Transcript of **Technical Conference Day 2**

Thursday, September 5, 2024

Conference for North American Electric Reliability Corporation

www.TP.One
800.FOR.DEPO (800.367.3376)
Scheduling@TP.One

Reference Number: 145661

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

(NERC)

Standards Committee and NERC Ride-through

Technical Conference

Thursday, September 5, 2024

9:01 a.m.

PARTICIPANTS

SHAHIN ABDOLLAHY, MPR Associates

MARK AHLSTROM, NextEra Energy

SYED AHMAD, FERC

MELISSA ALFANO, Solar Energy Industries Association

HUSAM AL-HADIDI, Manitoba Hydro

JOEL ANTHES, Pacific Gas and Electric

ROMEL AQUINO, Southern California Edison

JOHN BABIK, JEA

REBECCA BALDWIN, Spiegel & McDiarmid/TAPS

CHRISTIAN BECKMANN MENIG, Siemens Gamesa Renewable Energy

TODD BENNETT, AEC, NERC

KELSI BOYD, NERC

TROY BRUMFIELD, American Transmission Company

ADAM BURLOCK, TransAlta Corporation

JAMIE CALDERON, Invenergy, NERC

JOHNNY CARLISLE, Southern Company

AMY CASUSCELLI, Xcel Energy, NERC

TODD CHWIALKOWSKI, EDF Renewables

KEVIN CONWAY, Western Power Pool

CHARLIE COOK, Duke Energy

PARTICIPANTS (continued)

MIGUEL COVA ACOSTA, Vestas

SAMIR DAHAL, Siemens Gamesa Renewable Energy

MIKAEL DAHLGREN, Hitachi Energy

JOEL DEMBOWSKI, Southern Company

GERARD DUNBAR, NPCC

NANCY E. BAGOT, Electric Power Supply Association

MOHAMED EL KHATIB, Invenergy

PAMELA FRAZIER, Southern Power Company

SEAN GALLAGHER, SEIA

ANDREW GALLO, ERCOT, Inc.

MICHAEL GOGGIN, Grid Strategies

HOWARD GUGEL, NERC

THOMAS SCHMIDT GRAU, Vestas

MARK GREY, EEI

SAMUEL HAKE, AES

JOSH HALE, Southern Power Company

JOE HENSEL, Minnkota Power Cooperative, Inc.

ANDY HOKE, NREL

KATIE IVERSEN, AES Clean Energy

RHONDA JONES, Invenergy

SRINIVAS KAPPAGANTULA, Arevon Energy

PARTICIPANTS (continued)

SCOTT KARPIEL, SMA

SUE KELLY, NERC Board of Trustees

FRANK KENNEDY, Alliant Energy

SOO JIN KIM, NERC

ARNE KOERBER, GE Vernova

BHESH KRISHNAPPA, SEIA

MARK LAUBY, NERC

DOMINIQUE LOVE, NERC

JASON MACDOWELL, ESIG

RAJAT MAJUMDER, GE Vernova , NERC

ROB MANNING, NERC Board of Trustees

HAYDEN MAPLES, Evergy

DAVID MARSHALL, Southern Power Company

ARISTIDES MARTINEZ, NextEra Energy

AL MCMEEKIN, NERC

PATTI METRO, NRECA

THIERRY NGASSA, Power Electronics

LATIF NURANI, American Public Power Association

KAREN ONARAN, ELCON

MOHAMED OSMAN, NERC

MANISH PATEL, Electric Power Research Institute

PARTICIPANTS (continued)

DINISH PATTABIRAMAN, TMEIC Corporation Americas

LEVETRA PITTS, NERC

RYAN QUINT, Elevate Energy Consulting

SAM RAMSEY, ACP

ROBERT REEDY, DOE Solar Technologies Office

FABIO RODRIGUEZ, Duke Energy Florida

DANE ROGERS, OG&E

THOMAS SCHMIDT GRAU, Vestas

RUCHI SHAH, AES Clean Energy

ALEX SHATTUCK, NERC

JOHN SKEATH, NERC

TRAVIS SMITH, EEI

EWGENIJ STARSCHICH, Siemens Energy, Inc.

JEB STENHOUSE, Invenergy

KYLE THOMAS, Elevate Energy

VAIDHYA VENKITANARAYANAN [Nath Venkit], GE Vernova

BORIS VOYNIK, FERC

QIUSHI WANG, AES Clean Energy

XIAOYU [SHAWN] WANG, NERC

TIFFANY WASHINGTON, NERC

CHARLES YEUNG, Southwest Power Pool

PARTICIPANTS (continued)

BILL ZURETTI, EPSA

AGENDA

AGENDA

AGENDA (continued)

AGENDA

P R O C E E D I N G S

MR. BENNETT: Okay. Good morning, everybody, and welcome to Day 2 of our technical conference. We've seen a lot of familiar faces here back in the room, and I think we're starting to fill up online. So just want to welcome all of our online participants as well as those in the room.

As far as major notes this morning, I don't have a lot to add other than I'd just like to encourage our participants to continue the momentum from yesterday and the engagement from yesterday. It was top notch, and I can tell you there was a lot learned from it, and it provided a lot of good data points to help the Standards Committee move forward. So with that, Soo Jin, do you have anything you'd like to add?

MS. KIM: All right. I will be very brief. I just want to say thank you so much for everyone that participated yesterday. I think yesterday was a really

great day. I think that we got a lot accomplished, and I think we heard from a lot of different voices that I think filled in a lot of the gaps for the different issues that we saw come through on the comments with regards to the standard.

I would be really remiss if I did not thank the people who put this event together. I cannot tell you what a tremendous task it was to get this type of a conference put together in just a few weeks. So Jamie Calderon, first, I want to thank you because I don't know if everyone understands under her leadership, we've done so much work. And we've had to coordinate with so many different departments and had to bring so many people together just getting these panels together, just getting everyone informed, putting together this agenda, it was under her leadership, so I just want to thank you for that.

Also, we have a tremendous staff here at NERC, and so Levetra, Tiffany, Wanda. Also, the staff that could not be here today: Alison Oswald, Nasheema Santos. I can't -- the list goes on and on about how many people had to come together to make this event happen. All of

your hard work is so greatly appreciated, and we know we could not have done this event without the tremendous effort that came together in just a very short amount of time. And when I say everyone was working late at night, early in the mornings, just to make sure that this event came through very seamlessly, not only in person, but online, we owe them a tremendous gratitude.

And then I, also, for the other departments that are contributing, the engineering staff, Alex Shattuck, J.P. Skeath, all of the other engineers that have put together a tremendous amount of technical input, provided a lot of advice, thank you for being here. Howard and Mark, thank you for your leadership and also being here today. Robin, Sue, thank you so much for your participation and all of your remarks because, again, it has been a very collective and collaborative effort, and I think that we are moving forward, and we're making a lot of progress. Also, I just would like to thank the SC members. We did get some volunteers here to lead this SC effort. It is not just a NERC effort: Todd, Amy, Troy, Charles, everyone

who's volunteered, thank you so much because after today, there's going to be a tremendous amount of work to get a next draft put together.

