generic issues' dashboard. It's on the public website. You can follow the issue. It can show you where we are.

All these information documents are tabbed at the bottom there under documents. And then once you get into regulatory office space, you can see which plants are affected.

You know, how they're progressing. What actions they need to take. What steps need to be taken to take the generic issue to completion. It's a pretty good tool.

All right. Once we get through this screening process, you can see May 2016 we did a generic issues program staff screening. Which is just myself and my department and my supervisor and division director signing off to see if there's any specific screening criteria not being met. I can screen it out.

So if this only applies to one plant in the United States, it doesn't meet the criteria of two or more plants. It's not a generic issue.

So, I or my supervisor at that point cannot waste putting together a committee. Review

panel, they call it G-I-R-P, GIRP to waste time and effort.

So it's very economical this program. We take various steps to say push it forward or step back, depending on the criteria.

So, we took a look at it. And we said, we think it meets all seven criteria. We formed a review panel.

We did form a review panel. And you can see the screen report produced by the GIRP was on July 2017.

So you can see we've gone through about a year to get the screening report done. And now we're progressing into the assessment stage.

We issued an assessment plan. And you can see up there. The -- if you want to take a look at that.

It pretty much highlights what the activities are going to be done during the assessment stage. And it gives it kind of a time line so we can kind of hold people, you know, responsible to get something done at a certain time.

If we think it's going to be protracted and go beyond two, three, four or five years, then we might pull back and say we might take it out of the

program. Put it in a study. And then come back in.

So that's what the assessment stage does. We try to put a time. And we put milestones. And we try to meet those and keep people to those milestones. Okay, next.

What you can look forward with this generic issue coming up. We're going to put out -- or hope to put out an assessment report near the end of the year.

We should get all the tasks and milestones done. And if it meets the risk and safety criteria to go on into the regulatory office, we think it's a safety or risk important item, then we formally call a transition team.

We don't want to just hand it over to another department without a smooth transition. So we do a transition team.

We put members on the team that are on the GIRP review panel. And then we put people from the office it's going to on the team.

And we hand over all the information. And the Office Director will send a letter to the other Office Directors saying, you have it. And you have sufficient resources, you know, knowledge about the issue.

So we just don't want to hand it over to -- across the fence and say it's now -- it's yours. So, it's a very smooth transition.

Once it's transitioned to the regulatory office, the regulatory offices, like I said before, will determine what regulatory actions need to be taken.

It could be, like I said, INs, GLs, generic letters. It could be even orders issued by the Commission.

They're looking forward to see if there's anything that the industry needs to do. To look and see if there's any, not loopholes, but missing regulatory items and regulations that need to be adjusted.

And once they've determined that, they put out that information to the industry. They could put it out in a 54F letters to say industry, here it is. And you know, respond back as appropriate.

And one industry has taken all the actions, we review them. We verify them. And then we close out the generic issue.

I think that's the last slide, right? Oh, one more. Okay.

All right. The assessment plan. This was

a -- you can find this inside the assessment plan. And this is a very good overview of what milestones and actions are being taken during the assessment.

You can see which parts have actually been completed. And you can see what actions we plan on going forward.

I will ask Nick to chime in a little bit on what activities he foresees and adjustments to the schedule.

MR. MELLY: This is Nick Melly in the Office of Research. I just wanted to kind of key in on some of the important things that you're seeing up here in terms of the time line.

And in terms of some of the things that Stan was talking about in terms of the risk numbers that are used in the assessment plan. And what causes things to move forward. And what causes things to fall out of the generic issue plan.

So, currently right now, we're looking up there, and we're right around the first of the year we're looking at the Phase Two, large scale test plan. Right now we've finished four tests since September on the medium voltage.

And we're looking to also get low voltage testing done and bus duct testing done so that we can

have the information we need in order to create a zone of influence model for aluminum moving forward for these risk studies.

That's very important that we have all the data we need. So that we're not cycling the industry. Or we're not creating overly conservative models for the damage states.

To accomplish that, the NRC is working with EPRI to create the zone of influence. And we're going to have discussions here about a charter that's in the process so that the NRC can look at all the data with EPRI, and create a zone of influence that's appropriate for aluminum taking into account many different factors.

We want to look at the frequency of the event occurrence. Couple that with plant configurations such as a unit connected design and things like that, in order to create a good picture of what the zone of influence is.

We do not want to move forward in the generic issue with a conservative model giving us conservative risk estimates, because it's just not realistic.

That's where the pilot plant selection, the pilot plant studies come into play. We really

need help from industry because if we use our in-house modeling techniques such as the SPAR to move things forward as we have done for quick assessments, it may be conservative because there are a lot of large assumptions that have to be made.

If we can leverage the plant design, the plant PRA models when we move forward using pilot plants, we can get a better picture of what the risk is at the plants.

And we want to link that with moving forward through the generic issue, so that we can adequately assess the risk at plants.

It's an aggressive schedule right now. And we believe that we can accomplish these. We have a lot of things moving in parallel in terms of the testing, the data analysis with the working group.

We believe we are close to being able to select pilots, or hope to get pilot plants in this process, so we can start figuring out what needs to be done in order to adequately assess the risk. Which is necessary for the assessment plan right now.

MS. ANDERSON: Are we -- are we taking questions?

MR. GARDOCKI: One last comment. Like I said, the dashboard has all the information as -- in

regards to this generic issue.

You can always refer to that on the NRC public website. And in the future, we try to hear periodic meetings, you can probably expect another meeting right before we start the assessment report.

And we're going to have a public meeting with ACRS if they want to have a meeting to introduce this. And they kind of get involved with the regulatory analysis part of the assessment report.

So he can expect those as future activities as far as generic issues program public involvement. That concludes my presentation.

MR. HAMBURGER: Yes. So we will welcome questions from those in the room first.

MS. ANDERSON: Victoria Anderson from NEI. Nick, you mentioned that one of the things you'll be doing is working on making sure you have all the data you need to develop an aluminum zone of influence.

Are you looking at developing a single zone of influence? Or a spectrum of ZOIs based on different physical conditions?

MR. MELLY: A spectrum.

MS. ANDERSON: A spectrum?

MR. MELLY: We're not trying to just do a one worst case zone of influence approach for

aluminum. We're trying to link it in more a probabilistic manner so that we can look at the potential at the plant in order to get a more dynamic zone of influence based on important parameters such as the current, the voltage, plant design.

We don't want one conservative zone of influence that would be used for the study. We're really trying to get a -- to move the method forward.

MS. ANDERSON: Okay.

MR. TAYLOR: And if I could -- this is Gabe Taylor from the NRC. If I could just add to that.

At the workshop last April we talked about different approaches that we could do. And I think the idealized approach would be the dynamic ZOI that Nick alluded to.

It's similar to what the IEEE does for their arc flash calculations. So if we could get there, that would be great.

If we can't, there's other fall back options where we basically bin different categories based on the hazard and the frequencies. And have a ZOI for each individual bin.

And then, you know, the lease detail would be something like we have today. Which is, you know,

a one size fits all, which is kind of not where we want to go.

But what path we go hasn't been determined yet.

MR. MELLY: And it's actually very important to understand that when even looking at the test program that we have developed. Because we are testing at two seconds and four seconds.

And for the low voltage cases, we're going to be doing minimal tests at eight seconds. But we're not doing -- we're doing that for various reasons just so we can look at the spectrum of possible fall cases in the plant.

We're not trying to say, the four second test had this damage state. So now we're going to link all zones of influence to that four second test, which was the worst case.

That is not what we're trying to do with the test program.

MS. ANDERSON: Okay. Are we going to be talking more later about the considerations that go -- that will go into that development of the ZOI spectrum?

MR. MELLY: Right now I believe we're trying to work that through the EPRI working group --

MS. ANDERSON: Okay.

MR. MELLY: Charter. In that that is essentially what the whole conversation of the charter is going to be.

MS. ANDERSON: Right.

MR. MELLY: Is that -- we're going to be looking at the data that we have in-house, and coming up with a method to develop that.

MS. ANDERSON: All right. If we don't get into it in detail today, I think it may be useful to have another public interaction on that topic. Even if it's outside of the generic issue process. I think there may be some substantial technical input that stakeholders may have.

MR. MELLY: I agree. And we've had initial discussions already that we're -- we're looking at the data now. And we've just developed this charter.

We do plan on having several more interactions with the public when we move a little more forward in the process of developing an initial method. Looking at the data.

We plan on sharing the working group conclusions or the working group assessment with the public before any finalized method is developed.

MS. ANDERSON: Okay. Thank you.

MR. HAMBURGER: Thanks Victoria.

MS. UHLE: Hi. This is Jennifer Uhle from NEI. So, my question here is talking about this approach, which is great to hear.

However, the amount of test data you would need to really develop that doesn't seem to jive well with the, you know, having the, you know, four tests.

So, -- or then I would ask in reverse, if you plan on developing these zones of influence, then shouldn't that inform your method in how you develop them?

Shouldn't that inform the tests that you do run? So it -- you know, where are we in likelihood of getting to this state?

MR. MELLY: So to respond to that, we did hold a PIRT panel to discuss the test results of the Phase One testing.

And that was really to inform the Phase Two of testing of what we would need to do in order to create this spectrum of zone of influence, and what data we would need.

That's really what went into the development of the test matrix that is in the current test plan.

And while there have only been four tests performed right now on the medium voltage at two and four seconds and various currents, we're really trying to isolate parameters in this test series so that we can look parameter to parameter differences as we move forward.

Also, we are looking at the next series of testing this summer to have four additional tests at low voltage, various parameters. As well as four tests looking at the bus ducts.

Additionally, we're trying to look at when we can perform decrement curve testing, which I'll get into a little bit later, in order that we can have enough information to supplement the operating experience data that we do currently have in-house, as well as a wealth of information from previous testing at shorter durations using the IEEE 1584 data and things like that.

So we're trying to bring all of that together to create this. But as you say, it is a limited number of tests, but it is a resource issue.

Testing is fairly expensive, fairly slow, and there's a lot that goes into the testing itself.

MR. SALLEY: Yeah, Jennifer, and just to put the final piece on that, as a researcher you know

you can never have too much data. The more data the better.

I think we've -- from what we've worked in the April workshop, we have a pretty good matrix. Which we'll talk about in a little bit, as to how we parse this out.

And at the end of this afternoon's session on the working group, you'll see how that it fits into the NRC's scheme with the OECD NEA and how we bring that to bear too, with it.

So, we have parts long presentation. And I think it will provide you more information.

MR. MELLY: Yeah. And this was also one of the main issues that was brought up by the GIRP panel for the generic issue.

Is that we didn't want to come out with a conservative zone of influence for aluminum before we did this assessment plan. So, the real discussion by the members was, what test do we need to accomplish in order to create a realistic zone of influence?

And it was decided that we needed medium voltage tests, both low voltage and bus duct testing if we wanted a whole picture of what was going to be necessary for the working group to establish something.

MS. UHLE: Okay. And then you're, I would expect working with EPRI to plan these tests and ensure that they are prototypic in their set up?

MR. SALLEY: Yes. Like I said, we -- in April we've done that. And as a matter of fact for the September tests, we had members from EPRI, witness the testing with us.

And that and we plan to do the same in the spring and fall. That we have the working group that will be there to see the tests and get the information first hand.

MS. UHLE: Yeah. It's not so much the witnessing the test as is, you know, taking the comments that are proposed and factoring them in then, rather than dispositioning.

You know, going forward I think that would have to be done to really get to the point that we would, I think, all like, with the multiple zones of influence.

MR. SALLEY: Yeah. And I agree. And it's one of the reasons we made all the public comments and how we changed the test plan as a public document.

So you can -- the ML number is out there. You can see the effects it had from the meeting. And the changes it made.

You know also, one of the things is, we never really were looking at the decrement curve. And that was something that Ken brought up in the -- in the April meeting.

And we've expanded our test program to include that for the value we hope to bring to the testing. So we are listening.

MS. UHLE: Thanks.

MR. HAMBURGER: Thanks Jennifer. I know we have a question on the webinar. Do we have any more questions from those in the room before we jump over to the webinar?

(No response.)

MR. HAMBURGER: Okay. And just before we go to the webinar, both Nick and Stan will be here all day.

So if any questions occur to you as we move forward, please you can jump in and ask them or find them at one of the breaks. Yes. You may.

MR. AIRD: We have one question from the webinar from Mohammad Mustafa. He asks, did the GIRP review include existing codes and standards?

For example, National Electric Code, IEEE's et cetera, related to aluminum? Are they inadequate?

MR. SALLEY: I'll start the answer and I'll let me guys finish. You know, one of the things that we did when we were doing internal briefings, when Fred Brown was the DEDO and we first started going through the internal briefings with this, you know, Fred made the comment to us that the high energy arc faults are not unique to nuclear power plants.

You know, this is an electrical phenomenon, you know, it's not unique. Now granted in a nuclear power plant, you're all familiar we do move a lot of electricity around. We've got a lot of things happening.

So, it may amplify a little bit, or we've picked up on it. But, one of the things again with Fred, was to reach out and to see that very question.

If you remember the April workshop, we had the chief electrical engineer from the NFPA come down. And of course in the common vernacular in the industry is arc flash.

You know, you'll hear this referred to a lot as arc flash and arc flash events. So, we are working with the NFPA.

And again, I think too, with the test lab, the different scenes that we're taking it a little further then the arc flash events that commonly occur.

And you see them here.

We see them in the Metro in D.C. We've lost it. The Atlanta airport has had the one a couple of years ago.

Around Christmas you just saw it in New York City with the blue in the sky again. So, these events are happening out there.

We're going to talk a little bit about the differences in how we bin them in '16 with that. So that will be part of the discussion with looking between an arc flash, an arc blast, and a HEAF.

And again, working with the NFPA, one of the things Ken Miller and us have worked on, is definitions. To clearly define which of the different phenomenon.

So, that's kind of where we're at. Anything you guys want to add?

MR. TAYLOR: This is Gabe Taylor, Office of Research. So, I was on the GIRP panel.

And the information that we looked at was the operating experience that we communicated in the Information Notice 2017-04. As well as other international operating experience that was documented in the OECD reports.

In addition to that, Nick mentioned, we

looked at the SPAR models, SPAR all hazards model to see what the potential risk increase could be. Understanding that they are somewhat course, and not as detailed as the plant's PRA models.

We also looked into the NFP 805 transition plants, into their SEs and information available there to see what the potential HEAF contributions were.

And that's not -- that's using the existing models, so it wouldn't include the increasing, if there is an increase for the aluminum type HEAF.

So that was kind of the core information that we looked at to evaluate the HEAF and the screening, the aluminum HEAF and the screening phase.

As far as the NEC, that's more of a utility specific, whether they follow that code or not. And I really can't make any comment to whether it's adequate.

MR. MELLY: This is Nick Melly in the Office of Research. Yeah, as far as the NEC codes and the IEEE, they did a lot of the wealth of their data collection on copper.

They haven't specifically looked at aluminum. They do have some theoretical comparisons between copper and aluminum.

But their main focus is on personnel protection. Whereas we are looking a little beyond that for extended duration faults.

They are following closely what we're doing in terms of definition space. And they're -- we're going to be looking at their data in a little bit more detail as we move forward.

But in terms of saying whether their regulations are inadequate based on what we've seen, we can't really make that determination.

MR. SALLEY: And I guess a final thing on the aluminum, Frank Cielo is here. Frank, if I could ask on you, you do testing every day.

Is there any insights or anything you can provide to that?

MR. CIELO: Yeah, this is Frank Cielo from KEMA labs. I was just talking to my colleague Alex Feldman.

We do arc flash testing on a regular basis for lots of manufacturers. And it is absolutely for personnel protection.

And we've done your testing of course. And we've done high energy arch fault testing for some other customers.

It's just completely -- the consequences

are just -- they're completely different. In orders of magnitude different.

So, and one of the things you may want to think about is showing somebody a video of a regular arc fault test for, you know, to comply with the IEEE standard versus the HEAF. It's just like, pfft. I mean, it's so obvious, the amount of destruction. The amount -- the impact on our laboratory, the physical impact on our laboratory and what actually happens, it's just -- it's just absolutely incredible.

And you know, we test for every -- we're an independent test lab, all right. We're ISO/IEC 17025 certified.

We have no affiliation with any manufacturer, anybody. And we test for every manufacturer basically on the planet between our three laboratories.

And most of the arc fault testing, we do in the U.S. against the IEEE standard. And you really have to see it to kind of appreciate what this is.

Because the first time we did this for the NRC, we weren't sure we were going to continue, because of just the amount of destruction that we experienced at our lab. And the damage that we experienced at our lab.

But it's important testing. And it needs to be done. And we, you know, we just continue to work through it. Hope that helps.

MR. GARDOCKI: And this is Stan Gardocki. Back to your original question about the generic issues program involvement with industry standards.

We do look at the NRC endorses the industry standards to the regulations. So we'll find out if there's any adjustments that need to be made in the industry standard.

And then they have to go back and re-endorse it for the regulations.

MR. HAMBURGER: Before we get to you, we have a follow up question from the webinar.

MR. AIRD: Yeah. We have one follow up question. It goes, is this an electrical circuit protection issue? Or an aluminum conductor issue?

There are fast acting devices to preclude arc flash and protection schemes.

MR. TAYLOR: So at this stage we're trying to understand the hazard. We are aware that there are some protection schemes out there that are available commercially that could be use to fastly open up a protective device and clear the fault and the cycle, a few cycles.

So, we're aware of that. And you know, once we understand what the hazard is, and the frequence is, and understand what -- where the risk falls out in the delta risk, then we'll be able to have a clearer picture of where it goes moving forward.

And if it does make it into the regulatory office limitation stage. At that point there would likely be a lot of involvement between the NRC and industry in understanding the ways to protect the plant from the type of hazard, whether that be prevention, protection, or mitigation features.

So, we are aware of those technologies. But as far as this program, we're not trying to evaluate the adequacy of those feature devices.

And then regarding the comment on aluminum, you know, we did see the two tests in the first phase that showed some much larger damage areas. There were a few aluminum tests that didn't create any, you know, additional hazard, then what we're seeing in the copper.

They actually didn't even hold the fault in. So, not all aluminum type events may lead to some type of larger damage footprint then what we're seeing form the copper.

But from the September tests, when we ran those, the four tests that we ran, and Nick will talk about those in the next presentation, all four -- they were medium voltage. But all four did last for the entire duration.

And we did see, you know, a much larger damage footprint. And more so the energy release, because the energy is related to the duration of the arc.

And when you're running them for two to four seconds, there is a difference between that.

MR. MILLER: This is Ken Miller, Electrical Research. As Gabe said, we've about recognized that protection schemes in fact are supposed to clear these kinds of faults within very short periods of time.

We understand that. And but of course operating experiences has shown that sometimes that doesn't occur. There's failures that occur. And these kinds of HEAFs, you know, occur as a result of that.

And again, the important point here is to study and understand how destructive those can be as far as effecting the zone of influence.

So, again, we understand that protection

normally would take case of something like this. But, we're seeing cases where it doesn't.

MR. MELLY: Yeah. And to the second part of your question as well, this is Nick Melly from the Office of Research.

In terms of aluminum, we're also not saying at this moment in time that the -- if you have aluminum as part of your conductive pathway that it's more prevalent to have a higher G arching fault.

In terms of frequency, we're not seeing that from the data yet. It is an issue that we're going to be looking at when we take a deeper dive into the data.

But the frequency of occurrence from aluminum versus copper, right now we're not seeing as a change.

MR. HAMBURGER: Okay. Let's take the next question from the room, please.

MR. FLEISCHER: This is Ken Fleischer from EPRI. Not so much a question, but I did want to share some OE of one major U.S. manufacturer of switch gear in regards to type testing of copper bus bar switch gear versus aluminum bus bar switch gear back in the '70s.

Now again, to reemphasize that these were

two second tests, because the IEEE standard requires switch gear to be rated to two seconds. They noticed no discernable difference between the two tests.

The only thing that the test did to demonstrate was that the aluminum bus bar would have to be a little larger than the copper bus bar with a little bit of different spacing. But they did not see any of the extra aluminum byproduct from those two second tests.

We are also working to contact a few more additional manufacturers. But we did get one that actually told us they did the type tests with aluminum.

MR. HAMBURGER: Thank you Ken.

MS. VOELSING: Hi, this is Kelli Voelsing, also from EPRI. So, I think we need to clarify so that we're not mixing an apples and oranges discussion.

The reason that Ken shared that information that we received from a manufacturer regarding the difference between aluminum and copper type testing, is because from the comments from the gentleman from KEMA, we assumed when he said the testing is completely different, that he was referring to testing between copper and aluminum.

In offline discussions, he clarified that he was talking about the difference between flash testing and arc fault testing. So the duration of testing.

So I did want to clarify that apparently he was intending to communicate a difference in the duration of tests. Not a difference between copper and aluminum, which is the generic issue that we're supposed to be talking about here today.

And I'd also like to clarify that I think we have to be careful about referring to the damage footprint. Because we haven't necessarily validated any damage.

What we've validated is, you know, byproducts being deposited at a certain radius. Not damage.

MR. TAYLOR: Thank you Kelli. And that's a -- that's a good point. I was searching for the right words.

And it's really the observations from what we saw between the copper and the aluminum, where at the two aluminum tests, well, six aluminum tests now showed the larger area.

MR. CIELO: Yeah. This is Frank Cielo. Thank you for clarifying that. I didn't intend to

cause any confusion there.

It was the difference between the regular arc fault testing and this testing. Thank you for clarifying that.

MR. HAMBURGER: Okay. Any more comments from anyone in the room?

(No response.)

MR. HAMBURGER: Tom, do we have anything else on the webinar?

(No response.)

MR. HAMBURGER: Okay. We are ahead of schedule. So Nick, if you're ready to go, we'll talk about those preliminary observations.

MR. MELLY: All right, next slide. Again, this is Nick Melly from the Office of Research. I'm going to be discussing the testing that was performed in September.

Kind of a big picture look at some of the observations, some of the preliminary insights and the project goals.

I'm also going to be talking about some of the challenges, the measurement devices that we're using, and the general observations.

I also want to discuss the future testing parameters and schedules and some important milestones

as we move forward. Next slide.

So to start this all off, we did share the draft test plan to our OECD NEA members, as this initially started as an international project on June 30 of 2017.

We also put this out for public comment in the Federal Register in August for a month long public comment period. That closed on September 1, 2017. Next slide.

As part of that initial test plan, we did receive five comments from NEI. And we had 32 comments from our OECD members.

Since then we have received numerous comments both from NEI, EPRI, as well as some of the industry itself. Which we have discussed at the public workshop that we held in April 2018.

And we've addressed all of these comments and dispositioned them. Formally put that into our public document system, ADAMS, essentially addressing all comments and how the NRC planned to address them.

Whether they were going to be put into and incorporated into the test plan. And if any physical changes were made to the test plan, both parameter and testing method. We have the ML link that is up there.

So right here on the screen you're seeing

the Phase Two HEAF test program. This is the matrix that we discussed earlier.

This came about after the PIRT panel phenomenon ranking table -- parameter identification and ranking table exercise that we held in January 2017.

This was our best guess of, these are the amounts of tests that need to be conducted in order to answer the question and get the data that we need.

What you're seeing on the screen here is four box tests. Test 2-19, 2-21, 2-22, and 2-24. These are the tests that were performed in September that I'm going to be discussing today.

These were all medium voltage, 6.9 kV tests at 25 kA and 35 kA for two seconds and four seconds respectively.

Another aspect that you're going to see on the slide here, you see the two tests that are on the far right-hand side with Xs. These were identified that we may need to do additional testing.

And we wanted to be budget ourselves to be able to perform tests as things came up.

MR. TAYLOR: Nick, just to clarify. This is the -- showing 35 kA for the 6.9 kV test. We actually tested at 32 kA.

So this was from the original test plan.

MR. MELLY: And that is because the test facility itself, there are some limitations on the capabilities of the generator. So we actually had to reduce the current in order to achieve the duration of testing that we wanted to achieve.

The two tests that I was discussing earlier, the SPAR tests on the right-hand side, we have allocated those for the decrement curve testing that was a direct result of the comments from EPRI.

These are going to be tests where we're actually going to be simulating actual operating experience event at a unit connect design plant where the generator essentially fed the fault.

This is not a trivial exercise. We have a separate contracting action with the laboratory in order to develop the capabilities needed to do this test.

KEMA has never done a test like this before. So, getting their generators ready to simulate this, is a separate effort. Which is why we did not do them in September.

And we're currently pushing that forward right now, working with EPRI to establish what needs to happen. And the KEMA test engineers.

Another thing that you'll notice on this test matrix is that there are some tests in blue and some tests in orange. We're doing this as part of an international program.

The tests in blue represent tests that are going to be funded through the OECD NEA test program. And largely these are copper tests versus the ones in orange, which are the aluminum tests.

We're performing the orange tests first, because they're associated with the need of the generic issue program itself. So we are prioritizing the generic issue and performing the test that you see in orange before we do any OECD NEA tests.

Next. I'll take questions during the presentation. So, sure.

MR. HAMBURGER: Sure. This is a long presentation. So if you --

MS. UHLE: Okay. Thanks. Jennifer Uhle from NEI. So, I want to go back to a question that I previously asked.

And I think in your discussions about this test -- particular test series -- excuse me, I have a cold. You indicated that the industry comments, the EPRI comments, you dispositioned.

And this is the point about that we really

want to make or get across so that it's clear to everybody. The industry comments that were given to NRC, they were, I agree, dispositioned.

But that does not mean addressed in a substantial manner. There were numerous comments that the industry felt essentially affected the proto-typicality of the tests that were -- we got the answer, we'll deal with this in a next test series.

And so, we've been saying that industry has -- comments have been addressed. But, that's not our opinion with regard to the test series.

And that's why when we want -- we want to highlight the importance of truly listening to the comments. And not dispositioning, meaning, I heard you. I don't agree with you. And I'm not changing the test set up.

MR. MELLY: Do you have any specifics in terms of which comments were not addressed?

MS. UHLE: Yeah. And I'm going to --

MR. HAMBURGER: Well, let's -- if we're going to discuss those, I suggest we wait for the public comment period. Because that might be a detailed discussion.

And so it's --

MS. UHLE: Well, I just -- if you don't

mind, this can be very quick if we just -- and then maybe we discuss it later.

MR. HAMBURGER: Okay. Sure.

MR. FLEISCHER: Ken Fleischer from EPRI. One particular comment that actually we also verbalized during the April workshop, is we still didn't really see the benefit or -- really the benefit for the low voltage eight second test.

Unless that test could be justified by some means. And I know that it was originally mentioned at the April workshop that it was probably going to be discontinued and go back to the four seconds.

But we see that it's still considered as eight seconds. I don't know if that ever really got finally dispositioned as one example.

MR. MELLY: So this has been dispositioned. And the final test plan has not been released, because it is part of the OECD agreement.

However, you still see the eight second test as part of the low voltage. We did reduce the number of eight second tests.

However, we've added to the test plan that the eight second tests are not going to be used to inform the eight second or the low voltage zone of

influence spectrum.

However, we are trying to still do an eight second test only in term -- so we can draw comparisons between the low voltage and medium voltage tests where we might see a medium voltage case hold for longer than four seconds.

So the eight voltage second test is kind of just a place holder, because we are at the limits of the capabilities of the KEMA facility. So we cannot do an eight second test at KEMA for a medium voltage case.

MR. FLEISCHER: That's interesting.

MR. MELLY: However, we're trying to draw some comparison of what we see from the low voltage to what we can maybe expect to see in a medium voltage case where it does last for potentially longer then four seconds.

So, we have made that distinction in the test plan which we plan on releasing very shortly. That is the only reason that you see that eight seconds on the low voltage case currently.

MS. VOELSING: Kelli Voelsing from EPRI. And Ken can probably speak to this a lot more eloquently.

But, I'm not -- we see in the OE very

different situations that lead to potentially high energy arc faults in low voltage versus medium voltage equipment. So very different set of conditions that lead to those.

And so I'm not sure that there's a solid technical basis for extrapolating the results of an eight second low voltage test and saying that that's somehow applicable or representative to what you might see for medium voltage if the facility had the capability to do that.

And I would say that the generator voltage to k curve is another example of a comment. And I realize, you know, you're planning to address that in the future.

But, it's not going to be particularly relevant to the low voltage testing that's up coming. And so, is there a time line when those two reserve testing places are planned?

Because it would seem that the results of those tests might be critical to the resolution of this issue. And I'm wondering how those are going to happen before the planned time line for the first presentation of resolving that by December.

MR. TAYLOR: Okay, Gabe Taylor from Research. So, I'll touch on the last part of your

comment first.

The two orange boxes on the far right, the optional tests, as Nick mentioned, we're going to save those for the decrement curve evaluation. And later in the presentation we're going to talk about the decrement curve.

One thing that -- that's the type of experiment that hasn't been done at KEMA, trying to match that type of decay response from the generators. Typically they use super excitation to maintain a constant power source.

So because of that, there's a lot involved on their end analytically. And also validating that they'll be able to perform that type of testing.

So because it's not in our current contract, and there's the work involved that it requires us to go into our contracting process to make changes that are new. A new contract to get the work done.

So, through that process, it's not a -- it's going to take some time to get that in place.

MS. VOELSING: I think the complexity is understood, I'm just asking about the time line, with respect to the resolution of the GI that you propose by the end of December.

MR. TAYLOR: Yes, I apologize for the long-winded explanation, I was trying to provide as much detail as possible. So, when we get that process completed, we'll be able to perform the testing.

So, because where we're at in the contracting process phase, I don't have an exact time frame for you. But if I were to guess, it would be sometime later this year.

MS. VOELSING: Do we want to talk about the extrapolation of eight-second?

MR. TAYLOR: Yes, that was the next place that I was going to pick up. So, you remember from our April workshop, we talked about some small-scale testing and modeling. And over time, that has -- we have changed directions and the process that we're going through, because of some subject matter expert changes.

So, currently, the plan is to work with Sandia, using their area model, and basically, be able to develop that to run simulations to estimate different physical parameters, such as heat fluxes, pressures, particle ejecta, that sort of thing.

And by being able to perform these small-scale, as well as medium-scale, tests, we could have models and simulations that could -- basically, the

data would validate the models and then, you could use the simulations to develop ZOIs or that sort of type of information that would be useful in informing the eventual model that's used in the PRA risk assessments.

MS. VOELSING: So, obviously, modeling and simulation is always a valuable part of the process, but developing models and validating them based on an extrapolation, I'm not sure that that provides solid technical basis for the models.

MR. TAYLOR: They actually already have the model in use out there, and I believe EPRI is actually using it for some of their DC work.

So, what we really need to do is provide some changes to the sub-model, to accurately represent what we're trying to characterize. So, it's a multi-pronged approach, to try to understand this hazard.

We see some value in performing the small-scale work, but also, regardless of that pronged approach, there's also some value in having more than two points and you're trying to extrapolate for low and medium voltage.

So, while we did reduce the number of eight-second tests that were originally planned in the small-scale test, or in the full-scale test plan, we

still see value in performing that type of duration.

And in addition, we're seeing some operating experience that shows longer duration low voltage OpE. However, I think we are in agreement that the frequency of low voltage versus medium voltage and the hazard that it contributes are different between the two.

MR. HAMBURGER: If we have more questions about the small-scale testing or about the resolution of specific technical comments, let's hold those and let Nick --

MR. MELLY: I'd like to answer one thing. The extrapolation is important, we think, because we just simply don't have the ability to do an eight-second test at the KEMA facility.

We are trying to match, we would like a data point, so that we can develop this spectrum type approach to the zone of influence models.

We did see some OpE, such as Robinson, where it was between an eight-second to 11-second arc, in medium voltage. We do not have the capability at the KEMA facility to replicate this event.