I just want to remind everyone of our charge. When the Board invoked Rule 321, there are several obligations that we have to meet. And so I just want to remind everyone that we are addressing this particular project. I know based on the comments that have been coming in, many people would like to see an expanded effort. There are some comments asking us to open up other standards. I just want to say that we have to focus on this Ride-through issue. That is the next task. That is what's going out for ballot. We won't be opening any other standards, and we will be focusing on the particular issues that we had to address with regards to Rule 321, and that is with Ride-through.

We get one more ballot, and again, tomorrow starts the new drafting effort. It will not be just a blank sheet of paper. We're taking into account all of the comments. Nothing that has been submitted online or submitted to NERC staff is lost. And so I know that we

had a limited amount of time, and there's some consternation with regards to submitted questions. Everything is being reviewed. We are taking a tremendous amount of time to walk through all of the comments. And this is also a very transparent and public process, and so we are very committed to that, not just as a department, but as NERC. And so I just want everyone to be very assured that if there's any concerns, please reach out to me, and we will make sure that comments are addressed. We were -- or have to walk through the process with you again.

And the last thing I just want to say is that as we are required to under Rule 321, this will go out to Ballot One more time, and we have to conclude this effort by the 30th. And so I just want to remind everyone, we are under a very tremendously tight deadline, and so by the 30th, we have to conclude this process in order to present something to the Board in October at an open call for adoption.

And with that thank you so much for all of your time. I look forward to today's discussions, and I thank you again for being here and online.

(Applause.)

MR. BENNETT: Okay. Thank you so much, Soo Jin, for those sentiments and kind words and details about the path forward, so thank you so much.

So moving right on into our agenda today, I see we have a panel discussion on Frequency Right Through Exemptions in PRC-029. So today, I believe Charles is going to be -- help us be a moderator that as well as Alex from NERC, so I believe that if we want to get our panel together, we can commence.

(Pause.)

MR. YEUNG: Okay. Good morning. My name is Charles Yeung. I'm with the Southwest Power Pool. I'm a member of the Standards Committee, also vice chair of one of their subcommittees, the Project Management of Standards Projects.

Yesterday we heard quite a bit about the frequency Ride-through requirements and how they differ from, of course, PRC-024 and also the IEEE 2800-2022. Today's panel, we're going to be talking about what was left out of the current draft, which is exemptions from frequency Ride-through requirements. So as I mentioned

yesterday, we heard quite a bit about a lot of the obstacles and challenges to meeting PRC-029 frequency Ride-through. So today, our panelist is assembled to talk about, you know, what exemptions would have as far as an impact on how the industry can move forward as far as IBR Ride-through requirements. So Alex, you want to ask the first question, and we can down the panel?

MR. SHATTUCK: Sure. Yeah, we'll get started, and we'll probably just ask one and do follow-ups as we go down the line. So our first question today is -- for the panelists is, what are the financial and practical impacts between hardware- and software-based solutions? And Mark, you can us get started.

MR. AHLSTROM: Sure. Mark Ahlstrom. I'm representing NextEra Energy. You know, I think we have to be careful not to underestimate the impacts of, you know, the complexity and the effort of software as well because, as we know, with all the emphasis on modeling and getting all the analysis done, you know, even doing a software upgrade, you know, it takes a lot of engineering analysis, working with every --, you know,

every OEM for the various pieces, not just wind turbines or the solar inverters themselves, but the balance-of-plant issues, you know, coming up with an engineering redesign creating the models, verifying the models.

And as I -- as I wrote in my comments, you know, that has to be done on a plant-by-plant basis. Every plant is different. Even if you're using the same OEM for a particular wind turbine, for example, you might have different converters. We've got more than 10-plus converters in our NextEra fleet, you know, so it takes a lot of effort. And then, you know, literally, you're talking about having to go out, even for software, to many dozens of plants and many thousands of turbines. And I did put in my written comments by the way, that -- if you'd like to see them, I'd be happy to share them with anybody even if -- I don't know if NERC is going to post them or not, but I'm happy to share them where we went through the entire fleet and looked at the impact, and we'll get to that for the various curves in a bit.

But I think software impacts are reasonable to

bring up to 2800 compliance. I think you have to allow a couple years to do that because it's a complicated process. The hardware upgrades are an order of magnitude more difficult because all of the engineering with that, and also, like, with wind turbines, you have some up-tower things, you know, you can't --, you know, it can be much more expensive. But both of these are complicated processes, and we should not underestimate the impact of either of them.

MR. MACDOWELL: Yeah. Thanks, Mark. You kicked us off well. Good morning, everyone. Jason MacDowell here. I actually wear two hats in industry. I've been with GE Vernova's Consulting Services for the last 25 years, and, really, you think of GE Vernova as an OEM. Certainly GE Vernova is an OEM. We have a lot of OEM stakeholders here and participants that you heard from yesterday. I work in a group that really focuses more on systems integration, working not only as an OEM, but more representing system operators and system integration.

But the hat I'm wearing today is the second role I play in industry as the chief system integration

officer of the Energy System Integration Group. Just like Mark, we have multiple roles, and Mark representing ESIG as well in some of this -- the industry work that he's doing as president of the board there as well.

So I wanted to just build on what Mark was saying relative to the cost implications, and I think, Mark, you alluded also to schedule implications, which is the next question. And I think, you know, we all recognize that any upgrades that are needed, whether it be software or hardware, is more than just toggling a bit or just installing a part. There's a lot of rigor from a manufacturer's point of view, and all the way across the chain with the developers, the plant owners, equipment owners, the system operators, the utilities that needs to be done to accommodate any changes relative to what we'll call standard application products, right?

And, you know, when there -- if there's a need for a software upgrade or a hardware upgrade, in order to account for that and understand the implications of the benefits of those changes and, ultimately, the impacts

on their -- on the performance of what they will do to the grid and to the plant design, as Mark alluded to, is looking at the overall implication to the fleet, looking at the overall implication to that set of products. That includes a lot of engineering analysis. It includes a lot of analysis on the implications of the overall integration of the wind turbine or the solar inverter and the solar system or the plant for that matter. But it also includes a substantial amount of effort to really understand the implications in terms of modeling.

And then there's the open question of when you do the modeling, you got to validate, but what are the aspects that you need to validate that may cause a material change, right? And no doubt any software/hardware implications that we have are to improve the performance, but there are still -- there's the reality that the system operators and the utilities do have processes for interconnection and material change clauses, that if you do change something for the better or otherwise, if you make any upgrade, there is a process to reevaluate that from a system impact point

of view, right? So I think those are all of the considerations and costs that go into system upgrades and what's needed on existing products.

For implications on new products, there's a new product, I would say, introduction or integration and new technology integration evaluation that all system -- all OEMs will need to do and be able to communicate that through models, through documentation, and that takes time as well. So it's -- again, any changes that are made are made deliberately to look at how the product will respond and what is the implication of those changes relative to the lifecycle of the equipment and the -- and also the impact that that would have on the rest of the grid.