So, we are looking at how we can make comparisons between the low voltage energy release versus the medium voltage energy release, in terms of

duration. We do see that as a key important factor.

The PIRT documented duration as one of the most important factors for the high energy arcing fault and we're, again, seeing that from testing. So, we do see limited number of low voltage tests as an extrapolation point, an important test parameter. Okay, moving forward.

I want to discuss some of the challenges that we saw with the Phase 1 testing, and some the measurement limitations that we're running into. We had been testing with plate thermocouples, essentially using an Inconel plate to measure the heat flux and the temperature.

And you can see the picture on the left, the before image, versus the picture on the right, after it was subjected to Test 23, where we completely melted the Inconel plate and were not able to record any data at the three-foot location.

This was a limitation that we had not anticipated and we were not able to get any data from that test, because we damaged our instrumentation. This was a main issue that we were trying to deal with as we went towards Phase 2, is how are we going to collect the data that we need to inform the model? Next slide.

So, what we came up with with NIST was a tungsten slug calorimeter, essentially, a more robust measurement device using one-inch diameter tungsten slug.

It was very durable and the hope was that it would survive a direct impact from the high energy arcing fault at the three-foot location and beyond, or wherever we put these devices.

We were using a calcium silicate insulating board, a Marinite type board, around the tungsten slug, to essentially protect the device and get the data that we needed.

You see a picture on the left there, that is a picture of it under the heat release rate hood at NIST itself, cone calorimetry, testing the principles and developing that tool, so that we can use it in Phase 2 testing. Next slide.

Another challenge that we faced with the Phase 1 testing was, how to get the pressure results from the events themselves.

We had a lot of interference with electromagnetic interference for our pressure devices that we were using in the Phase 1 testing, so we didn't fully believe the results that we were getting, because of this large interference.

Pressure is a very important aspect of these high energy arcing faults. As we said, we can have blast effects with these, where we can create pressure waves within a compartments and potentially damage boundaries between fire barriers, or between fire areas, or have pressure effects on other equipment.

A good example of this is the event that occurred at Turkey Point in 2017, where we did breach a fire barrier and damage a fire door between two adjacent switch gear rooms.

This is one area that we're looking at and we really needed to dial in on how we were performing these pressure measurements, so that we can get a better picture of what is going on. Next slide.

So, as we move forward to Phase 2, we decided to move to a fiber optic measurement device. KEMA has upgraded, essentially, their facility and we're getting much cleaner results.

All the pressure measurements that we have received in the Phase 2, the first four confirmatory tests, do appear to have worked adequately and just as we expected and things are looking good in that area. Next slide.

We are also looking at video as data, as

part of these test series. It's a very fast event. We're using a lot of different videography tools, such as our infrared cameras, essentially to look at the temperature of the event as a whole.

We are -- there are some challenges with this, because it is such a quick event, and we're seeing temperature ranges going from ambient to 35,000 degrees at the initiation of the arc itself.

So, there are some compromises that we needed to look at, in terms of our infrared cameras, such as the field of view, the speed, and the temperature ranges that we can achieve. Next slide.

We have improved the infrared camera technologies that we're using, both through NIST and Sandia, trying to look at a dynamic picture of what is going on during the test itself.

For our Phase 2 camera capabilities, we have a greater temperature range and higher resolution.

And all of these infrared techniques that we're using will be shared, potentially, in a separate NUREG report, that our colleague Dave Stroup is working on currently, and we're going to be pushing that forward to our Phase 2 test program. Next slide.

Another important tool that we're using

and that we have recently developed for this test program is our data acquisition system.

Right now, we're using an isolated data acquisition system with an independent power supply. We've seen in other test programs that the arc itself can short out the data acquisition.

And like we said, these are fairly slow tests, we can only perform a few a week, and if we lose a data acquisition system and all the data, it's a complete waste of a test.

So, we have spent a lot of effort in how we can create redundant systems in order to collect all the data that we need. Our current system has 72 channels, we're only using about half of those channels currently.

And I'll discuss different ways that we're adding capability to this data acquisition system to potentially collect more information, as we move forward. Next slide.

So, what you're currently seeing on the screen is our test setup for the Phase 2. We have different instrumentation racks, located at three-foot on all sides of the cabinet and above.

And additionally, we have a six-foot rack located in the direction where we believe the arc is

going to travel. We've had fair success in the past with predicting the arc path, based on the electrical setup of the cabinet itself and where we're initiating the arc.

However, it's not an exact approximation for every test case. Sometimes, the arc will tend to migrate, as we've seen done in previous tests, so we really need to have a way to collect information on all sides of the cabinet itself, so that we do not miss the arc ejecta and all the energy release, to have a useful test in all cases.

Some of the challenges with this is that it's a lot of instrumentation, it's a lot of data, and it's a lot of time to set up the tests. Next slide.

What you're looking at on the screen here is what one of those typical racks looks like and the types of instrumentation that is on each rack. We have ASTM E thermocouples that we're using, that link to the IEEE standards.

We have plate thermocouples. We have the tungsten slugs that we discussed. We also have a lot of passive instrumentation on these test racks, such as cable coupons, aerogels, and carbon tape, that we're using to measure the ejecta from the event itself, looking at the byproducts that are created at

different distances away from the arc.

We're hoping that all of this will feed into the model that we select, as we move forward with the working group.

You can see here, this is a lot of data. So, we're trying to spend our resources wisely, we want to work with our modeler and figure out what data exactly they need before we go and post-process all data and all collection points that we took during the test. Next slide.

Additionally, we're working with Sandia, trying to leverage a lot of their DOE advancements and their camera capabilities, high speed capabilities, leveraging that, so that we can use it for this test program. We have various cameras located away from in front of the test cell itself.

And additionally, we've developed a system to put a camera inside the test cell, using mirrors and, essentially, to look at the arc location without damaging their expensive cameras.

Worked fairly well in the first series of tests and we hope to continue that as we move forward, because, again, the video data is very important as we try and assess what happened during the event, both the infrared, as well as the high speed. We're able

to understand things now that we were not able to see in the first series of testing. Next slide.

Another thing that we're doing in this test series is, we're doing the full weights and measurement of all of the test equipment before we test and after we test.

We want to get a picture of how much material was vaporized, both in the conductive pathways, the aluminum in the different phases of power, as well as how much was vaporized of the cabinet itself, if we had cabinet breach.

This is something that was not done in the first series of testing and does take considerable resources post-test arrangement. Next slide.

This is the piece of equipment that we used in the first four tests that were conducted in September. It was a single compartment GE-Magne-Blast Metal-Clad Switchgear, where aluminum busbar was located in the rear of the compartment that you're seeing there.

This was the equipment that was discussed in the April workshop and was selected with some interaction with the industry. It was deemed to be a typical cabinet that we would see in the U.S. operating plants. Next slide.

This is the actual in-KEMA design setup before one of the tests. You're looking at the cabinet. The front door of the cabinet is located on your left-hand side. You see pressure transducers located on the sides of the cabinet, under that 219 symbol.

As well as, you're seeing our protected instrumentation racks located, again, at the three-foot and six-foot locations, in order to collect the information that we needed from the ejected arc.

This was a -- for each one of these test series, you see the racks there, themselves, we could not reuse a single instrumentation rack, because of the damage from the event itself.

There is a considerable amount, about a week of prep time that went into building these instrumentation devices at the KEMA facility before they are used.

So, it is a considerable amount of work that goes into a single test and they're not reusable, so that kind of explains why these test take as long as they do to prepare for, as well as to run a single test. Next slide.

What you're seeing here, and I'm not sure if you can make it out clearly, is the arcing wire

that we're using to initiate the arc itself across three phases of power. It's a thin -- Ken, can you go over that with the mouse by any chance?

MR. TAYLOR: Yes, it's a 24-gauge single-strand tin-copper wire, per the C37.27 standard, IEEE.

MR. MELLY: And this was a change that we made based on some of the comments we received during the public workshop. We initially had been initiating these arcs using the low voltage standard, because they had a rationale for the ionization of the wire that was created itself.

However, from one of the comments, we decided to change that to the medium voltage case that was used, and we went with a thinner gauge wire. That wire was able to maintain and hold the arc in all cases during the test week. Next slide.

So, here are the four tests that we did perform. These are pictures of the rear of the cabinet itself, post-test. The first upper left-hand picture you see there is our Test 219. This was a two-second arc at our 25kA.

And moving across, you have our two-second arc at 35kA. On the bottom left, you have our four-second arc at the 25kA. And the bottom right is our four-second arc at the 35kA, 32kA, I'm sorry.

You can see the progression in damage states, however, we did breach the cabinet in all cases. We do see this linking up with operating experience, where an arc occurs in the rear of the cabinet itself, it does create a cabinet breach.

From the video itself, we can actually witness the metal in the back of the cabinet essentially vaporizing and ejecting the energy towards our instrumentation devices.

One thing to note here is that we do see fairly repeatable results. That was a challenge when we had equipment donated from a ton of other countries, where we essentially didn't have the same piece of equipment.

Which is why, in the second phase of testing, we're trying to use the same make, model, and initiate the arc in a similar location, so that we can have comparable data as we move forward.

We were successful in locating our instrumentation and we're using the arc initiation point as our main parameter to decide where we locating things.

In all four tests, we did see the door in the front of the compartment open, due to pressure effects. It was a single-latching door. We were able

to re-close the cabinets after the experiment itself. We saw minimal bending, but we didn't see many thermal effects at the front facing of the cabinet itself. Next slide.

Another aspect of this I want to discuss is some of the observations we're seeing from our measurement devices themselves. We were again using that calcium silicate Marinite board for our ASTM E slugs, as well as our tungsten slugs. And we saw some unusual effects occurred during the test series. Next slide.

What you're seeing there is a before and after picture of one of our tungsten slugs that was located on the three-foot rack. On the right-hand side, you see this green silicate glass-like material, that has bubbled up from the Marinite itself.

And we're looking into trying to match material property characteristics for the Marinite to the temperatures of the exposed surface, with the data that we've collected from that tungsten slug.

We have -- those devices did survive and we were able to actually collect valuable temperature, as well as heat flux information from the majority of our tungsten slug devices.

So, we do see that as a success moving

forward in the ability to capture these high energy cases at a close proximity to the cabinet. Next slide.

Again, our plate thermocouples did not survive the highest heat fluxes that we saw there, which did expose us to a new problem that we had not anticipated, which was once the plate thermocouple vaporizes, the wires and the wire pathway that is behind that device becomes exposed, which damages all the other wires behind it.

So, there were some cases where we still lost data because of the high energy that's released from the cabinet, and we're currently working at ways to enhance the protections, so that we do not lose any of the valuable data. Next slide.

Again, another thing that we're looking at to improve our cost-efficiency of the test program is, we have been using the ASTM E slugs.

That is largely so that we can have a direct comparison between testing that was done as part of the IEEE work, as well as ASTM work. However, we may see this as a redundant testing device, which we do not need to use moving forward.

It's one area that we hope to bring up with the working group, after we can look at all of

the data for these devices, to see if we even need to use these moving forward and maybe make each test a little bit more cost-effective. They're fairly robust, however, they did not survive the high intensity arc itself. Next slide.

Another big ticket item that we're looking at for this test program is the deposition of ejected byproducts, as we move away from the cabinet itself for these aluminum tests.

What you're seeing here in these two pictures is some of that ejected material, which is the white powder coating that is on the wall of the test cell itself.

We did take black carbon tape samples of this material and we're going to be performing post-test analysis at Sandia to look at exactly what that byproduct was, both at the wall, on the three-foot test stand, and the six-foot test stand.

One important note is that we didn't really see this type of ejecta during the two-second arcs that we had in this test program. The majority or the bulk of the material was during the four-second test.

So, that's another issue that we're looking at, that these aluminum tests might not have

the amount of byproduct material ejected, depending on the duration of the arc itself.

So, this was a question that came up just recently in this series of testing that we're going to be evaluating. We have a question?

MS. VOELSING: Yes, sorry, this is Kelli Voelsing from EPRI, again. I'm sorry, I may have been confused, but I thought the latest information I received was that, although you took samples with the carbon tape, you did not plan to have Sandia analyze them, because of resources, and you were counting on the small-scale test results to do the material characterization. Did I misunderstand what I was previously told?

MR. TAYLOR: Yes, there must have been some misunderstanding. So, we put samples in a number of locations. On every rack, we had a number of different types of samples, aerogel, black carbon tape, PVC samples, and we have hundreds of samples to analyze.

There's probably five or six different ways that can analyze each sample. And really, putting the samples in the testing is not the expensive part, the expensive part is the post-test analysis.

So, what we're trying to do right now is understand exactly what the model needs and what samples need to be analyzed and how they need to be analyzed, before we move forward and expend the resources to analyze the samples.

So, they've done some preliminary, picking off one on each rack and analyzing it for different parameters.

But as far as analyzing the samples that are needed to inform the working group's work or the modeling work, we haven't initiated that type of resource expenditure. So, we're trying to be as efficient and as effective as we can to get the information that's needed.

MS. VOELSING: So, to date, either from the small-scale or from this testing, there's no material characterization results available?

MR. TAYLOR: Not to the public, no.

MS. VOELSING: Or to the working group?

MR. TAYLOR: Or to the working group, yes. They have done some preliminary analysis, but even on the small-scale, the small-scale is really focusing on the modeling.

And until they have -- because the changes in direction on the modeling and the approaches, until

we have the modeling approach nailed down, we didn't want to analyze the samples yet.

So, all the samples are still out at Sandia, there's some preliminary information that was provided to the NRC, as just a quick look, but as far as a comprehensive analysis of the samples, we don't even have that yet.

MS. VOELSING: It might be helpful to the -- even to have the quick look, to know what the material was characterized at. And will there be any potential for stakeholder engagement on these models that you're working on with Sandia? Because that doesn't seem to be a part of any of the discussions.

MR. TAYLOR: I'll let -- do you want to answer that or -- okay. So, yes, when we get far enough down the line, I think that's, as Victoria made mention, it would be very valuable to have feedback on the modeling and what we're getting out of that.

MS. VOELSING: It might be helpful to have feedback on the front-end, to make sure that what comes out the back-end is appropriate.

MR. TAYLOR: Agreed.

MR. MELLY: And we do see this as a very important piece, as we move forward. Again, the material composition, as well as the conductivity that

we're talking about affecting equipment is a big part of the aluminum issue.

And we recognize that and we have been working towards ways of improving the data that we've collected, so that we can draw this conclusion. We do see this as an important aspect. Next slide.

And again, this is a picture of some of the metal ejecta that we did take samples of at various distances from the cabinet itself, that's what you're seeing on the ground here. Next slide.

And to even push that forward, we have looked into new ways to actually address, actively, conductivity measurements within the room itself, during the test that we do conduct.

We're going to be using a developed tool, instrument, in order to look at the conductivity during a test cell, as we do these four low voltage and four medium or bus duct tests in the summer.

These are essentially resistant devices, where their initial intent was to measure the corrosion effects in smoke environments, to look at how they affect conductivity changes in real-time.

And we're hoping that, if we do use these as we move forward, as we coat these in byproducts, we can get a real-time estimate of conductivity changes

within the test cell itself at various distances.

This is a new device that we've not tested before, we're currently working with NIST, not right now, because they're furloughed, but we're working with NIST to add these into the test program itself and put these in the future tests that we're running.

We're doing some shake-out tests right now to see if these will be useful and the type of data that we can collect using these.

As I said earlier, the next four tests that we have planned, or the next eight tests that we have planned, include four low voltage tests, at 15kA and 25kA, the tests that are identified here. A two-second test and eight-second test is slated for the next series of testing. Next slide.

And additionally, we have our bus duct tests. We're going to be doing a copper bus duct with an aluminum enclosure, which is typical that we see and that we saw from a survey of how much aluminum is out there, that was performed by NEI.

As well as, we're going to be looking at aluminum bus in an aluminum enclosure. So, these are the tests that we have slated for the spring/summer. Next slide.

Some of the important OECD, the next phase

actions and some of the important milestones that we have upcoming. We've completed most to this date. We also are going to be getting some international equipment for the OECD NEA tests. We have just received that in-house.

And the next big milestone is the second series of tests that we're going to be performing in the spring, May, summer time frame. We have not established a firm date yet, we're going to be working with KEMA, as well as NIST, when they're off furlough, to establish the dates for the upcoming test series.

Any questions on anything that I've went over in the last portion of this presentation?

MR. HAMBURGER: We'll take any questions from the room first.

MR. SCHAIRER: Yes, this is Mark Schairer with EPM. Can you elaborate a little bit more on how the data you're collecting will support the zone of influence spectrum?

In particular, are you going to differentiate between ignition and damage of cables and different cable types, like thermoplastic, thermoset, Kerite? So, is the data you're collecting, will that be sufficient to support that spectrum?

MR. TAYLOR: So, we're -- Gabe Taylor,

Office of Research. So, that's one thing that we've been trying to get a grasp around is, we're doing a lot of work to understand the hazard, but on the back-end, the fragility that you're speaking to, does equipment or cables become damaged or do they ignite?

That's an area where -- the applicability of the current data, that's more thermal fires and damage via these high energy short duration exposures. We're trying to get a grasp of how we would go about doing that.

So, again, we're looking at possible heat conduction type modeling, similar to the THIEF model that we have in FDTs, to try to characterize what the thermal fragilities, from a function standpoint and from an ignition standpoint, are.

But if there's -- it's an area where we're definitely seeking feedback from anybody that has expertise in this area, to help inform the process going forward, because that's a very important concept of determining what the ZOI is, is what those thresholds or fragilities are.

MR. SHUDAK: This is Tom Shudak with Nebraska Public Power. As far as your other testing that you're going to do on copper buses, were you anticipating doing those before you released your

report or are you going to do some comparison between the copper and aluminum from just a zone of influence from these control tests?

MR. TAYLOR: So, we have the original testing program for the Phase 1 OECD test. So, they potentially provide us, for a comparison. But as far the GI Program, that test data from Phase 1 and anything else that we can come up with from either NFPA or IEEE to compare it from, we will.

As far as the other tests in this matrix, we don't envision those testing being performed before the assessment phase would need to be completed. So, the comparison of those wouldn't be available for the GI Program.

However, later on, when we complete all the testing and we work with EPRI through the working group and come up with kind of the updated guidance for 6850 Appendix M replacement, that obviously would be a very valuable comparison.

MR. PRAGMAN: Chris Pragman, Exelon Nuclear. I just want to follow up on Tom's question, because my understanding of the GI process is that the decision is based on a change in CDF, or delta CDF. So, if you don't have the base model involving copper, how do you quantify the delta CDF for aluminum?

MR. MELLY: So, the CDF or the delta that we're going to be using right now is compared to the current 6850 Appendix M zone of influence model. So, we're not changing that.

However, if we need to look at the zone of influence as potentially greater, through the working group or through the charter, that is how we would establish a delta.

From the current modeling techniques that are used, that three-foot, five-foot, with the caveats, versus what we establish for the aluminum, that would be the current delta that we're talking about for the Generic Issue assessment phase.

MR. PRAGMAN: But it seems like to make an apples-to-apples comparison, you'd have to compare four-seconds copper to four-seconds aluminum. 6850 isn't four-seconds anything, it's more a empirical number based on past experience.

MR. MELLY: And that's why we're not trying to simply say, it's going to be a four-second model. We're going to be developing a model specifically for aluminum, using this data, and then, applying that to the plant.

However, the current model that is in regulatory use is that 6850 model, so that would be

the baseline risk, what plants have currently modeled to, versus what we come up with as a working group for the generic assessment phase.

The eventual models, as we move forward and complete the entire test program, will be looking to change both the 6850 and the aluminum, so we may be altering the copper zones of influence as we move forward.

However, for the Generic Issue assessment phase, the baseline is the current modeling techniques that are part of the regulatory basis versus what the working group comes up with for the zone of influence of aluminum.

Again, not a single four-second conservative model, but a spectrum that uses the frequency of occurrence, plant design, as well as all the data available, both the spectrum of two-second, four-second tests.

MR. PRAGMAN: So, it sounds like we're saying we're going to -- the baseline is 6850, which is based on experience. The GI process, we'll use a model -- I mean, when we're using models as licensees, we're expected to benchmark them somehow.

So, I don't understand how you would benchmark your model versus experience. I don't feel

like you've explained that well enough yet.

MR. MELLY: And hopefully, that will be the next meeting that we have, where the working group establishes the basis for this new model that we've created, using both data, operating experience from the plants and the frequency to explain what we will be using moving forward as a zone of influence for these aluminum cases. Again, we're not changing the baseline, which is the Appendix M of 6850, though.

MR. PRAGMAN: Thanks.

MR. TAYLOR: I just had one thing to add to the previous comment from Mark. One thing I forgot to mention, in our -- and Nick probably brought it up. But on our instrument stands, we also place cable samples, so we can look at those afterwards and see the effects from the event or the test.

MR. MELLY: Yes.

MR. TAYLOR: Cable coupons, yes.

MR. MELLY: We use various materials of cables as well on those. Tom, do we have questions on the webinar?

MR. AIRD: We have one question on the webinar, from Mark Hewlett, APS. He asks, are the connectivity sensors mounted in a manner representative of location inside a nearby cabinet or

direct exposure?

MR. MELLY: Currently, the thought is that we're going to put them direct exposure at various distances away from the cabinet, such as on our instrument racks at the three-foot, six-foot, and maybe beyond, where we anticipate deposition of materials.

However, the current test plan does have adjacent cabinets as a potential. And if those tests are performed, then we can put the conductivity measurement inside of that cabinet, to see if we're getting any influence inside the cabinet itself from deposition of materials.

MR. TAYLOR: And from those sensors being used in the smoke type testing, orientation plays an impact on the measurement.

So, if there's feedback on -- we have a solid state protection cabinet that's got circuit cards in this orientation or we have this other cabinet that has circuit cards in this orientation, that would be useful information for us to incorporate into the testing, to ensure that we're being representative of the configurations.

MR. HAMBURGER: Any other questions from those in the room? Anything on the webinar. Okay.

And again, I think all of the staff here is going to be here for the rest of the day, so if any questions occur to you, don't hesitate to ask. And I think Mike Cheok has a --

MR. CHEOK: So, Ken, before we go to the next presentation, I would just want to revisit what I said at the beginning and then, we can go from there.

So, I think what I said at the beginning was we are going to have to be very methodical in doing our tests and evaluating this issue. And the second thing was, improving our communications. So, I will, I guess, say it again.

So, in being methodical, we have to do things correctly. We have to do tests that are realistic, that are in conformance to some standards. We have to do tests that are practical.

So, what we heard this morning was some discussion of the tests, but on the -- and the second part of the Generic Issue is not just the testing, but to look at operating experience. And we haven't got to that part of the test yet. And that becomes a very important part of resolving this Generic Issue.

So, we also need to be very realistic, in terms of looking at OpE, operating experience, so that

we can be realistic and so that we can be using parameters that are plant-specific, that we see in our plants.

So, what's going to happen -- what we continue to have to do is to marry the results from the testing with a frequency and a look at what we have out in the plants.

So, what we are hearing this morning is only a smaller part of the whole Generic Issue. We will continue to have to involve all our stakeholders, in terms of trying to be looking at operating experience.

We have to be looking at plant-specific information. Like I said this morning, we have to look at the design, plant-specific designs, configuration-specific designs. We have to look at plant practices.

And so, on the other hand, on testing, we also have to understand what the zone of influence is. And we will continue to work with our testing partners and with EPRI on, once we get the tests back, we will have to look at what the results show us, how we look at the raw data, and how we can interpret the raw data into something that could be useful.

And so, yes, Sandia modeling on the data

will be available to us, hopefully soon, and when we get it, we'll be glad to share it with EPRI and the rest of the industry: this is what the data is showing us, this is what we will -- this is how we will use it, in terms of modeling.

And at that point, we -- it's going to be a public meeting, everyone's going to be asked for feedback on how they think the data and the modeling is going to match.

Again, so, we are a little bit ahead of the schedule. I mean, off-the-cuff right now, we are hoping to get some data soon. NIST being not in a work status now kind of delayed some of our data collection and analysis.

But once we get that also, obviously, we will walk that through the work group, which you will hear this afternoon, and then, with the rest of the public in a forum where we will present the data for everyone to analyze.

So, the second part of what I said this morning was communications. And I would like to have everyone's input, and I'm not sure I got that feeling, and I'm not sure I want to be talking past some of the questions and comments this morning.

So, I think what I heard was, we said we

dispositioned a lot of the industry comments, but that in dispositioning the comments, we may not have come to a -- we did not address them, for lack of a better term.

So, I think what we need to do, maybe this afternoon or maybe after this meeting, we will sit down with our staff and we'll -- if you all will provide us with very, more specific comments on, this is what we thought we gave you, we did not see the resolutions to this, we'd be glad to discuss this again in the next public meeting.

We'll be very specific as to, this is your comments, this is how we will address this in the next phase of testing or in the next task, in terms of frequencies or in the characterization of the zone of influence.

So, I think we can be more specific, in terms of addressing comments in a public forum, so that we understand your comments better and you can understand our responses better.

So, let's see what else I've got in my notes from the last two hours. I think I got it all. I mean, so, we will talk about the decrement curve. We will talk about using the need for an eight-second duration test.

I understand that there's some sensitivities to test extrapolation. So, things like that, I think we can address and we will address it specifically in the public forum.

MR. HAMBURGER: Thank you, Mike. If we don't have any more questions from the room, I think we're overdue for a break. So, let's come back at 11:00. Come back at 11:00.

Again, bathrooms are out the door on this side of the room, to the left. Cafeteria is open, again, that's to the left, down the hallway, and that will be on your left as well. My contact information is up on the screen. If you have any issues, give me a call, it's probably the best way to get a hold of me at the moment.

(Whereupon, the above-entitled matter went off the record at 10:42 a.m. and resumed at 11:07 a.m.)

MR. HAMBURGER: All right. So, we're going to resume with Gabe Taylor.

MR. TAYLOR: Okay. Welcome back. So, myself and Kenn Miller are going to go through future test planning for the aluminum HEAF testing and the equipment selection. Next slide.

So, during this presentation, we're really

trying to communicate what we're planning on doing, the upcoming tests, and also, receive feedback on anything that we can do to improve how we go about testing the equipment as we move forward.

Just as a refresh, I know Nick brought this up in this past presentation, but if we look at the overall test program, including the OECD test report, you can see that we've completed the four medium voltage 6.9kV tests, in the fall, September. One clarification is that it was 32kA, not 35, as the slide shows.

So, for the aluminum HEAF, we're really, on this enclosure testing matrix, we're really looking at the right portion of the matrix, and the individual tests that are highlighted in the peach or orange color are the ones that are NRC-sponsored.

So, that leaves us with four low voltage tests, at 480 volts, two current levels, 15kA and 25kA, and durations of two and eight seconds. Note that we also will be planning on running four-second tests as part of the OECD program.

On the far right, you can also see two tests that aren't connected to any part of the test tree matrix.

And as we communicated previously, we plan

on using those two spare or optional tests to evaluate the decrement curve. The decrement curve will be evaluated at the 6.9kV, and it's yet to be determined what current level we'll be testing that at.

But those are information that we're trying to work with EPRI and understand the best way to represent realistic plant decrement type conditions. So, just -- and I have a later slide on the decrement curve. So, that's low voltage.

If we look at the equipment that we're -- we haven't procured any equipment yet. We've put out bids.

And right now, what we're look at for the aluminum bus low voltage enclosures, either a Westinghouse DS type switchgear or a General Electric AK series switchgear. So, these are the low voltage switchgear load centers that will be just downstream of your step-down transformer.

As far as frame size, we're looking at 1600 amp or 200 amp continuous frame size rating. And then, also, for interrupting capacity, we're looking at anywhere between 42kA and 65kA.

And those numbers really came out of the evaluation we did to support the workshop last April, looking at what was common for plants out there. And

although our sample size wasn't the entire fleet, it was about a quarter of the fleet that we sampled from the information that we had.

And as far as -- these were the common ranges of equipment that was out there. So, if you looked at an average, interrupting capacity was right around 50kA for what we looked at. Next slide.

Okay, moving on to the medium voltage bus ducts. For this type of testing, we're looking at a combination of enclosure and busbar material types. And also, there's a combination of NRC solely-sponsored tests and OECD-sponsored tests. The voltage level we chose for this was 4160 volts and a single current at 25kA.

The combinations, as you can see, are copper bus/steel enclosure, which is OECD only. Copper bus/aluminum enclosure, which is similar to the test we ran in Phase 1, the Zion bus duct experiment, so we have two tests there at two and four seconds.

Then, we have an aluminum bus/steel enclosure. In that case, we'll run one of the two-second tests, there's an OECD test for four seconds. And then, aluminum bus/aluminum enclosure, we have two tests there for two and four seconds.

We do have two spares test, and at this

time, we haven't determined a need for those yet. But there could be a potential there to evaluate decrement curve or some other type of configuration, as we see fit.

So, if there's feedback to support those optional tests, we'd be interested in learning that. So, and one thing, just to be clear, these aren't the iso phase bus ducts, these are typically non-segregated phase bus ducts. Next slide.

As far as the general characteristics of the medium voltage bus ducts, again, non-segregated phase bus ducts. I gave you the voltage already.

As far as the rating, we're looking at 1200-2000 amps rating on the busbars and then, also from a withstand rating anywhere from 31.5 to 63kA, which that's typical out of the standard that's identified there for medium voltage bus ducts.

One area that's still uncertain at this time is, for our measurements, we need to stabilize the arc in one location.

And if you're familiar, from the testing that we did in the first phase, the OECD program testing, because of electromagnetic effects, it basically propelled the arc out the end of the bus duct configuration.

And if you look at the OpE, there's typically some feature that stabilizes the arc, whether it's a bolted connection or a grounding bar or some other cause.

Recent OpE, there was an event that happened exterior to the plant, they had an exterior bus duct, and because of the coatings that they had on the busbar, that acted to stabilize the arc in one location.

So, right now, what our thought process is is what's shown in the graphic there, is that if you see the power supply from the laboratory, coming down the left side of the image, the copper colored conductors, it then runs horizontally into the bus duct.

And in the bus duct, we make a physical separation of the bus duct and, on the left side, we place a shoring wire at that location to generate the arc there. The idea there is that would stabilize it in that general location, where we'd then have the instruments located above and below.

Another option could be to use the epoxy insulation that was used in the industry testing. What we found in some communications with external parties is that that type of insulation isn't common

inside the plant. So, that's one non-conformity that we would potentially introduce into the testing, if we performed that.

Another option that we also had some feedback from the Japanese experiments is that they put a grounding bus perpendicular to the orientation of the phases, the bus phases, and that helped to stabilize the arc as well. But then again, that's something that's not common to the types of configurations that are in the plant.

So, just to kind of summarize, right now, we're looking to put a gap in the bus ducts to stabilize the arc, but if there's any feedback or logic to support some other configuration that would provide a more reliable means to maintain the arc in one location, so that our instruments could capture reasonable and usable data, we'd be very interested in that type of feedback.

And then, from informal surveys of some of the equipment vendors, common enclosure housing thickness, looking at 11-gauge aluminum housing. The conductor for aluminum, for the aluminum experiments, to follow the ASTM standard that's specified there.

So, if there's any other types of design considerations that are out there we should be

considering, we're very interested in learning those. If not, we'll work with our electrical contractor to try to find and procure bus ducts that are representative of the types of installations in the field.

Okay, now it's moving on to the decrement curve. And we talked about this a little bit earlier. Last January of 2018, EPRI published some white papers.

In the one white paper, they went through a number of different scenarios. And one of the scenarios they to be most common to exhibit a long-duration arc was cases where it's a generator-fed fault.

So, basically, you'd have a fault between a generator and a protected device, so you wouldn't have a main generator breaker to clear the fault. And then, the generator would basically feed the fault until the exciter voltage dropped out and stopped providing energy to the fault.