As Mark also alluded to, any of those changes, particularly around frequency, really depends on the technology, and it depends on the overall design. So it's not as easy as a broad sweep to say, oh, that one change to meet a wider band of frequency Ride-through is going to have this implication on this product for this amount of time. It really depends on the overall design.

There's probably, and I'm reaching out a little bit, and I would love to hear some feedback from my OEM colleagues because this is ultimately an OEM question about the cost implications. But really the -- one of the biggest implications, especially on, you know, a system like a wind turbine and also, you know, other aspects like solar inverters and what have you, is looking at the impact of frequency deviation on auxiliaries, right? And those auxiliaries are not --, you know, are not necessarily implicitly modeled in a lot of the system models when we look at the overall performance.

And I tell you know, I was on the first PRC-024 Drafting Team back in 2007 when we started this journey long time ago, and on -02 as well, and that was the first time that I had experienced, you know, the NERC drafting team process where FERC mandated through Bob Snow, and, Mark, I think you remember Bob, you know, his comments there well, that we needed to have a standard that was completely technology agnostic.

At that time, the Ride-through curves on both voltage and frequency were more difficult. At the time

we had a lot of debate about what is fair, what's reasonable, what's capable, what does the system need relative to the technology at that time, over a decade ago. And it was far more constraining for synchronous machine technology, especially on frequency relative to inverter-based technology even at that time. And I think that's also the case today where we have frequency deviations that are a lot more sensitive on rotating equipment that are not inverter based than the inverter based. And I think we have to keep that in mind, too, about when we go down the path of looking at the costs relative -- the cost of compliance relative to what the system performance will be, and how each resource will be, you know, integrating and looking at their -- the individual performance.

We're engineering a system. We're not engineering one piece of the system in a bubble, and I think, you know, that's a big consideration around the cost of compliance relative to what we expect from renewables to Ride-through compared to the rest of the system. So I'll leave it at that.

MR. ROGERS: Maybe to take just a little bit of a

different course because that explains some of the technical difficulties at a high level pretty well. Maybe look at what the actual practical impacts are going to be and financial impacts for the -- for the GOs and how that -- how that has to be considered to some extent.

What we've heard a lot today is we don't quite yet know what it's going to take, especially for these legacy -- you know, these much older legacy and even some of the stuff, you know, built in the past decade, what it's going to take to be able to allow those to meet the requirements as set forth in the current draft. We just don't know. What is that cost going to be? Again, we don't know. We don't even know if it's possible in some instances.

So right now with this, you know, and looking specifically at the discussion around exemptions for frequency Ride-through, if passed today as written, we don't know what the impacts -- reliability impacts specifically, but also cost impacts, to eventually the end users, what those reliability impacts are going to be to the bulk power system. We have no idea, and that

hasn't been quantified yet. Does frequency Ride-through capability, ROCOF, everything, all these technical issues that have been discussed, do they need to be considered, especially moving forward? Absolutely. I don't think anyone in this room saying that that's not the case. But right now, where we sit today, if the standard was to pass as written, we don't actually know what the reliability impacts of the bulk power system would be, and there's a chance that it could be a net negative. And I think that's something, when you're looking at a reliability standard, you have to take very heavy into account.

So I think I'll just leave it at that. There's some really excellent discussion about the technical aspects that I'm not going to be able to talk, so -- or top. So I think that's just really my takeaway is right now, when we're looking at financial and practical impacts, we don't know what those are going to be, and especially with the practical impacts, we don't know what the scope of that's going to be. We don't know how bad it's going to hurt. Thank you.

MR. GUGEL: So Howard Gugel, vice president of

regulatory oversight at NERC. Not sure I can really opine on the financial and practical impacts of these, but I just want to opine a little bit on an area that I can, and that's the reliability impacts. You've heard that a little bit earlier.

You know, we're in a situation even today where in some of the markets, there are times when 99 percent of the energy being absorbed by the consumer is being done by inverter-based resources, green resources. If in those scenarios we have frequency excursions that take those offline, nobody's going to ask after the fact what were the financial and practical impacts? They're going to say, why didn't you guys solve this problem before we got into it? And that's -- I'm not saying NERC. I mean, that's going to be industry as a whole, that we need to make sure that we've got that on -- that in our focus.

So, but I think also you've got to take that into account with what are the practical and financial implications of that. I'm not saying that you throw that out the door. I'm just saying that if we get into a scenario where we are almost entirely being provided

energy by inverter -based resources, and we know that there's an issue with frequency Ride-through or voltage Ride-through, and we haven't addressed somebody's -- that we're going to have a lot of questions that we'll have to answer at that point. So just, I think we need to take that reliability impact into account when we think about the practical and financial impacts.

In addition, you know, we -- you heard yesterday that projections are at this point that potentially by the end of the decade, we're going to be at about 50 percent of resource that will be inverter-based resources overall, not just at certain times of the year. And so we need to ensure that the traditional benefits and reliability impacts that have been provided by synchronous generators can still be provided on the system. So you've got to look at that impact there also.

MR. YEUNG: Alex, do you have any other comments or questions for the first question?

MR. SHATTUCK: Nope. Nope. We can move on to the next one.

MR. YEUNG: Okay. So thanks, Panel. Obviously a

lot of unknowns on costs, especially from Dane, his comments, but of course, the other dimension of implementation and compliance to PRC-029 is how long does it take, so the next question is about a timeline. So what is the timeline of this one, specifically about software-based updates, necessary to meet the PRC-029 frequency Ride-through requirements, and how does that differ with hardware based? Yesterday we heard some comments that even if it's a software-based solution, there could be limitations or requirements for hardware upgrades as well. So the question is, how long does it take to do software updates for PRC-029, and does that differ from hardware?

Also, I'd like to add one more dimension based on a lot of the discussion we said yesterday. This question is asking about meeting PRC-029 criteria, but if you can also add whether that changes, whether it's 2800-2022 criteria instead of the PRC-029 criteria. So you want to go this way?

MR. GUGEL: I don't think I can opine on that because, again, that's kind of outside of my bailiwick.

MR. ROGERS: Yeah. Again, the technical aspects

are going to be better handled by the two gentlemen to my right here. But one thing, again, I think that I can speak to is, you know, from our discussions with our -- with our OEMs, is the uncertainty on this. We've been told, you know, it may be possible for some of the equipment, especially with legacy equipment, it's a -- it's a big unknown if there are going to be software updates that are possible. And if there's hardware updates, I mean, to some extent, when you -- when you use the term, "hardware," eventually it is going to be possible, right, if you go far enough up and build enough things out, you change enough things, you're going to get there. But at what point does that become, you know, much more like a repower and not an update? Not certain on that.

But again, I think the primary concern, at least from where I sit, is the uncertainty around this and the inability -- the inability for us to know if software-based updates are going to be available for these, if hardware updates are going to be available for these, not necessarily just the timeline, but are they going to exist? And then if they do exist, what

is the timeline, and I don't have answers for that, again, back to the uncertainty.