So, we found that information very useful and, as I mentioned earlier, we're trying to work with our testing facility to be able to replicate some of the field experience that was provided to us via EPRI. It does require new contracting, which takes time.

And also, it requires some analysis and verification on the laboratory's part, to make sure that they can run the experiment that meets our needs, to replicate that type of exposure.

So, it's not a rudimentary process of going out and doing this, this isn't very common or we're not aware that it's been done in the past, but we do have confidence that it can be done moving forward.

And that's feedback we received from EPRI and during the workshop and during the public comments, and we're definitely taking that into consideration and making changes to improve our test program.

So, that's one example where we made changes, but we're also looking for any other feedback to improve our testing, because in the end, we have to have something that's usable to make realistic methods and models to inform our risk analysis.

So, just to summarize, our initial focus here is to support the Generic Issue Program. We're focusing on the NRC-sponsored aluminum type tests, to support the GI Program in its assessment phase, to provide useful information to determine what the ZOI or the ZOI model is, to support the risk assessment.

And although the decrement curve, the process for getting all that is slow, we're trying to expedite it as much as possible.

There could be possibilities, if they're interested, for industry to perform that type of testing. We could support it on the measurement side as well, if that is a faster means of getting it done.

I think that's all I had. So, I really appreciate any feedback on our planned approach this coming year.

MR. HAMBURGER: Gabe, if people have feedback that occurs to them after this meeting, can they get in touch with you by email?

MR. TAYLOR: Right. You can email gabriel.taylor@nrc.gov. My information's on the meeting notice. As well as Nick Melly, nicholas.melly@nrc.gov.

MR. HAMBURGER: Okay. Any questions from those in the room? About any of the equipment Gabe's presented?

MR. TAYLOR: I'll just make one additional thing, while we're waiting. We'll run it no differently than we've done previously.

In the first phase, we identified what equipment was available and then, we worked with EPRI

to make sure that was consistent with the type of equipment that's found in the field.

So, we do have some initial leads on equipment last week, but there's a few bids still out there to see. And once we get that information, we'll work with the working group to understand which equipment is most applicable for the series of aluminum tests.

MR. HAMBURGER: Okay. Any questions or comments? Tom, anything on the webinar? Okay.

Well, I think the next presentation is slated for an hour and I think there's going to be some comments and questions on that, so I don't want to get into that before lunch, because I have a feeling that may delay lunch.

So, unless anyone objects strenuously, I think we can go to lunch now and take a little extended lunch. Come back at 12:45? 1:00? You okay with 1:00? Mark, unless you think you can get it done in -- okay, we'll come back at 1:00.

(Whereupon, the above-entitled matter went off the record at 11:21 a.m. and resumed at 1:00 p.m.)

MR. HAMBURGER: All right. Thank you all for returning promptly.

Just a reminder, for questions and

comments, please state your name before your comments, so the court reporter can transcribe it properly, and try to use the microphones for any comments or questions, so other webinar participants can hear it.

Mark?

MR. SALLEY: All right. I take it everybody had a good lunch. We've got a lot to cover this afternoon. So, we'll pick it up.

Back on May 11th, 2017, in this room, there was a briefing for the Commission. And one of the industry execs was at the table and briefly described the HEAF and the work that was going on. And he made sure to make the point that the industry really wants, speaking for the industry world, the industry really wants to work with NRC research on resolving this. The vehicle that we typically use in research is the MOUs I described earlier with EPRI. And we try to get the scientific arms together to do that work.

For those of you that have been around fire protection and have been here a while, if you think back 20 years ago or so, again, in this room we had a whole different topic in fire protection that we were working, and that was multiple spurious -- everybody remember that? -- with the hot shorting of

circuits and all that. It was a big issue in the late nineties and at the turn of the millennium.

Today we don't talk too much about it. It seems to be solved. Everybody's comfortable doing it. The utilities know what they need to do. The inspectors know how to inspect it. And we have done a lot of work.

And as a part of the success of that, it was that MOU between research and EPRI. If you remember, we did a whole series of tests. The CAROLFIRE program was the first one, and we worked through it, again working together to get a good scientific solution.

So, we've seen success with this before, and it's worked quite well. I think we really advanced the science, and it's good science. So, again, with that in mind, we want to reach out and work with EPRI on the technical solution to the HEAF.

Next slide.

So, what we did in the past few weeks, working with Kelli and her folks and mine on this side, is we had a number of calls and discussions, and we thought we'd put together a Charter for what this Working Group is going to attempt to do. We held it out as a draft until today, again, for any feedback

from stakeholders or industry on where we're looking to move forward.

Again, the basic mission statement here, I think it's quite obvious: to improve the understanding of risk from electrical arcing fault hazards in nuclear power plants. And you'll notice we chose the words "arcing fault hazards" and not directly to HEAFs. I think that's part of it and the fact that we want to get the correct binning and get the correct selection of the events. So, that's the basic Charter for the group.

Next slide.

So, the goals of this Working Group:

Obviously, a better understanding of the key factors contributing to the occurrence and severity.

You can read them here.

Advancing the HEAF fire PRA modeling. Again, we have the single model out of 6850 for the zone of influence in Appendix M. We also have the one FAQ for the bus ducts. We think we can do a lot better with that.

And then, analyzing the plant impacts and the risk implications. If you look at that, that should look very familiar to everyone here. That's

basically HEAF in the form of a risk triplet. So, again, following the sound principles is how we want this group to move forward.

Next slide.

So, this is where it kind of gets a little interesting. There's a lot of famous quotes and a lot of people have said things about, you know, getting the right group of people together. I think one pops into my mind, Lee Iacocca. If you remember Lee Iacocca from the automotive world, this is the man, basically, that came up with the Mustang in 1964, and then, he saved Chrysler later. So, he was a pretty heavy hitter in there.

He had a saying that kind of went something like this: I hire people smarter than me, and then, I get out of their way. So, that's kind of the philosophy that I want to look at with this Working Group, and this is the Working Group that we've assembled between Kelli and myself working for some of our best experts out there. You may of the people. Some or a lot of them are in this room here today. And again, they're very good people.

Also what's here, we put two levels of management. The Project Managers, again, Kelli and myself. If you have questions or want to talk to

someone, we're there. And then, our sponsors that are above it for the whole program, which is Mike Cheok, my supervisor, and then, Tina Taylor.

A lot being said with putting the right people together and getting out of their way. We've talked a lot about zones of influence and things of that nature, and how we want to do this. And I really think that, as we're putting this group together -- and they're just starting out, by the way. So, we want data, we want this, we want a lot of things. But this group is just getting together. Like I said, the Charter is a draft. Any input from anyone today was welcome, and then, we'll get started with this.

But looking at HEAF -- and I'll set the bar real high for this group -- don't just lock me into a ZOI or something like that. I mean, the sheet's clear. We're starting out.

If we look at HEAF and we talk about the tests and why we're doing some of the tests and different things, we basically have one equation with six unknowns. Okay? And if you think back to college and your early days in engineering, most of us went through you could do one equation, two unknowns, and work it through and substitute, and bring it back, and all that.

But this is a complex phenomena. I mean, what effect does the voltage play? What effect does the current play? And what effect does duration play? What effect does the material play? What effect does the enclosure do? We know there's a lot of variables here.

And I think, as a part of this Working Group, or what I challenge them to do is tell me this. Does voltage matter? Does current matter? We've fought a lot about duration. We're seeing the material properties seem to matter between copper and aluminum.

So, this group has a lot of work ahead of them to do it. And I don't want to tie their hands, but I want to let them do their thing.

In a perfect world, if this group was, I'll say it as a manager, very successful, we would have an equation where you could plug in the voltage, you could plug in the current, the enclosure, and come up with the zone of influence.

And maybe it's not a box like we've been doing 3 foot x 5 foot. If you look at some of the data we've gotten from video, it's more of a sphere. Is that the correct thing?

Or the FAQ group, when they worked the bus

duct out, I think, Industry, what do you call that, "the cone of death," or something, for the cone that comes down from the bus duct? Again, I don't want to limit the group. I want to let the physics and the science do what it needs to do.

So, these are the people that we've selected. I think we've got a good group here, very capable. And we want to let them get on with it.

Let me see what I've got. Next slide.

Again, deliverables. To improve the risk models. The PRA stuff is driving it. That's what's got us here. We want to look at the frequency and the binning and the zone of influence. And again, I'll zone of influence loosely. I think the group can come up with what they need to for that. It may be a sphere. It may be an equation. It may be different things they can come up with.

Again, our goal was to look at the risk to the plants. We talked a little bit about pilots, and that's something, again, where we'll need some help from industry. If you go back and look at 6850 and the history of that, again, for the folks that have been around since the 2000 timeframe -- we published that in 2005 -- one thing that we constantly at the end of AFP-805 we're hit with is, you know, we never

really piloted it. We piloted it in pieces. We never did a full pilot. If hindsight is 20/20, everyone agrees back in 2000 we would have piloted 6850, and it would have been a better tool for all to use.

So, here's an area, too, where we're looking at pilots. Again, we're still in the discussion phase as a part of the Working Group. Remember, this is just starting up. But that the Working Group would develop the models and the tools and the data and how to do that, and then, let the licensees or the consultants implement it in the plant to do the pilot. So, that's kind of where we're at with that right now.

Again, we really hope to advance the science, to reduce uncertainty, to improve realism, all the things we strive for, and to update the current guidance. It is funny, when we started out in the testing way back with the internationals, our goal was to go and to provide the confirmatory test that Appendix M, 6850, was a good model.

And for the most part, we were doing really great and we were thinking, hey, this is a good -- man, if you had to pick a one-size-fits-all HEAF model, up until about that 22nd test, we're saying this was right on. And we were, you know, Nick and I,

patting each other on the back that this is really going to be successful until those later tests came and showed us that there's more to it than that.

So, again, we want to get that accuracy and we want to get that fidelity in it; and again, understand the variables and the parts they play, which, again, will be the update to the guidance for 6850, Appendix M, and the supplemental, the FAQ -- I think it's 37 or 47 -- for the bus duct.

Communications, we talked this morning is important. We will strive to have open communications with you. And I guess, as the Working Group, like I said, the key is we've got to let them do a little work. It's just getting together. And I think as they get to key points in that, we can agree upon things that we want to share with the larger group as to how we're moving forward.

Next slide. So, I've got one more slide here.

Priorities. And these are the NRC's priorities as to how this Working Group moves forward. I kind of want to give you the big picture of this. This is not a short-term thing that we do in six months or a year, but it's a little bigger.

Obviously, the first thing we want to look

at is the aluminum HEAF. That's the driver for us in the GSI program, and we want to solve that portion first.

You saw the matrix that Gabe and Nick used earlier this morning, how we laid all the testing out. And we want to pick those aluminum pieces up first and get this Working Group going.

Again, the decision from the GIRP was that we want to go out with the most accurate model. We don't want to go out with something that's very conservative, do some more research, have it combine, and have people do the work two and three times, but to come out with the most accurate, realistic model as possible. That's the goal that we're striving for.

It's a timely goal. If we get our testing done, we get this group going, we believe we can achieve it, and we have the schedule. So, that's our first priority.

You also know that the way we originally started this program was with an international program. HEAF is not unique to the United States nuclear plants. It's worldwide. We see these, approximately 10 percent of the most significant events, we see with our international partners are HEAF. There's a lot to learn, and everybody pretty

much understands that.

So, the OECD/NEA group, we're in the process of signing out the agreement now, where we want to go forward with the second form of testing. And this will do a lot more of the copper and it will be a lot more confirmatory, and again, bring a lot more of the realism into the total understanding of HEAF.

As a matter of fact, the German equipment has already been shipped, and we have already received equipment from Germany. So, there's a lot of interest from our international partners to work on this.

Our goal with our international partners was to keep this Working Group going because they would have momentum, they would have understanding, they would have experience, and to look at refining the other models, again, the Appendix M, for the copper and the different conditions.

We could, then, take that and put it out for public comment and get our OECD partners, our experts in the foreign countries, and let them do a peer review of it, so that we could have a good, high-quality product.

So, that's kind of the big picture looking forward, that we go for the aluminum piece first, and

then, we work into the second phase of testing with the OECD and the NEA.

Again, the whole goal at the end of the day is to improve the realism and fidelity of our models.

Kelli worked very closely with us. Kelli, that's kind of the end of my presentation. If you have anything you'd like to say on the side of EPRI or anything, this would be a good time.

MS. VOELSING: Are you saying you want me to give my presentation now?

MR. SALLEY: If you're ready. Is it on the Working Group?

MR. HAMBURGER: Sure. That's fine.

Before you give your presentation, does anybody have any questions for Mark?

MS. ANDERSON: I have a question.

MR. HAMBURGER: Oh, okay.

MR. SALLEY: Okay.

MR. HAMBURGER: And, Mark, would you mind just telling people where they can find the current version of the Charter?

MR. SALLEY: Yes. If you look at the meeting notice today, the one -- we updated it last week. It's a two-page Charter. It's a link at the

very bottom. You can just load it. It's an EPRI Dropbox, is it?

MR. HAMBURGER: I believe it's a link to the EPRI box.

MR. SALLEY: Box, and it's in there, a copy. Again, it's a draft. So, we'll take any comments/suggestions.

MR. HAMBURGER: Victoria?

MS. ANDERSON: So, this is Victoria Anderson with NEI.

That was actually my first question. You said that stakeholder input on the Charter was welcome. And I checked out the meeting notice this morning, and I don't think I noticed that link. So, even if it is available, maybe there's a way we can better publicize it. Maybe make it available in ADAMS, if we really want to get as much public feedback as possible. I mean, I was hunting for it and I couldn't find it.

MR. HAMBURGER: I believe it's a link at the bottom of the meeting description.

MS. ANDERSON: Right. But, I mean, again, I was motivated --

MR. HAMBURGER: I'll put that down as --'

MS. ANDERSON: -- to try to find it, and

I still struggled.

MR. HAMBURGER: Okay. So, I'll put that down as an action item for NRC.

MS. ANDERSON: If we're really looking for broad stakeholder input, that's not really going to help it along.

MR. SALLEY: The millennials got me on that one, Victoria.

MS. ANDERSON: What's got you?

MR. SALLEY: The millennials got me on that.

MS. ANDERSON: I'm not a millennial. So, I can't help you there.

MR. SALLEY: My millennials.

MS. ANDERSON: Okay. They'll help you.

MR. HAMBURGER: And of the documents, including the Charter and the presentations from today will be packaged up and placed into ADAMS and made publicly available.

MS. ANDERSON: Okay. So, I think the sooner that can be done with the Charter, the better to help with soliciting feedback.

MR. GARDOCKI: And we'll try to put stuff like that on the GI Dashboard.

MS. ANDERSON: Excellent. That's an

outstanding idea.

MR. GARDOCKI: So, that's a great place for all this information. Okay?

MS. ANDERSON: Outstanding idea. Definitely fully support that.

How will other stakeholders and the public be able to interact with this Working Group? Like will information come out of this group? Will there be draft reports put out? Will there be public meetings on where they're going?

MR. SALLEY: Yes, we can decide that however it's best for everyone. And again, I'll work with EPRI and Kelli. I think that once we maybe get a product that we think is far enough along would be a good time to put a draft report out, give folks 30 days to comment on it, whatever. If we see significant comments, we could hold a public meeting and discuss it.

Or, again, how we talked with the pilots, and I think that the Working Group itself could do some presentations as to what their logic was, how they came up with it, and what the intent was. So, we can do that in a public forum, if you like.

MS. ANDERSON: Great. You mentioned Kelli, and she showed up behind me.

(Laughter.)

MS. VOELSING: Yes, I was going to say, the names that are on the list for the Working Group predate me or my involvement. And to your point, Mark, if there's other industry stakeholders and experts that have technical expertise to contribute to the Work Group, I would think we would want to consider their participation. So, there should be room for that.

MS. ANDERSON: Okay. And just one other question or I suppose a question/comment hybrid is: you underscored the need to have the pilots to support this Working Group and the pre-GI resolution. Right now, I think plants would be hesitant to volunteer for that because we heard this morning is we're not 100 percent sure what we're going to be evaluating or what we're looking at, or how to deal with the fragilities, or how to deal with this or how to deal with that.