MR. MACDOWELL: So the reason I'm pausing here is because I think, as always, the answer depends. It depends on the nature of the upgrade and whether it's software or hardware based. Like I alluded to and what I just said earlier, it's more than just toggling a bit or just installing a part, right? There's a lot of rigor that needs to go into evaluations on the overall equipment, on the integration design, on the modeling, on the validation, on, you know, evaluating if you need to do anything more from the interconnectivity point of view. So, you know, the question I think was aimed at how much -- how much time does it take manufacturers to decide how to -- how to change things from a software or hardware perspective, but we really need to look at the overall picture of the implication to actually get that deployed and to get it in place so that, you know, the implication of that software or hardware changes realized on the grid.

Software changes obviously tend to be a bit quicker than hardware upgrades as a general point of

view, but not always, right? It depends on the amount of analysis that's needed. Generally, with frequency responses, as I said before, we're looking more probably at some of the evaluations on impact on the auxiliaries and not, and then that brings up the question, well, how do we represent that at all in our capabilities and modeling? And that's typically, generally through the Ride-through curves and the protection that's applied to fundamental frequency phaser domain models, and maybe in a little bit more detail in EMT models, right?

But to generate those curves, it sounds simple, right? They're just a bunch of stepped-based curves that are overlaid with the frequency and the voltage profiles that the models are given. But it takes a good deal of effort to actually generate those curves, or at least look at the impact of any changes that are happening and see whether there is an -- you know, a need to reevaluate the curves themselves. And that is in a series of systemic, design-based modeling, and also, if needed, testing, depending on the upgrade.

So that whole process can take on the order of

weeks to months, sometimes even longer, depending on the implication, for a software upgrade. For a hardware upgrade, it could take on the order of years, right, to go through the overall testing and capability implications on the turbine and on -- you know, ultimately leading up to the modeling and impact on the rest of the grid. So I think it's not an overnight thing. It's something that needs to take in careful consideration on, you know, ultimately how long it's realistically going to take to get this overall capability deployed, not just changing, you know, the software or hardware in the equipment itself.

MR. SHATTUCK: Okay. Before we move on, just to make sure we compare the things we talked about yesterday, but do you have any kind of thoughts, Jason the difference between a timeline for meeting 029 draft language and 2800?

MR. MACDOWELL: Yeah. I don't have any specific things yet because we haven't done the evaluation specifically relative to everything we have, and, again, I'm speaking on behalf of ESIG --

MR. SHATTUCK: Yep. Mm-hmm.

MR. MACDOWELL: -- not on behalf of GE Vernova. But generally, you know, and many of you know Julia Matevosyan, chief engineer at ESIG, who's been very, very much in the NERC/IRPS -- you know, with you, Alex, in the leadership of IRPS. This has been a central discussion overall, not only with PRC-029, but Ride-through, and there's a lot of discussion and debate about the overall implications of that. And I think, so going back to the discussion that you and I had, Mark, maybe even last week, you need to do the analysis, right? There needs to be a set of studies to look at what specific things are you trying to fix? What are the specific issues that we know that are out there?

And I'll caveat this, Alex, with your question to say you did a really nice job outlining what is the real issue in your presentation yesterday morning, looking at all the events that have happened, the frequency deviation on those NERC events that are primarily driven by other things outside of the implication on frequency, right? You have momentary cessation. You have all of these questions about how

solar will respond. In some cases, there was a little bit of wind in that, but it was mostly solar responding. The frequency deviation due to those events that were on the order of a gigawatt to maybe gigawatt and a half had very little implication in terms of the grid frequency itself, so it wasn't a frequency Ride-through issue really at all. It was other things that needed to be coordinated and modeled and taken care of.

So I would say, let's look at the issues that we're really trying to resolve, understanding what the real implications are, and then try to solve those instead of having a theoretical what if this happens. And, you know, let me take a step back in PRC-029: what would really cause a frequency deviation that would be that big? You would have to have a very, very large deficit of instantaneous generation tripping offline, very large power plants, likely not renewables at this point, maybe could be if you had gigawatt class renewables, but it could be large nuclear plants. It could be a large part of the grid tripping offline that would cause, you know, an underfrequency or a large

load like data centers, multiple gigawatts tripping offline, causing an overfrequency. Could be a large HBDC station tripping offline that caused that event. It's really not renewables that would be the cause of it, but we want to make sure that in those cases, that we don't have a disproportionate of any type of generation tripping offline causing a further reliability risk, right?

So those are the types of analyses that we need to be doing. What are the design basis events that we see today? What are they -- what are they looking forward? And I really think that, you know, as we transition from a world that has a lot of synchronous machines today -- large nuclear, large coal to renewables -- those design basis events from that perspective are going to get a little bit smaller. But with the data centers that we're seeing and all these large loads that are integrated, those design basis events may be causing us to get bigger. So let's look at that, understanding what the frequency deviations are and try to solve for that, and understand what the implications are across all the fleet. And I think that would be

much better placed to understand the system.

Now, the last thing I'll say about PRC-029, and I will say something about GE -- put my GE hat on just for a second. Several years ago, GE Consulting was commissioned to do a study for the Wind Energy Institute of Canada, backed by the renewable -- the Canadian regulator, and worked with David Jacobson, worked with all his system utilities across the board to understand what was the impact. And the big thing that we took away from that is that Manitoba and Quebec had very large and wide frequency bands in their Ride-through characteristics because there are very specific system needs for that. They have large HBDC connections in remote parts of the grid that, on purpose, really created the need for these wide frequency Ride-through capabilities.

And the Canadian grid codes for those provinces tackled that, but generally in most other places around -- all of the interconnections across North America don't need that wide frequency ban. It's covered by the grid codes there, but we want to make sure that we're looking at fit for purpose across -- a need

across all of North America. And then if there's any specific needs in any region, making sure those regions have the protections in place to suit those particular needs as needed.

MR. SHATTUCK: (Off mic comment.)

MR. AHLSTROM: Sure. I actually think we do have pretty good emerging evidence about the size of the elephant with regard to costs and effort and the difference between the 029 curves and the 2800 curves. Now, NextEra, of course, has a lot of solar and storage, but -- in addition to wind, but we've been in wind a long time. And I'll give specific numbers actually for Question 3 in terms of the exact difference in terms of megawatts and turbines for 029 curves and IEEE 2800 curves.

But let me just start by saying that we've done a thorough analysis of -- based on the information we had available from our OEMs and everything on the plants. NextEra has Type 3 and 4 wind turbines. We have 27 gigawatts, 150 plants with 13,700 turbines using 14 major turbine models with sub-model configurations in addition, four wind OEM models, and more than 10

converters. These go back as far as the early 2000s.

You know, and based on discussions with the OEM so far, our estimate is that, you know, using the 029 curves, I'll just mention here briefly and I'll go into details on the difference with others later, 66 percent of those turbines would require a hardware exemption with the current PRC-029 curves. Now, that's 22 percent of the gigawatts, 66 percent of the turbines because we're talking mostly about older wind turbines, obviously, you know.

So as I said, I'll go into details about how that's improved by going to IEEE 2800 or -- and how that compares with PRC-024 in a moment, but, you know, that's what we're looking at here. We understand the hardware impacts of this, I think, quite well. We don't have specific costs because we don't have the quotes on -- from the OEMs and the other components and all that, but, you know, this is a substantial impact that would have hardware requirements, you know.