The licensees in the audience can correct me if I'm wrong, but, until some of that is better defined, I don't think you're really going to get a volunteer. So, I think the sooner we can better define some of that, and we can get some realistic inputs, the sooner we'll be able to get some pilots to volunteer.

MR. MELLY: Yes, we absolutely understand that. And the Working Group is currently also working towards a pilot plant resource need or resource allocation, what would be expected of the pilot plants. We drafted that late at the end of last year, and we're working that through the Working Group to say, would this be the type of resources that any pilot plant would need to allocate to doing this? What type of information are we looking for? How it would move through the process. So, we're still fairly early in that step, and that draft is being shared within this Working Group to see, is this the type of information we need to collect and how would it move forward?

MS. ANDERSON: So, I think you correctly identified the resources as one specific concern the pilot plants would have. I think another concern we need to pay attention to is whether or not they're going to be asked to consider information that they believe, based on OE, to be unduly conservative.

I don't think a plant is going to volunteer to put their information out there to be evaluated with information or analysis based on extremely conservative testing or results, to possibly come up with erroneous conclusions. I just can't see

a plant being willing to do that.

MR. TAYLOR: Yes, I agree. I think one thing from other projects we worked on, such as the spurious operation one, where they basically use data from all the tests, we use operating configurations, and then, the experts' judgment to modify or adjust the data. So, I agree, we want to get a realistic model to characterize the risk. And I think letting the Working Group work through that process should be able to get us there. But we're too early to --

MS. ANDERSON: And I think that underscores the need to have continuing public interactions, so that potential pilots have more confidence in that. And then, there's potential for them to volunteer.

MR. HAMBURGER: Thank you. Any more questions for NRC staff about the NRC/EPRI MOU or the Working Group?

(No response.)

MR. HAMBURGER: Any questions on the webinar?

(No response.)

MR. HAMBURGER: Okay. And just a note for those on the webinar. Before the end of the day, we are going to open up the phone lines to make sure

nobody has any questions that they haven't put down in the chat.

All right. We are now officially in the public question and comment session. We have two prepared presentations.

Kelli, would you like to go first?

Okay. The first presentation was provided to me by Kelli from EPRI.

And you can use the podium, and I can step through. Or, if you want to take the buttons?

MS. VOELSING: First of all, thanks for the opportunity to comment. My name is Kelli Voelsing. I'm the RSM Program Manager at EPRI.

So, we have been participating and following the development of what's going on with high energy arcing faults and in preliminary discussions of the Working Group Charter with Mark and his team, and with Mike Cheok and Mark Thaggard as well.

I will say that at a high level I think we are aligned on the tasks in the Working Group Charter, the issues that need to be worked through in order to have a realistic understanding of the risk and the potential contribution to risk from aluminum. But I think there's significant work and technical challenges that we're going to have to work through in

order to get to that answer.

So, maybe perhaps for those of you that don't know, my technical lead on fire PRA is out right now on a medical leave, having just had a baby. And so, I have been given the opportunity to learn a whole lot about high energy arcing fault in a very short period of time. And the analogy that keeps coming in my head, as I think about these, I thought it might resonate with some of you all, which is, when we see the videos, when we see the pictures, when we talk about these enormous volted three-phase long-duration faults, I absolutely understand how the first reaction to seeing those is obviously one of concern. That could be a significant issue with significant damage at a nuclear plant.

But I think back to loved ones -- and hopefully, none of you -- but if you've been given a diagnosis and you hear the words "You have cancer" from a doctor, the first thing that's going to go through your head, oh, you know, invasive surgery. We're going to cut out large portions of tissue and poisonous chemotherapy and radiation, and obviously the worst-case scenario. It's very easy to envision that.

But I think very quickly you get into the

details, and you start hearing from the doctor about locations and size and phases and genetic markers of the tumor, and all of the discriminating factors that go into the appropriate treatment of a cancer. And I think what I've learned about high energy arc fault is that there's a lot of those discriminating factors in not only what we see in the testing, but what we see in the OE and in the experience of our plants as well.

And just like proceeding with a worst-case cancer treatment, sometimes proceeding with a worst-case treatment or a one-size-fits-all model or approach to understanding HEAF would ultimately do a disservice to the patient; and that for the best outcomes, we have to understand those factors and we have to take them into account, as we understand both the risk and the mitigation plans for how we deal with those.

So, I guess I was just saying, it keeps coming into my head that I understand why the concern. And obviously, these worst-case HEAFs would be a significant or could be a significant safety impact, depending on the configuration, the location of the plant, the equipment that could in a zone of influence. But there's a lot of other factors that we have to consider before we get to that conclusion.

So, if we could go to the next slide?

I'll start here, and I think we've already heard this today. But I just wanted to put in context that, currently, the Bin 16 treatment in NUREG-6840 or EPRI 1011989, the Fire PRA Methodology in Appendix M, that we've been referring to is a one-size-fits-all for everything in Bin 16. There's one zone of influence. There's one initiating event frequency. And it's certainly easy to imagine that, if you double or triple or quadruple the zone of influence, you're talking about taking out entire rooms or large zones of potentially impacted equipment. So, we have to consider what all goes into Bin 16 and is it really a some-size-fits-all approach that we should be pursuing.

So, if we'll go to the next slide?

Some differentiating factors that may come into play here. We do see distinct differences in the types of events, the damage profiles of events between medium voltage and low voltage equipment. I'll talk some more about that.

The location. It's probably true that there is aluminum out there in bus ducts, whether non-segregated or iso phase bus ducts. But that equipment is outside or in the turbine deck, and doesn't impact

safety-significant equipment, it may not still be a significant contributor to risk.

We see differences within Bin 16 between switchgear and motor control centers, bus ducts, that all of those have different probabilities in terms of is this likely to be a long-duration or short-duration event; is it likely to be a flash or a blast versus a HEAF? And I think we can start to draw some insights there.

Source of the fault may be another important consideration that we haven't really talked about yet. We saw a picture of the wire that was being used to generate the fault on the aluminum busbars, which would be, obviously, on the switchgear on the load side of the breaker. Whereas, a good portion, more than half of the industry experience is that the fault is generally generated on either the breaker side or at the stabs, which is generally not where the aluminum is present. So, that may be an important consideration in terms of testing, in terms of where do we put the fault.

Electric configuration. At the time of the white papers last year, we had reviewed a good portion of the industry. We've now reviewed all 103-104 units to determine which units have safety-related

buses or buses that are subject to unit-connected generator design without a generator breaker, such that you would have a long-duration fault that has to spin down. And that applies to some plants. It also does not apply to a lot of plants. And so, I think we need to consider that as well.

Material. Obviously, the reason we're here today is the presence and location of aluminum.

And then, again, operational issues. We would be remiss to not acknowledge that the best way to prevent the risk of a HEAF is to not have a HEAF. And although there are not one smoking gun, we do see in the OE that a large majority of HEAFs have, although not the same preventable cause, they do have preventable causes that relate to cleanliness, maintenance practices, human performance.

So, next slide.

Again, we are in alignment on the major tasks of the Working Group Charter. We think those are the right tasks that need to be worked through and appreciate the commitment from Mike Cheok and Mark Salley and their teams to work through that in a methodical fashion that considers the spectrum of risk and the probabilistic aspects of that spectrum of events.

So, the first task is to improve the risk models, supported by all available information, be that testing, data, whether type testing, manufacturing data or manufacturers' data, or the current test programs, or other testing.

OE from the industry as well as expert engineering judgment because the bottom line is I don't think we're ever going to have enough resources to test all the configurations, all the possible configurations that we might like to test.

And then, there are basically two tasks that we've aligned on that support that. The first is a realistic representation of the frequency of events represented in Bin 16 and an appropriate modeling of the various zones of influence for the events included in Bin 16.

And then, following that, once we have developed those methods and agreed and aligned on those approaches, and tested them, and make sure that we feel like they're practical and implementable, then, obviously, that translates into updated guidance. So, I think, in general, we are aligned on the major tasks of the Working Group. Perhaps the timeline and the ability to get through those tasks I think will be an evolving issue, as we really start to

dig into the technical details.

So, I have a slide with a lot of words for kind of what -- and again, I don't have answers for all of these or necessarily any of these, and certainly some technical experts in the crowd who can support, as necessary, but we wanted to identify some of what we think, in working through these tasks in the Working Group, what are some of the key insights that we think we need to take into account as the Working Group, as we work through these?

First, with respect to the frequency work, you've heard about binning or sub-binning or this idea that Bin 16 includes multiple different kinds of events represented. And so, I just wanted to give you a flavor of what we're talking about there.

So, right now, the total population in Bin 16 which is the frequency bin and the fire events database that supports the arcing fault inputs into the fire PRA. So, from 1964 to 2017, the total population of that bin is 28 events across the U.S. nuclear industry.

It does include a wide variety of equipment. There's not a lot of events, but there's a lot of potential sources that come into that bin. So, it includes medium voltage, low voltage. It

includes switchgear. It includes motor control centers. It includes bus ducts, and it includes -- basically, in the Charter we refer to it as the arching fault hazard because it includes things that would be characterized as flashes or blasts that really didn't do damage outside the component and did not, essentially, have a zone of influence or create a post-event fire, as well as events that are definitely high energy arcing faults and do have that larger zone of influence and immediate damage or fire or immediate damage to components.

The data includes events with and without post-event fires and with and without post-event damage. And perhaps it's obvious to say, but with only 28 events, it may be that we have to use some engineering judgment and for different types of components or different aspects, what we actually know about the probability of having a flash event or a blast event versus a HEAF event. Because with 28 events, you can only break that out down into so many sub-bins. And you've got 30 bins and three-quarters of them have one event or zero events in it, I'm not really sure how much that tells you from a statistical perspective. So, we're going to have to be willing to bring in other expertise and data and judgment into

that consideration.

But I do think, nevertheless, the OE in the ISAs database and the OE in Bin 16 does give us some pointers about things that are critically important. So, I'll highlight a few of those here.

First of all, medium voltage equipment, 84 percent of the events in Bin 16 that were damaging occurred in medium voltage equipment. So, we're not seeing large numbers of these events in low voltage or high voltage equipment.

I'll also add that, for low voltage equipment, there were two damaging events in low voltage equipment in this population of 28 events. In both of these cases, they were allowed to exist for a prolonged period of time because there was not enough energy to trip the protection features in the design. So, they simply didn't have enough current to cause a trip, and that's why they persisted for a long period of time.

And so, although they're in the bin and they do indicate post-event damage in some cases, we need to do some more digging into what that damage actually was. And it appears that the damage was due to a post-event fire and not related to the HEAF itself.

And then, of the events with external damage, the graph at the lower right of the slide shows a breakdown of these events. In Bin 16, there were 11 of them that caused external damage. Seven of 11 of those were in bus ducts, either iso phase or non-segmented bus ducts.

And so, I would point out that our experience in fire PRAs tells us that, generally, due to the location of the bus ducts -- you know, they tend to be outside or in the turbine building, and not impacting safety-significant equipment -- so, they tend to be lower contributors in the fire PRA. So, more than half of those causing external damage would have been in that type of application.

So, if I can go to the next slide?

Similarly, some early thoughts or insights related to the zone of influence work that we've been referencing. And I think we've pointed to this as well. Currently, the zone of influence that is used is based on one event that at the time it was created was kind of the worst-case known event. It was a SONGS event, and it's the basis for the 3x3x5 zone of influence that's currently used.

So, just consideration of the test protocol that we're involved in now and trying to come

up with a zone of influence versus what has been done, it's important to recognize the differences in those approaches if you're trying to come up with a reasonable delta CDF.

And then, secondly, to date, small-scale, no large-scale, test results on HEAF or the byproduct characterization have been available for analysis. And so, to fully have a robust set of comments about future test plans and the data that needs to be collected to make sure that we can make good decisions, we don't really feel like we can do that until we've been able to analyze the existing data.

So, useful insights which might play into that feedback on future testing related to zone of influence work is, first of all, aluminum oxide is an excellent insulator material with very low conductivity. And aluminum in most situations will oxidize almost immediately to aluminum oxide.

And so, one of the reasons we're particularly interested in the small-scale or material characterization properties is because, if the white dust or very fine particles that we're observing at distant locations are primarily aluminum oxide, and they're not conductive, it may be that they don't really -- you know, they may be very fine and spread

easily like volcanic dust, but if they don't contribute to damage, then that may not constitute a zone of influence necessarily in a PRA.

Finally, we know from testing and OE that the arc will travel away from the source. And so, in the testing that's been done, as we said, we induced the arc at the switchgear, at the busbars, and it's going to immediately blow out the back of the cabinet. And if you put cable coupons directly in front of that, is that -- we've talked about the location of the arc and the potential impact that that could have on the testing. But also, when you're trying to understand the fragility of components, it's important to represent cables and cabinets and other SSEs in a manner that's consistent with how they might be configured in the plant.

Again, just the fourth bullet there is kind of a similar concept. I know some of the OECD testing on bus ducts, they, I believe, had the bus duct on the ground. And so, if you're talking about a conical zone of influence, which is what we currently use in the fire PRAs for bus ducts, well, if you did the testing on the ground, then you would, obviously, not be able to get that downward zone of influence that you would expect to see in the plant.

And that wasn't part of the NRC's current test plan, but I just point that out as indicative of the kind of things we need to make sure that, when we're configuring this equipment and collecting test data, that the data we're collecting is representative of the way the equipment would be installed and operated in the field.

And then, we've alluded to this as well. Bin 16 does include significant frequencies that include arc blasts and arc flash events. Of those 28 events, we have looked at them, and at least 10 of them -- there's a few that we want to understand more about -- but at least 10 of them would be classified as flashes or blasts, which, per the definitions proposed by the NRC, would cause no damage external to the component, and therefore, essentially, a negligible zone of influence versus the one-size-fits-all zone of influence.

Early insights on plant risk. I think this is going to be a challenge for the Working Group. Although EPRI is not involved in the generic issue process, it's certainly something we're going to have to be able to address as part of the generic issue.

This idea of an average plant risk is an elusive concept, especially in this situation, because

there are some drivers, some designs, some risk factors that would certainly make you more susceptible to this type of risk, the most obvious being, do you have aluminum installed in these components or not? A good fraction of the industry may not have aluminum or may have aluminum only in bus ducts where it's not particularly significant to risk.

A review of all of the U.S. units shows that 70 percent of plants are not susceptible to a long-duration generator-fed fault on a safety-related bus. So, we've identified this as one of the primary drivers. You know, where can you get a long-duration fault? When there's only one breaker and that's where the fault occurs, then you have to wait for the generator to spin down while you're still feeding that fault. But 70 percent of the U.S. industry would not have a safety-related bus that is even susceptible to that kind of fault.

Even when the long-duration generator-fed fault can occur, the following factors must be considered. So, we've talked about the voltage decay as the generator spins down. And I'm glad to hear that we're looking at how do we make that in future tests reasonably represented.

The presence or absence of aluminum and

the proximity of aluminum to the fault location, and then, other equipment in the zone of influence, and the actual fragility of that equipment.

With respect to the bus ducts, I will say our not 100-percent survey of the U.S. industry, but our reasonable survey of the industry suggests that it's not rare to have aluminum in bus ducts, mostly due to weight and cost. So, we probably are going to find aluminum there, but the risk is dependent upon the SSEs within the zone of influence. And aside from some spatial considerations at very specific plants, it's generally a low contributor to risk in most fire PRAs. So, having a larger zone of influence in those situations is probably not going to make much of a difference.

Testing considerations. We talked at the beginning about differentiating factors, the breaker-initiated versus switchgear-initiated fault. And I have a side views of a breaker, and in the NRC's presentation they showed the shortening wire across the switchgear busbars that they used to initiate the fault.

I will say, we found that more than 50 percent of the experience in the industry is that it is the moving parts where you rack breakers in and out

where the fault is likely to initiate, either due to maintenance or human performance, or other causes. But it generally will tend to be on the breaker side or at the breaker stabs or where those moving parts come together.

And those parts of the breaker are made out of copper, and they travel through some porcelain bottles and through a torturous path, through some more porcelain components before they move into the segment of the cabinet where the switchgear busbars would be.

And so, we don't know, but it could be important to consider that because, you know, if the fault initiates there, it has to sustain itself and move far enough along, and continue to sustain energy in order to make it to the aluminum busbars, and then, still have enough energy to cause this larger-than-expected oxidation. That may be important to consider.

I think we've touched several times on the data for evaluating damage. Just the mere observance of damage to instruments at 3 feet or presence of substance at a distance from the test does not, in and of itself, dictate a zone of influence. To agree with the NRC, that's not an easy question to answer. You

know, how are we going to take these -- you know, what instrumentation, what equipment? How are we going to take measurements? How are we going to know what part of that is due to aluminum versus everything else? That's part of the switchgear. How are we going to have a baseline to compare to in order to come up with a zone of influence? I think we have to consider that as part of the design of the future test program.

And I am personally not familiar with the Sandia model. So, I don't have any comments on that model or the fidelity of the model, or the ability of the model to predict damage, and therefore, a representative zone of influence.

So, target selection is critical to assure the results are representative of plant equipment. Usually, in a switchgear room you're going to have multiple cabinets. And therefore, does the byproduct penetrate through the cabinet? Does it cause damage inside another cabinet? Does it move through the louvers? That's a little different than just having a rack directly in front of the blast.

Actual location and data collection to assess impact on operation. To date, the OE does not suggest large-scale deposition of byproducts or damage outside the cubicle. So, when there has been

byproducts, you know, in general, we have been able to wipe them off and close the cabinet and everything still works. So, we need to make sure that we're using representative equipment to assess fragilities and zones of influence.

And then, clarity on what conductivity and what material is being measured will be a challenge for the test program. And along with representative conditions that lead to the longer-duration faults, this is why I asked earlier about the extrapolation of an 8-second fault in low voltage equipment to be representative of high voltage equipment. And so, this really gets to that point.

In medium voltage equipment, we see very clearly in the OE that the dominant contributor there is this unit-connected design where the generator has to wind down as the voltage collapses and continues to supply energy into the fault for a long-duration period of time.

For low voltage equipment, what we see as the contributor most frequently there is it's a long-duration event simply because there's not enough energy to trip the protection scheme. And therefore, the current is just below what you need to cause a trip in the circuit. And so, it just continues to

propagate. So, there may be long-duration arcing fault events, but they may not have the high energy, because, by definition, if they did, the equipment or the protection system would be expected to trip.

And so, I think you can see how what leads to a long-duration fault in low voltage is a different condition than leads to a long-duration fault in medium voltage. And so, the extrapolation of one to the other I think would have to be reviewed by the Working Group to make sure that we're comparing apples to apples in our extrapolation.

So, to kind of circle back to where we started, at least our hope, like what the NRC said, is that we come out of this with a refined Bin 16 treatment and supplemental guidance to update NUREG-6850, and an acknowledgment that all arcing fault events are not the same, and that risk should consider the probability of various types of events and associated zones of influence, neither of which are probably a one-size-fits-all.

In the diagram there, maybe the cabinet in the middle is a low voltage cabinet and probably is most susceptible to high energy -- or not high energy -- but an arcing fault with a relatively or non-existent zone of influence. And maybe there's some

probability of a larger zone of influence. And then, maybe it's the bus duct with aluminum that has a larger zone of influence because it does have a low minimum. And we do see in the OE damaging types of HEAFs occurring in that type of equipment.

So, this is by no means intended to illustrate the answer. Just that we think that there's a nuance in the answer, and that we hope what we end up with at the end of this is a reasonable representation based on all the input and the expert judgment of the probability of the various types of events represented in Bin 16. That's kind of component- or application-specific. And then, also, a representation that zones of influence for each of those probabilities is also probably variable.

So, with that being said, we look forward to continuing to work with the Working Group. As I said, it's been a good collaboration on the Charter, making sure that we had the right tasks identified in order to get to a technically-solid basis for improving our state of knowledge and our modeling of the risk of high energy events or arcing fault events.

MR. HAMBURGER: Thank you, Kelli. Would you be willing to answer any questions from the audience, if they have any?

MS. VOELSING: I'll try or --

MR. HAMBURGER: Okay.

MS. VOELSING: -- I'll defer to the technical experts. But sure.

MR. HAMBURGER: Okay. Any questions for Kelly from the room?

(No response.)

MR. HAMBURGER: From the webinar?

(No response.)

MR. HAMBURGER: Okay. Thank you.

And I have one more presentation that was provided to me in advance by Victoria Anderson from NEI.

And after this presentation, the floor is open for any questions that anybody might like to ask.

MS. ANDERSON: All right. So, we wanted to talk a little bit about the context of the technical information that this effort is gathering and the operating experience and the technical information we have so far, and put that in the context of the risk evaluations that are done as part of the pre-GI process.

Because any decisions associated with the generic issues process are designed to be risk-informed, and really the specific thing we're looking

at here, as I'll get onto in the next slide, is the change in core damage frequency due to potential aluminum HEAFs needs to be treated as the core damage frequency due to aluminum HEAFs minus the core damage frequency baseline. And I think one thing we talked about a little bit this morning was that we aren't really sure yet how we're defining that baseline, and it's very important that we define it appropriately.

Next slide, please.

So, most past generic issues have been dispositioned according to delta CDF instead of CDFs. If you look at this chart here that talks about which issues you exclude from further consideration and which ones you continue, the X-axis is core damage frequency and the Y-axis is change in CDF.

Based on our knowledge of the fire PRA CDFs out there in the industry, which would really tell us about our HEAF baseline, we believe the results for this pre-GI evaluation would be in this green region. We don't think anything would be over 1E minus 4 on core damage frequency. So, therefore, the determination is going to be based on delta CDF, which really underscores the importance of properly defining that CDF baseline.

In either factor in that determination of

the delta CDF, any conservative assumptions could result in an inappropriate decision. It could wind up putting you in the incorrect region. And if we try to make a decision based on a single assessment of the baseline risk or we just use one specific event, initiating event, frequency, or consequences, we'll wind up with an inaccurate and unrepresentative answer, which is not what you want in a generic issue program.

Next slide, please.

So, this chart gives sort of a pictorial of where we think we might be and what kind of decisions we might be making. So, I'll just give an explanation of what the different dots are for those in the room.

The orange dots are perhaps guesses of where we think we might be, based on some of the initial bounding testing that's been done. The blue dots are where we think perhaps realistically some of the plants may lie in that delta CDF versus CDF region if we applied some of the insights from the tests done to date. And then, that green dot is perhaps what we would decide our assessment would be, based on just those orange dots, if we aren't really adequately considering all the input from various plants.

So, there's really two things to consider from this chart. The first thing is, should we be making determinations based on just a couple of small samples interpreting data from bounding results so far, when that may actually not be representative of what we see in the industry? And the other consideration is, are those orange dots themselves based on conservative assumptions? And perhaps we don't have anything outside of the excluded region. I'm not saying that these are the answers, but this is a stylized representation of where we may be finding ourselves and underscores what it's very important to make sure that we are accurately assessing both the baseline risk and the potential delta risk from including aluminum.

So, moving on to the next slide, we have been talking about this in terms of, well, what have we done with past GIs? It wound up being a matter of delta CDF.

So, if you look at what we did with the seismic GI, when that came out, we didn't even have the amount of information relative to seismic PRAs that we have relative to fire PRAs right now. But, even with that limited risk-informed approach, there was a pretty high variability in the decisionmaking

that we came up with.

So, again, if you go back to that previous chart, even without detailed information, we've found a lot of variability. So, we anticipate that you would find, with additional plant detail, you would continue to find more variability.

So, we believe that it's extremely important that we include realism in the assessment and in resolution of the pre-GI. It's important to make sure that we're really isolating the specific impacts associated with the inclusion of aluminum because that's a scope of this GI, and appropriately shore up what that CDF for that baseline is, so that we can accurately calculate a delta CDF and accurately assess this issue.

We believe that a lot of plants may not require action. We think a lot of plants will fall into that region to exclude from further consideration. If we have a properly-conducted pilot with proper insights and proper consideration of OE and properly-constructed tests, I don't think that we'll find ourselves in that delta CDF region that has us moving forward.

So, if we move on to our last slide, I think what our priorities for the evaluations are

-- and these are not just priorities in terms of what we think is most important, although they are that, too -- these steps really need to be taken sequentially for us to get to a proper answer. So, we need to make sure that we fully understand and evaluate data from previous tests. I think we heard a few times today that some of the previous test results weren't fully understood; we didn't have full material characterizations complete yet. And we think that that's critical to get that done, so we can get a better picture of what phenomena we're looking at.

We need to achieve consensus on the technical approach for frequency and zone of influence work. It sounds like the Working Group will be taking that on. So, we fully support continuing with that.

Once that's complete, I think that would be the appropriate time to move on to any additional testing to resolve any identified gaps, so that we make sure that our tests are carefully constructed to close those gaps.

And finally, complete a realistic evaluation of the plants using all that test data in OE.

So, I think just one more thing I want to underscore in my presentation is that it was mentioned

earlier that the industry comments were dispositioned. We turned in comments following the workshop last April. I know that there still have been some changes to the test plan made. But, based on the comment resolution we saw, it doesn't look like the test plan would really support a fully realistic evaluation of this pre-GI. And we do think it's important to perhaps look at those comments again before we proceed with further testing. Because, right now, we don't think that the testing plan fully aligns with what is needed for a realistic evaluation.

MR. HAMBURGER: Would you be willing to answer any questions?

MS. ANDERSON: I'll answer any questions.

MR. HAMBURGER: Okay. Anybody in the room who has questions or comments for Victoria?

MR. HYSLOP: Hi, Victoria. J.S. Hyslop, NRR.

You talked about the baseline and not really having a baseline. I know we had some comments earlier about 2 seconds versus a different model. Is that what you're getting at when you say that? Because there is a baseline, at least one that's been used in regulatory analysis, and the NRC has accepted it, and licensees have acted on it. So, can you

clarify that for me?

MS. ANDERSON: What I mean is, if we're trying to determine what the delta CDF is for the specific impact of aluminum involvement in a high energy arching fault event, our baseline needs to be isolating out -- needs to be defined such that we're isolating out the unique impacts of having aluminum involved. And right now, I don't think that we have the detailed information on the phenomena associated with the testing results we have. That's not really reflected in the baseline. If I understand, right now the baseline is simply what we get from 6850 right now, which is based on one event. So, we wouldn't really be comparing an appropriate baseline to an appropriate CDF from the aluminum impacts.

MR. HYSLOP: So, does that mean that, if you feel that the testing and the analysis truly represented aluminum, that you couldn't use the 6850 baseline? Is that what you're saying?

MS. ANDERSON: I don't think that you would be able to just take the 6850 baseline by itself. I think you need to do a more nuanced evaluation once you have a better understanding of the phenomena that we're observing in those HEAF tests that involve aluminum.

MR. HYSLOP: So, you're recommending, after we understand the issue, just looking back at 6850 and verifying that's a suitable baseline or making a decision --

MS. ANDERSON: Or adjusting it. I don't think it's going to be a matter of verifying. I think it's going to be a matter of adjusting it in some way to make sure that you're uniquely reflecting just the impacts of aluminum.

MR. HYSLOP: I guess that might be a plant-specific analysis as well.

MS. ANDERSON: I think you could do it on a generic basis or using representative plants.

MR. HYSLOP: Yes, that sort of gets to the pilots --

MS. ANDERSON: Yes.

MR. HYSLOP: -- because, earlier in your slide, you talked about having not just one PRA.

MS. ANDERSON: Correct.

MR. HYSLOP: And certainly we need several pilots, so that we can look at this and not just have to rely on one answer.

MS. ANDERSON: Yes, absolutely. But, as I noted, I think we need to have a better idea of what we're going to be asking the pilots to do before we

get any volunteers.

MR. MELLY: Hi, Victoria. This is Nick Melly in the Office of Research.

Can we go back to the slide with the dots, the third slide?

MS. ANDERSON: Yes. Which, by the way, are not representative of anything. This is a pictorial -- yes, it's a cartoon.

MR. MELLY: All right. I was kind of hoping that there were numbers behind them right now, but --

MS. ANDERSON: No, no. It's a cartoon.

(Laughter.)

MR. MELLY: Okay.

MS. ANDERSON: I mean, aside from the fact that we know that almost all the fire PRAs sit in that CDF region.

MR. MELLY: Right. I wanted to speak to this, just to reiterate the fact that the pilots are really necessary as part of this process. The generic issue assessment stage needs a risk evaluation. If we do not have the pilots to do that, it falls back on the NRC staff in order to make approximations, to make assumptions on what that risk would be at various plants.

Some ways that we've done this in the past are the SPAR model, and there are conservatisms within and there's some limitations on the NRC staff at what resources we have available to make our assessment. For instance, spatially in the room it's very difficult to tell what other CCDP targets would be involved in a SPAR model versus the wealth of information that the plant PRA models actually have. So, that's just I wanted to stress that the pilots are very important if we're looking to get a realistic representation of the increase or the delta risk.

MS. ANDERSON: And I'll say it again, that we're not really going to be able to in good faith encourage a licensee to volunteer as a pilot until we have confidence that the evaluation that's being done is based on realistic evaluation of the operating experience and realistic testing.

MR. MELLY: And I hope that, with the products that the EPRI Charter and the NRC Working Group come up with in terms of frequencies, zone of influence, operational experience to support that, will bolster some confidence in that approach.

MR. GARDOCKI: Hey, Ashley, this is Stan Gardocki. Oh, this Victoria. I was thinking that's Ashley. Sorry.

(Laughter.)

MS. ANDERSON: That's Kelli.

MS. ANDERSON: Ashley is at home with her baby. She's beat all of us today.

MR. GARDOCKI: Okay. Just one comment on this graph. We've used it in the Generic Issues Program, and people understand that it's not a go/no-go definitive line there.

MS. ANDERSON: Yes.

MR. GARDOCKI: It's a gradient --

MS. ANDERSON: It's soft line, yes.

MR. GARDOCKI: It's a gradient line. And if you go back to the PRA Reg Guide 1.197, you'll see that notation in there that says you take a gradient approach when you get near that line. So, it gets a little bit, you know --

MS. ANDERSON: Yes.

MR. GARDOCKI: It gives that go/no-go approach. Okay?

MS. ANDERSON: Yes. I should take a blurring tool to that and sort of make it nice and fuzzy. If you're right on the line, you still have further evaluation to do probably.

MR. GARDOCKI: You can try. I'm doing that in updated documents that we have --

MS. ANDERSON: Yes.

MR. GARDOCKI: -- to try to show that.

MS. ANDERSON: Actually, I believe NEI put in a comment to the effect that that should be done --

MR. GARDOCKI: Yes.

MS. ANDERSON: -- in NRC documents.

MR. GARDOCKI: One question I do have is, we put an IN out about a year ago. And based on operating in a plant, you have to take an IN that the NRC puts out and evaluate for your plant to see if it has impact. But the NRC doesn't have resources to go out and see what reaction the plants had to the IN that we put out. I don't know if your agency can somehow get that information to see how the plants reacted to that IN. If they put it in a corrective action base, and they say, well, does it apply to our plant, does it not apply to our plant, and what action plan they have and correspond to that IN, that would be a resource available maybe for your reach-out to the plants that already out there. They don't have to do anything. They already have done that, or supposedly have done that.

MS. ANDERSON: Yes. From what I understand, I believe most plants looked at that testing and they believed that it was not

representative of their plant configurations and I think determined that there was no action needed on their part. So, are there any licensees with action to the contrary? There are a couple of licensees in the room, but I don't see any of them getting up to correct me. So, I do not believe any plants made any physical modifications as a result of that Information Notice.