So I guess we'll just go to the next question. I'll give more detail, but, you know, that gives you a side -- you know, we actually -- I think other

independent developers out there, other renewable developers are doing a similar exercise. Everything I just mentioned is documented in my written comments, and I'd be happy to discuss it with you in more detail.

MR. SHATTUCK: Thanks, Mark. So yeah, we'll --

MR. GUGEL: Real quick, that there was something that I could weigh in on the points that I heard. And Jason, if I could, with all due respect, I do understand wanting to look at actual scenarios and things, but part of what we're charged with doing and part of what our industry is charged with doing is considering what-if scenarios.

Our reliability coordinators and our transmission operators need to understand predictably how units are going to occur on the system and how they'd be able to do in an emergency operation system. If they don't have that, and if what we're saying here is that we really don't understand, in general, how that's going to happen, I am concerned that they're going to be flying blind. So part of what we're doing with PRC-028, 029, and 030 is providing that predictability for them to be able to understand, at a minimum, for units

going forward, but also understanding where we're at a place right now, if that makes sense.

MR. MACDOWELL: It does. Yeah, completely agree, you know, and I think that forward predictability is complex and it's difficult. And one other thing that we've been really focused on at ESIG and also with GE Vernova with some of the planning work that we're doing with system operators, is really focused in a lot more on integrated system planning to the regard of understanding where are the real pinch points, right? And a lot of the planning that has been historically, and with no fault at all. It's just the systems that have been planned out today have practices that have been in place for decades around understanding where are the system stress conditions on peak load, on light load, maybe a shoulder condition.

And those conditions are no longer the biggest risk. There are other risks around peak IBRs that are not associated at all with peak load, light load, or traditional shoulder conditions. There's peak ramping needs relative to the variability and uncertainty of inverter-based resources, variable energy resources.

There's limitations on headroom for frequency response and Ride-through. Understanding what those system conditions are and try to solve for those, and what is the frequency deviation and frequency response going to look like in those system conditions? Absolutely, right?

So that's what I was saying is, looking at this deterministically and a bit stochastically with integrated system planning saying, what do we expect when we see penetrations of renewables going out to 2030, 2040, and understanding what those frequency deviations really will look like, and then what is the resource mix that needs to respond to that and be resilient against that. And that's all I'm saying is use a forward-looking view with integrated system planning to help plan out those scenarios.

And perhaps, you know, I have to give credit to the Drafting Team. Being part of NERC drafting teams in the past, I know how difficult it is to balance a lot of these issues when we don't have all the resources to do deep technical studies, right? There's a lot of work that could and should and probably would

be done if we had a different organizational structure, but realizing that, you know, the drafting teams have the limitations that they do with the visibility on what's looking forward. But I think this is an opportunity to look forward more, not only for Ride-through, but looking at integrated system planning as a core part of our practice moving forward across utilities, across, you know, NERC requirements in response to Order 901, in response to 2023, in response to 1920. Those are the things that I think we have an opportunity to look a lot better at and really define what problems are we trying to solve. That's all I was saying. Thank you.

MR. SHATTUCK: Thank you. Well, we'll get into the detailed question here, Mark.

(Laughter.)

MR. SHATTUCK: So Question Number 3 here is, do you expect equipment to fail to meet the frequency Ride-through criteria as specified in Attachment 2 of draft PRC-029 due to hardware limitations? And there's sub-questions just to kind of quantify them, but, you know, what's your estimate of products that would be

affected? How does this change if you consider 2800, and how does this change when you consider PRC-024? So, you know, any estimates or real numbers or megawatts would be super helpful for kind of quantifying all of this.

MR. AHLSTROM: Sure. Well, yes, there are hardware impacts, and I've got the numbers here. So with the PRC-029 as drafted for the wind fleet that I'm looking at here, you know, we'll have to do a similar analysis on solar storage, but it's not quite as substantial there. We estimate that 6 gigawatts out of the 27 gigawatts would require an exemption for frequency Ride-through due to hardware limitations. That involves 9,000 turbines, all four of our window OEMs, and all 10-plus of our converters, so it's quite substantial. It's much significantly improved by moving to the IEEE 2800 curves. That would still be 4.5 gigawatts out of the 27 impacted to some extent, 6,400 turbines, but just two of the OEMs and two of the converters that would have to be -- have hardware upgrades. How does that change with respect -- you know, if you go to PRC-024? It's only 200 megawatts

that would require exemptions, 200 turbines, one OEM, one converter model.

So clearly it could be argued -- you know, I think IBRs should actually do what they reasonably can to support the grid. I'm a huge believer in grid services, reliability services, as you know, and that inverters are going to be cornerstone of the future. We, you know, so I'm not saying we shouldn't go to the 2800 curves. It could certainly be argued that it's discriminatory, but I get that it's, you know, what can we get out of this technology. But the reality is, you know, with PRC-024, you know, we're basically compliant today with the wind fleet, and I think also with solar and storage, you know.

So it could be argued that the technology agnostic fair path would just be to say, look, all legacy stuff, just continue to comply with PRC-024. All new stuff, as soon as we can get the new OEM models out, you know, you comply with 2800 curves. And a good reason, by the way, of complying with 2800 is I think that will be our stepping stone toward grid-forming inverters that we're trying to accelerate as fast as possible, so within

hopefully five years or so, you know, we can have a fair number of -- a fair share of those inverters doing grid forming, which would further, you know, support the grid and the grid services and the response to the disturbance there as well. And that provides our pathway forward toward 2050 when, you know, I think the legacy fleet will be a minuscule piece of the IBR fleet at that point, and the IBR will be state-of-the-art, you know, inverters and enough grid forming that we have an extremely good, stable set of grid services to deal with this, in addition to balancing and flexibility and so forth.

So I'll leave it there. The difference between PRC-029 as drafted and 2800 curves is significant and has a big cost impact, and certainly on the number of hardware upgrades and the cost and effort to get those done. Thanks.

MR. MACDOWELL: Yeah. So I want to parse this answer again with my ESIG hat on. And I think the general consensus of what Mark just said is that the difference between the proposed curves in PRC-029 relative to 2800 is substantial. Exactly what are the

numbers across the fleet across North America, I mean, I think we still need to evaluate that just because of the evolving nature of the standard. But I think especially on, like you said, Mark, on legacy units, we've been well served with PRC-024 to date. According to what you've said so far with your analysis yesterday, there was no implications that any of the big events that have happened over the past almost decade were due to a frequency Ride-through issue. And for existing units, there's really not an issue that we're trying to solve today.

To your point, Howard, what are we trying to solve for in the future, right? We need to evaluate that, but I think the very, I would say, the middle ground that seems to be the most reasonable at this point, we put a lot of thought into the 2800 requirements, as Mark said, and manufacturers are really engaged in getting all of the capabilities built into the new equipment. There are certain areas that are looking at retrofits, and I think some of you know, some of the things that are happening there. But by and large, most of the 2800 capabilities and requirements are

achievable with a reasonable amount of effort in terms of the capabilities.