PARTICIPANT: I would say, because of the prototypicality of the --

MS. ANDERSON: Yes, yes. I think that was the determination, was that the tests that the Information Notice was based on, most plants believed that the data didn't have applicability to their plant. So, they did not take any action to make physical modifications. But, again, there are many operating plants throughout the fleet, and I don't have full knowledge of what all of them have done, and no licensees have come to correct me yet.

MR. BOYCE: Hi. Tom Boyce. I'm the Branch Chief for Regulatory Guidance and Generic Issues.

These might be just feel-good comments, but I'm observing this and I just wanted to share that, from the program perspective, having the

participation today is really very positive. The worst scenario for the GI program is that we don't even have public meetings and we don't get this input, and we do operate with one-size-fits-all and perhaps overly conservative type of outcomes. So, I think this is very positive.

And the best thing for the program and for safety, honestly, is if all those green dots and those orange dots became blue dots. So, we're not in it just to do something. We're in it to make sure safety is accomplished.

MS. ANDERSON: Yes, we concur with that.

MR. HAMBURGER: Okay. Anything else for Victoria?

(No response.)

MR. HAMBURGER: Okay. Thank you.

MS. ANDERSON: Thank you.

MR. HAMBURGER: Anything from the webinar?

(No response.)

MR. HAMBURGER: Okay. So, the floor is now open for anyone who would like to make any comments about any of the presentations we've given today or anything tangentially related, HEAF-related.

MR. BOYCE: We just got a question from Paul Gunther on the GI process. So, his question is,

"Will the GI process look at any age-related degradation mechanisms that might contribute to the risk frequency for HEAF events?"

MR. GARDOCKI: This is Stan Gardocki.

As part of the Generic Issues Program itself, we would look at the initiators of the event and the contributors to the probability of the event in the risk analysis. As far as aging management specifically, the NRC has its own aging management program for life extension, AMR process, and they have specific engineers that work on cabling, submerged cabling, and they put out the report on that as influence to aging management. I don't know if that addresses it correctly.

Do you want to add some more?

MR. MELLY: This is Nick Melly from the Office of Research.

In addition to when we do the frequency work, we also trend the frequencies of fire events within power plants and the most significant events. So, we're trying to capture any aging-related issues when we're looking at the root cause of the events themselves, as well as the frequency of occurrence in the plants.

Currently, we have seen no increase in

frequency of high energy arcing fault events that are solely attributed to aging concerns. When we look at the root cause, it's kind of all over the board of different factors, such as human-related failures, design specifications. Aging is also in there as well as foreign material. It is an aspect that we're aware of, and we look for it when we evaluate the frequency of these events.

MR. TAYLOR: Yes, this is Gabe Taylor, Office of Research. I'll just add one additional piece of information that kind of goes on what Nick said.

Back when we issued the Information Notice last year, although we didn't do any type of formal trending analysis, I did do an informal kind of back-of-the-envelope-type evaluation. And from the data that we had, the operating experience that we had, we didn't see any increase, any decreasing trend versus time. So, it looks like it's somewhat of a constant hazard or a constant failure rate type of event.

MR. HAMBURGER: Any other questions from anybody in the room?

(No response.)

MR. HAMBURGER: You have one more?

MR. BOYCE: Yes. We have one more

question from Rob Cavado. His comment or question is, "I want to reinforce the comment earlier that we need a public meeting prior to finalizing the actual PRA modeling to ensure the updated HEAF modeling is usable and realistic." So, more of a comment.

MR. TAYLOR: Yes, I don't think we've changed from this morning. I think we agree, agree with that. And when we get to that stage, we'll probably engage the stakeholders.

MR. HAMBURGER: Okay. And just for --

MR. CHEOK: Actually, I also have one question. I said this morning that we need to get a clarification of industry and other stakeholder comments. I know that we have received an abundance of comments, and I think the staff feels like we have dispositioned them. I get the sense that a lot of the disposition is not satisfying. Put it this way.

So, I'm going to offer again -- I heard it from Victoria again, which is what reminded me of this. That one of the steps that was proposed by NEI was that we resolve all the comments before we start on the next set of testing. So, I don't want to do the next set of testing and hear that we did not resolve all the comments. I think that would not be fair to the staff or to all of our stakeholders.

So, again, I think I want to work with the staff and work with NEI and EPRI on maybe a date as to what we can do in terms of resolving all the remaining comments, all the comments that need to be resolved before we start our next set of testing.

MR. HAMBURGER: Go ahead.

MS. UHLE: Okay. Jennifer Uhle from NEI.

So, thanks, Mike. We are very interested in working together collegially here to address the issue. And we recognize the importance of a pilot in determining the delta CDF. And so, yes, we hear you and appreciate that.

But there's also the element of the modeling that has to be, I think, discussed because I think at least what I've heard is that we'll be given the results of the modeling. And that, to us, is not pleasing, considering the modeling -- having a modeling background myself -- can go in a very conservative direction. It can go in a very non-conservative direction.

And so, if we are going to be as an industry -- you know, the generic issue disposition is going to be impacted by the modeling. We would like, the industry would like to play a role in at least commenting on the modeling approach, rather than just

the data or the results that get generated through the use of the model.

So, the more cooperation, and cooperation -- obviously, NRC still maintains its independence -- cooperation is what I mean when I say "communication" and justifying a variety of assumptions. The more that occurs, I think the more confidence that people will have in participating in a pilot, which is going to be a critical part of this.

But, if we are just given a model and it's used, and we haven't participated or aware of how it was developed, that's going to be problematic from our side of the issue.

MR. TAYLOR: Yes, I'll go ahead and respond to that. I think I agree with what you said. We need to get involvement early on. Probably I misspoke earlier about not getting involvement early on.

MS. UHLE: Okay.

MR. TAYLOR: As I said earlier, we're just changing approaches. Just recently, that happened. So, I think once we get moving, we'll obviously be working with EPRI through that format. And then, as we move along, we'll identify points and try to bring in other stakeholders via public meetings or other

forums.

MS. UHLE: Okay. Great. I appreciate that, Gabe.

And so, if I can just continue and say that, getting industry information to give to the NRC is obviously work on our part as well as your licensees. And so, having assurance that this information is going to be used in a realistic manner would also help in encouraging the industry to be more willing to participate in the process.

Thanks.

MS. VOELSING: This is Kelli Voelsing from EPRI again.

Mike, I really appreciate your commitment to go back and make sure that we addressed and resolved all comments. And at least speaking for EPRI, we'll make sure that we get you any that we think are still outstanding in a concise format.

I would, however, say that I think there's a strong probability that there will be additional comments that we want to take into account in planning future test phases based on the results of previous tests. And so, until we have those test results and the ability to spend the time and look at them, we probably don't have a complete set of comments. But

we'll certainly get you the previous ones in a concise and consolidated fashion.

MR. CHEOK: So, at lunch today, Stan Gardocki came over to my office, and coming over to this meeting, Tom Boyce was also talking to me. And they looked at the generic issue timeline, right? And we saw that this morning. And rightly so, the generic issues staff would like to see things move on, so they do not drag on forever. And if it's something that's a safety case, we should not take forever to resolve something that potentially could be safety.

But, on the other hand, we also have got to get it right, right? So, I think when we talk to Stan and Tom, we understand that this process maybe may take a little longer because we want to get it right, but we still cannot push it out too far. But we understand the sequence of events that you laid out, and we'll talk, talk over this with the staff on the effect of the test schedules, the availability of the lab, and things like that.

But those are comments that are good comments. We will take that into account.

MR. GARDOCKI: To point out -- this is Stan Gardocki -- point out exactly what this conversation was, we had the pilot plants. You could

see on the screen the assessment plant timeline. And the people on the phone, if they want to go to that in my presentation?

We plan on completing the assessment by the end of 2019, and then, rolling it all up and have the assessment report done in the first quarter or two of 2020. It's a very aggressive schedule based on getting all this testing complete.

Based on the comments we are having today, we see the pilot plant study is being done right after June, July, and completed by August. And that's in the summer of this year is when we're going to do that additional testing with the bus ducts and the low voltage. To complete the pilot plant study prior to that testing is going to be a challenge.

MR. CHEOK: Again, we will work this out. I think it's more important to get this right. I think everyone wants to get this correct. So, we will take everything, all the comments we heard today, into consideration, and we will work out a schedule that is not going to drag this thing out too much. But we will work to do the right, to get the right information, so that we can resolve the issue that has a recommendation that could be defendable and that is robust.

MR. HAMBURGER: I think we have one more question on the webinar?

MR. BOYCE: Yes, we have a brief question from Mohammad Mustafa, Entergy.

His question is, "Do existing Appendix R and NFPA 805 separation criteria remain adequate?"

MR. HYSLOP: I don't know. We'll have to see what the testing does. Certainly, this generic issue is looking at a PRA and looking at risk results, but I don't think it's limited to that. I think we talked about Appendix R, the impact on that as well. So, we just have to see, and I can't speculate any further than that.

MR. HAMBURGER: I just want to do one final sweep of the webinar for anyone who may have called-in only. Can we open up all the phone lines on the webinar to see if anybody has any questions they need to ask? And if you don't have a question, now is a great time to put yourself on mute.

Just give us a second to open up all the lines.

Anybody on the webinar with a question?

(No response.)

MR. HAMBURGER: Okay. And again, if anything occurs to you later, you can get in touch

with anybody on the meeting notice. We will sure the comment or question gets to the right place, and we'll get back to you.

Any last questions from anyone in the room?

(No response.)

MR. HAMBURGER: Okay. And just a note. I have two actions here for me. One is to circulate the Draft Charter.

MR. BOYCE: We have, I think, one question from Rodney Pletz. If you have your question, you can ask it now. I unmuted you. Go ahead, Rodney.

(No response.)

MR. HAMBURGER: We have to open up the phone lines again in the control booth. No, he says we're good.

Rodney, do you have a question for us?

(No response.)

MR. HAMBURGER: Okay. Well, if you can type it, we'll answer it.

So, I'm going to make sure that the Draft Charter gets circulated and placed in public ADAMS for industry comment before that becomes finalized.

And I will also publish today's meeting package that includes all the presentations, the

transcripts, and everything that was presented today.

So, if nobody has anything else, I want to turn it over to Mr. Michael Franovich. He has some closing remarks.

MR. FRANOVICH: Good afternoon. I'm Mike Franovich. I'm the Director of Risk Assessment in NRR.

I am Co-Chair of the GIRP. Mike and I co-chair the GIRP. There's a reason we've structured it that way. We want to make sure that when or if this issue migrates to NRR in terms of a transition, that the expectations are really met.

Stan this morning described in detail the process for the GI program. An issue migrating over to NRR in the Program Office, there are a series of processes that we have in the Program Office. Certainly, if there's a viewpoint that there's an imposition of a new requirement or a new position, we will go through a very structured process. Even if it's a generic communication such as a Regulatory Information Summary, we do have processes to ensure that we're not imposing undue burdens.

We have revamped those processes, actually, as many of us have gone through, or, actually, all of us have gone through backfit reset

training. And I want to emphasize that it is not success for us to have incomplete information moving in the regulatory program space and trying to move forward with some types of expectations for licensees to do more work.

Certainly, some of the issues discussed today about risk modeling, fire modeling, the testing and how representative it is, those are the types of issues that would come up in our internal review in NRR. Because when we look at it, we actually bring those types of issues to our leadership team. The leadership team is looking at it from a resource impact, not just a safety perspective, but a resource impact, as we have to approve resources to be able to move forward. And that looks at both how long those processes can involve and what will be the ultimate end state.

We've talked about a lot of testing today and the need for more communication. And I won't reiterate that. There are some very good characterizations of that.

I think it was recognized early on in the GIRP when we did the Assessment Plan Report in the summer timeframe that this is living plan; there would be give-and-take back and forth.

If you notice in that plan, there are a number of highlighted engagement points, in particular, with ACRS. ACRS is a vital stakeholder for us and they will scrutinize the pedigree of the work and the fidelity, any kind of outcomes that come from the research activity. And also, they want to know which direction we'll be moving in. Those processes engaging with the ACRS are very public, and information is released in advance of the meetings at ACRS. So, there are other engagement points where information will be made available to other stakeholders, not just the ACRS.

But point well taken about more interaction. I think the interest we've had both here in the room and on the webinar illustrates the need for more dialog.

The other thing I want to really point to is, ultimately, this comes down to a risk management equation. And in risk management equation space -- set aside the regulatory piece -- there's both prevention and mitigation. And I think we need to not lose perspective, that if more can be done with prevention in terms of looking at predictive maintenance and preventative maintenance practices, at least that can help shape the risk management approach

to the issue and resolution.

We had some dialog. Kelli shared some information about parsing more of the data and looking more closely at the OpE. But we may not be able to do statistical changes based on some qualitative analysis, but if there are better practices that are going to be promoted, we can take those matters into consideration.

Victoria had some graphs up with the lines that aren't really fuzzy, at least drawn on yours. We do have some documents that do have some fuzzy lines, by the way. NUREG-1855 on the treatment uncertainties actually some illustrative points there, how to weigh those in decisionmakings when you're not clearly on one side or one regime versus another regime in terms of thresholds.

But, to that point, we would consider qualitative type of information there to say which direction are we taking. The other thing we need to keep in mind is, if there are other improvements in the fleet, and we talk about FLEX, although FLEX was not designed specifically for this type of hazard, there is an optimization process that the industry has promoted that we're well aware of and we're engaged. And that's in NEI 1606 and 1608.

Some plants have gone forward and actually done some modifications for other hazards to mitigate those risks by modifying FLEX. With very subtle mods, they've been showing -- granted, it's plant-specific type of risk -- that there can be significant reductions in risk.

So, irrespective of the regulatory piece for a moment, just keep those in mind. If you're out looking at doing modifications of the plants and you see somewhere where there's an opportunity here to do that, it may be a great opportunity in the span of doing other work at the plant.

But I do want to note again, when we get to the transition point, there will be open questions that we need to make sure we have a smooth transition of the issue to the Program Office.

There will be a risk-informed resolution of the issue one way or another. That's the climate we're working in. It's a smart climate.

And with that -- we are well ahead of schedule, actually -- I will open it up for any last questions here in the room and on the line.

MR. HAMBURGER: All right. We have one question in the room, and then, we'll get to the last question on the line.

MS. VOELSING: Again, sorry not a question. Kelli Voelsing with EPRI.

Mike, I did want to give you confidence regarding the holistic treatment, that at least from an EPRI perspective, we've gone back and looked at is there more guidance needed around these maintenance and operational best practices. We found that there's plenty of historical documents on that research, and we've engaged with our advisors in both the maintenance organization and the engineering organizations, discussed it with executives, and we highlight those in our pointers to those best practices. So, that is definitely work that is out there in the industry and ongoing. And the holistic treatment at least is not lost on EPRI, and I think the industry is well aware of that through our advisory structure and their interactions with NEI as well.

MR. FRANOVICH: Okay. Appreciate that.

MR. BOYCE: We have one question from the webinar. Rodney managed to get his question in. So, here's his question. He says, "This question is more for participants from the industry. As we work to refine and define the impact of HEAF, are any sites taking action with their operators and fire responders

to train them in the potential for increased ZOI from these events? In other words, the survey that we did over a year ago gave at least preliminary identification of where HEAFs with aluminum are located and could happen. Are any sites improving their fire response training or fire preplan information to account for these events? Do we need any or want any industry alignment on this during the interim period while the GI process continues?"

MR. HAMBURGER: I can't make anybody field that question, but if anybody would like to?

MS. UHLE: This is Jennifer Uhle from NEI.

I don't have an answer to that question. As with any issue, there's plant interdependency -- or excuse me -- plant-specific dependencies of the impact of the current knowledge. But, going forward, we certainly, as an industry, are getting our views together and ensuring that there is a common understanding at both the staff and management level. And we can certainly bring that up for consideration on the industry side.

MR. BOYCE: We have a comment from Rob. He says that, "We already have procedures in place that address full compartment losses. This bounds the issue."

MR. HAMBURGER: Okay. Any last questions or comments before we close the meeting?

All right. Thank you all for your participation.

(Whereupon, the above-entitled matter went off the record at 2:31 p.m.)