Compare that relative to what's proposed in PRC-029, that's a much bigger gap that needs to be overcome with a substantial cost -- potentially a substantial cost and a substantial timeline to that. And I go just back to my points before is, one, there is that substantial amount of effort and cost and time that's relative to what's proposed in PRC-029. We want to make sure that it's a cost that is very well understood and very well spent to understand is it really the problem that we're trying to solve, right? So going back to fleshing that out, when do we need to solve it? Is that really an issue in all systems, or is it an issue in a specific system that we're trying to scale in ways that don't -- doesn't necessarily need to be scaled across interconnections? Well, we can't answer that question yet without having the analysis done to back it up.

So going back again to the integrated system planning, evaluating what scenarios would we need any sort of Ride-through capability from any resource, not

only inverter-based resources, to me, is a very critical step along the way.

MR. ROGERS: Yeah. So again, focusing on -- more on specific impacts, I guess, to generator owners and, you know, speaking for -- you know, my opinion on OG&E's position, as well as a lot of the other GOs who are connected to our transmission system, we have a pretty aging renewable fleet, specifically talking about wind, in our part of the country. And answering the question specifically, do you expect equipment to fail to meet the Ride-through requirement, the criteria in Attachment 2, yes. We have approximately 500 megawatts of wind that we own. All 500 would fail to meet the Ride-through criteria in PRC-029 as written.

Looking at IEEE 2800 and PRC-024, that shrinks significantly. One thing that does not change, though, is still compliance with PRC-029, even if you were to make the modifications and shrink the -- you know, shrink the Ride-through zone to something a little bit different, is rate of change of frequency. When the equipment that we have installed and many others in our part of the country was built, rate of change of

frequency wasn't a design consideration. It wasn't something that was talked about. There were probably some industrial standards that took things into account for specific pieces of hardware, but to try and apply that to the system as a whole and say that it's even capable of -- to state, you know, with the rigor necessary to demonstrate compliance with the reliability standard, that it's capable of performing at any given rate of change of frequency, would be very difficult to generate any such claim and be able to stand behind it.

Now, that's not to state that it can't do -- you know, do so. It's obviously withstood frequency changes that have some rate of change of frequency, and it can do so. But what is that, how do you determine it, and then how do you have evidence to demonstrate that you're capable of doing so is a whole nother question. And I'm not -- again, this kind of comes back to the uncertainty. How do you even determine these things for this? You know, us as generator owner, we're in a very difficult position with our resources to try and be able to make these

determinations, relying back on the OEMs to some extent. And then when you talk about the difficulties, you know, with projects, hardware and software, and everything else, that the projects were probably kicked off a lot of this stuff in the late 90s -- mid- to late nineties -- with installation had taken place in the early 2000s. Getting those archive designs out, trying to build up what these are actually capable of on things that weren't necessarily considered at the time of building, and then presenting a GO with an estimate on what these things, you know, can actually perform in these -- you know, with these parameters, such as rate of change of frequency or frequency Ride-through capability, how long can we, you know, withstand a whatever, 4 hertz frequency change for -- you know, can we do it for 6 seconds, can we do it for 3 seconds, whatever the case may be.

And I'm going to lean back a little bit on some, you know, some different industry experience I have working in manufacturing. So when you start talking about all these legacy components that are in these devices that were built a very long time ago, they were

spec'd out to a very specific thing, right? Everybody specs everything out. We gave -- you know, we gave the requirements to the -- to the OEM. The OEM is then going to give those requirements to all their subs. Those requirements are what was built to at the time.

There may be variations in components that are in these things that are not necessarily -- we're not able to account for today because they met the requirements that were given to all these subcontractors, everyone that built your parts, but they're still going to perform differently on criteria that weren't accounted for, and that's something that you were going to see across the fleet on a lot of these things. So again, it gets back to this concept of uncertainty with -- especially with these legacy equipment. So I want to be very careful to make sure that I'm not saying this looking forward. This is about exemption criteria for things that were built in the past, especially, you know, kind of at the beginning of the transition, so to speak.

So when you're looking at these assets that were put in the ground, you know, say circa 2005, there's

aspects of this that we can -- we're quite certain we can comply with, especially looking at IEEE 2800 and PRC-024 with the -- you know, with the bands as far as frequency with your curves for frequency Ride-through. But there are other considerations that just aren't necessarily accountable for and that we'd have to rely on the OEMs to some extent to give us that information. And, you know, kind of with some insight I have that some of that information is going to be very, very difficult to state with certainty that, again, meets, you know, again, back to what we're talking about here, reliability standards, that meets the criteria to demonstrate evidence of compliance with a mandatory and enforceable zero defect reliability standard. And that's going to be very, very challenging for a lot of these older assets.

MR. GUGEL: Well, that was a little loaded. So I'm going to probably reserve my comments until we get to the legacy thing because I think that's something we're going to have to deal with throughout all this, but very much appreciate the comments that I've heard so far. I'm hoping at some point we get away from the

mindset of zero defect and start talking about effects on the system, but yeah, let me -- let me reserve until we get to the legacy issue.

MR. YEUNG: Okay. Thank you. Thank you. Can I get a time check, Jamie?

MS. CALDERON: We have plenty of time.

MR. YEUNG: Okay, because we have three more questions and d

MS. CALDERON: There's plenty of time.

MR. YEUNG: Okay.

MS. CALDERON: (Off mic comment.)

MR. YEUNG: Okay. All right. So the next Question Number 4, I think, Dane, you alluded to it. Again, thinking in terms of what kind of exemptions should be allowed for frequency response -- I mean, frequency Ride-through capabilities. The question is, for GOs, what are some of the difficulties you might have in obtaining the data to assess your compliance from the OEMs? You know, what are -- you know, is it available especially for legacy equipment, as you said. And again, the context of this question is about the need for exemptions.

MR. AHLSTROM: So again, this comes back to what is currently available on this, and what is currently available is what was provided initially on build. So we know what the -- if you look -- you know, so if you look at a lot of this equipment, it wasn't necessarily even in the -- framed in the context of Ride-through capability. But you're looking at, lack of a better term, tolerance bands, bands of operation this equipment can successfully perform through. You know, and sometimes it's given in, you know, plus or minus percentages. Sometimes it's given in, you know, absolute hertz, whatever the case may be. But that's, you know, that's what we have currently, so as far as the difficulty in obtaining any further information, a lot of that is going to fall back on the OEMs to provide this based on analysis of these -- of these older -- of these older equipment, the -- you know, the components that went into it, how that -- how that stacks up and what the outcome of that is.

So I don't think I can accurately speak to, you know, what the -- what the technical challenges are going to be because that's -- you know, that's not

something that I'm going to be privy to as far as the efforts that are going to go into performing these analyses or potentially testing, or some combination of both, on these legacy assets to determine what the -- what the capabilities are. But for us right now, you know, the difficulty is that, you know, that information doesn't currently exist in a lot of cases, especially for this -- for this very -- you know, relatively speaking, for what we're looking at here, old equipment.

MR. AHLSTROM: Yeah. Jason wants me to go next as a GO, and then I can turn it back to him as an OEM in this case, I guess, because, you know, look, this is going to take a highly cooperative, collaborative process between the GOs and the OEMs with regard to the IBR devices we're talking about across the board. And we heard a lot of this yesterday, that, you know, the IBR are still on a very fast learning curve, which means that we're going to continue to see dramatic price improvements where they get cheaper and cheaper, but it also means that they are innovating more on the scale of electronics and software rather than on the

traditional scale of generators as we know it, right, which means every three to five years, they're coming out with a whole new generation of inverters, in particular, turbine -- you know, wind turbines.

So in other words, the whole -- all of the engineering expertise of the OEMs is devoted to a new product line, as we heard about yesterday, building for that next product version. They don't have, you know, their development engineering staff looking at the older devices. They're looking at what the next one is going to be. They've retired the test bench on all this stuff once they've done that and taken that old version out of production. As those of you who go through the interconnection process, no, we have a problem with -- you know, I wouldn't call it a problem. It's an opportunity, I think, with IBRs that, you know, if you had -- if you're delayed for several years to get through the interconnection queue, by the time we actually get our, you know, our GIA, the model of equipment we may have thought we were going to use is no longer in production. We have a better one available, but it's different, you know, with different

models and so forth.

But that's the reality, and that's the advantage of IBRs is that they're innovating to respond to what the grid needs and what the market needs faster than we've ever done with conventional resources. But that does create this challenge that, you know, how do you -- especially with retrofits, I mean, you have to -- I think, by the way, it's beneficial to have a hardware exemption process to encourage everybody to immediately get started on looking at what are the impacts with their OEM, you know, rather than just you get to the compliance period where, okay, here's what I can do. And then you say, well, that's -- you know, we think you could do more, and then you have to go back and go to the OEM again, and it just delays the process and delays the implementation actually.

So I think 2800 with an exemption process makes a lot of sense, but you have to be sympathetic that, you know. We're not -- it's not easy to get the engineering talent back on this. And then we got to balance a plant, you know, the plant models that have to -- or the GO's responsibility with some other

consultant or other in-house experts, you know. It's a big deal to figure this out, you know.

So I think I'll leave it there, Jason, and let you take a, you know, next crack at it. But the logistics, the -- you know, the process of doing this and getting those retrofits out to the field, you know, it involves the OEMs as well as the GOs, and it's highly complicated. You know, you don't -- it's not a slam dunk, whether it's software or hardware.

MR. MACDOWELL: Yeah. That's why I had him go first. Well put, Mark, you know, and I completely agree, and nd to me, you know, the question is well founded about what the challenges are. I think it certainly goes beyond just documentation. And documentation is one element of it to look at what those legacy units are capable of, and then, you know, also realizing that those legacy units were designed to a particular fit-for-purpose form earlier mentioned. And now we're looking at a, you know, a situation where we need to have, you know, looking forward, a much broader set of capabilities than that equipment was necessarily designed for or tested for, modeled for,

integrated for. And this is where that communication comes in very -- in a very deep way as needed between GOs, OEMs.

And I'll also say, from an OEM perspective, and Arne pointed this out yesterday in the OEM discussion, is that it's not only the OEM, but it's really a matter of all of the packaging of all the components, all the equipment, all the -- all the auxiliaries that the OEM has to pull together in the wind turbine, in the solar and battery resource, right, and any other resource for that matter. Same thing with gas turbines, right, or steam turbines. There's a whole bunch of complex systems behind the fence that have to be coordinated.

And a big deal about that documentation and capability understanding is that some of those legacy units are sourced with equipment from companies that maybe don't exist anymore or that have substantially changed. So it trickles down or trickles up, however you want to think about it, to understanding how do you go back and reevaluate those legacy systems for, you know, all the components that maybe don't have companies are around anymore, or at least don't have

documentation for that old -- that older equipment, and that may not exist anymore, right? So it is -- it is more complicated.

You know, if we were to have a test bench that we could test for that old equipment, that would be easy, but it's not easy to take an existing piece of equipment that's been in the ground 15 years or more and pull together a complete test regime that typically is done in a lab environment where you have a lot of capability to replicate the grid. And many of, you know NREL, CGI, and there's other test facilities that are out there for this purpose. That lab environment and type testing environment is there, fit for purpose for performing thousands of tests under very specific conditions. How do we replicate that in the field to renew the capability that we want to do with a piece of equipment that's in the ground, and, you know, and we need to retest for another purpose that it was never meant to do. So I think those are some of the biggest challenges, right? It's not only about documentation. It's about the entire testing and modeling process it takes again, to show, hey, how could we be compliant or

not?

Now, that said, it's not that everything is going to be all incredibly difficult. If it's a small change that's needed, we can do some sort of analysis in some cases and say, okay, we'll have a sense whether it's -- it has a big impact or not, but there still needs to be that evaluation. And that evaluation, if you take any OEM's fleet at tens of thousands to hundreds of thousands of units, you know, depending on who, where, what, how, it really does get, you know, a substantial amount of effort that's needed in that with resources that are fully focused on meeting the needs of the requirements, PRC-024, PRC-029, whatever it happens to be, IEEE 2800, on new units alone. And we don't have an unlimited number of resources to look at both, so I think that's the balance we need to strike. Thank you.

MR. SHATTUCK: Thanks, Jason. I think you're last, right?

MR. MACDOWELL: Was I last? Okay.

MR. SHATTUCK: It seems like the last question might be a bigger discussion, and we probably covered a lot of the next question. So I would say let's maybe

be mindful of our time for this next question so we can spend it on questions from the group and the final question. So we'll go with our fifth question, which is, what difficulties do generator owners have when attempting to coordinate their plant to successfully meet criteria specified in Attachment 2 of the draft PRC-029? I think we all alluded to a lot of this so far, so yeah, just keep it -- be mindful.

MR. AHLSTROM: Yeah, very, very briefly. I think the bottom line is all of the OEMs we're talking about are global OEMs, part of the global supply chain. As we heard yesterday, none of them have a product in plan that would be compliant with the PRC-029 curves. 2800? Yes, you know. So I think you have to look at this from a supply chain on a global basis. If anything, we're trying to move toward global unified IEEE-IEC standards, I think, for IBRs in the future because of this global supply chain nature. And, you know, not complying with 2800 is not going to fly in terms of being able to get the equipment we need and be in production with this. And I don't -- I don't think the advantage, if there isn't one, you know, justifies the

disruption in that and how much that would slow down and increase costs for the U.S. market on those products as well. So it's just really not a -- not a starter for me.

MR. MACDOWELL: I think I probably addressed this in my last comment as well. So I would like to maybe take the opportunity to talk a little bit about a related subject on exemptions, particularly, because I do think there's a big benefit to the exemption process, specifically, in terms of the fact that exemptions will get you a level of documentation, right, and understanding maybe what the gaps are, and I think that is valuable. Exemptions also take effort, right? Exemptions do take a certain amount of capability to actually look into what the difference maybe would be relative to what the old products are. So it's not that you get a free pass even if you get an exemption, but what you do get out of an exemption is at least an understanding of maybe where the gaps are, right?

And that in itself for planners, for GOs, and OEMs is valuable to understand what are the gaps in the

performance that we see today based on the models that were provided and integrated of the plant at that time, relative to meeting a certain requirement, like the Ride-through of PRC-029. So I think that's my plug for at least considering and having an exemption process in place for frequency Ride-through that allows us visibility as to why we can't meet something.

MR. ROGERS: No, I think that was -- that was quite well stated. You know, as far as the difficulties in attempting to coordinate the plant, you know, it goes very much hand in hand with what we talked about previously, having all the necessary information, having the necessary parameters, and, you know, knowing all these things from your plant, top to bottom, to be able to run the appropriate studies and determine, you know -- you know, are they coordinated appropriately as per the draft standard.

I think, again, everything that was just stated was very spot on as far as the need for exemption and what that allows, and the benefits that that does provide as far as, you know, having not just a blanket write-off, you know, can't meet it/move on type

exemption, but having something where you really fully document the known capabilities of the plant. You also document the unknown capabilities because, you know, it -- as we stand right now, and maybe this changes as OEMs, you know, are able to develop more information on these legacy pieces of equipment, that'll shrink. But right now, there are some unknowns, and documenting those unknowns are -- you know, would be very beneficial as well for anyone who's attempting to assess the reliability of the system as a whole. And, Howard, to get to your point just a minute ago about, you know, moving from that mindset of zero defect, mandatory enforceable, to looking at the impacts of any particular thing on the reliability of the bulk power system as a whole, I think the exemption criteria really does help with that because it allows for what information we do have, especially right now. What information do we have today right now that, by the time that this -- you know, this standard gets filed with FERC and then becomes effective, you know, we'll have -- we'll probably have more information. The OEMs are probably going to determine some things, but we're

still not going to have it all. But that will allow for whatever in information we do have to start immediately flowing, and I think there is real benefit for that.

You know, Alex, some of the stuff that he talked about yesterday with those studies and everything, it allows for further examination within -- with that new information on where the risks are, what are we seeing, what's causing these issues, what other things -- you know, what systemic things do we have? Are there things specific to this location that we can -- that can be mitigated outside of this very specific issue of frequency Ride-through, and what things can be done to address those more systemically? And so sorry, I rambled a little bit, got a little bit off topic, but building off of what the previous commenter said here, I think that that's -- you know, there's a lot of benefit in that.

MR. GUGEL: Yeah, I would agree, and certainly, at least personally, I'm a supporter of trying to figure out some way of finding an exemption that would work. I think as we get into the next question, we'll

probably get into some of the more technical details on that, and hopefully they haven't started the vat of tar with the feathers out there for me when we get to that topic. We'll see.

MR. YEUNG: Okay. Thank you, Panel. Our last question hopefully will wrap up a lot of the things that have been discussed, and I believe it will based on this last -- the responses to this last set of questions. Last question, it's kind of lengthy. I don't know if everybody has the actual wording, so I'm going to read through it as clearly as I can, and then kind of give a little kind of a summation about what the question's asking for.

So the question is, many commenters have said that it would only be fair to grandfather existing facilities and those in construction facilities -- the ones that are already in the pipeline -- grant them exceptions from Ride-through requirements due to the cost of retrofitting, and we've heard a lot of that. Other commenters have said that their facilities have an expected shelf life of up to 030 years, meaning there may be facilities in place well into 2050, and at

that time, IBR penetration is expected to be much higher, the system will have changed, and that they are not able to comply with the requirements that are written today, these PRC-029 requirements. So how should NERC balance the burden on generators, the cost burdens, who may be asked to incur large retrofitting costs with the burden on the transmission owners, the planners, in my case, operators, who like certainty, and the end use customers from poor or unexpected IBR performance?

So in a nutshell, that question is asking about really the -- there's going to be a lot of industry costs, effort to meet the frequency Ride-through criteria, but there needs to be a balance between those costs and the benefits they have to the system reliability.

MR. GUGEL: Yeah, I would agree, and this is the point at which I'll be able to lean in, I think, a little bit more. I do think we've got to carefully construct some exemption criteria because it only makes sense. The last thing we need to be doing is retiring additional capacity out there when we know the margins

are already tight at this point. So that's -- you know, to me that's off the table.

I think where it becomes a little bit more difficult when you start sharpening your pencil is how do you define "legacy?" If I've got a piece of equipment that's been out there for 15, 20 years, and I do a software upgrade or a hardware upgrade, and have the ability at that point to make a change, is it still considered to be a legacy piece of equipment? Would I be required to make sure that I can meet the new -- the new requirements, whatever they are, that we set up for PRC-029? You know, at what point does a piece of equipment no longer meet the definition of "legacy," but it has enough new pieces of equipment that it's -- that it's considered to be something that should be brought up to speed?

And then the other, I think, complicating thing that we have here is, you know, there is a significant amount of generation that's in the queue right now, especially offshore wind. There's some sites out there that they're talking about being larger than 2 gigawatts connecting onto the system, which is just --

I mean, it's huge. First time I heard about that, my eyes glossed over and I got very panicky. Would that be considered to be in construction at this point if it's in the queue, or would -- you know, would it also be that we need to take those generating units and make them comply with PRC-029? Those are the questions that I think we need to struggle with.

At some point, we need to draw a line in the sand say, no new generation that's put in place, IBR based, can be put in that doesn't meet this criteria. And whatever the criteria that's developed eventually for PRC-029, you know, we need to make sure that we've got a date certain that says after this point, nothing new can go on the system that doesn't meet the performance requirements that we have in this. That's just my personal opinion. I know that creates a lot of documentation issues for generator owners, for OEMs, and trust me, it's going to create a lot of issues for the auditors as they go out trying to figure out what's what. But it's the right thing, in my opinion, to do, both making sure we have the exemptions for existing facilities, but then also making sure we've got a line

in the sand that says, we know going forward that these units will be able to perform in a certain way.

MR. ROGERS: No, I think that was very well said. You know, there's really nothing to disagree with that. You know, I think we need to be careful, though, kind of looking at the question specifically, when we start using terms like "grandfathering in" and then, you know, "cost of retrofitting," and things of that nature. So grandfathering in, specifically, maybe I would disagree with that concept, right? Like, if you look at something and it was built prior to whatever, you know, it's good, right? Just wave a hand, bless it off and we're done with it, and I don't think -- I don't think that's the case. I think, again, it gets back to these very detailed exemptions. You provide all the information you can about your equipment, and you do the best that it can do to provide these services, right, this frequency Ride-through, this voltage Ride-through, this, you know, withstanding rate of change of frequencies. You ensure that it can do the best that it can do. You know, it's not just it's old, well, let it run, it's good, that's fine.

So I think, you know, we need to be careful whenever -- you know, and speaking as a GO, we need to be careful when we look at concepts like this. We need to make sure that the equipment in the ground is performing at the best that it can do. Now, then I think you also need to stay away from terms, or potentially stay away from terms, like we heard a little bit yesterday about like "maximization" and "maximizing capability," and what does that really mean because a lot of this stuff, again, you're looking at very specific design parameters that this stuff was put in the ground with, and you need to ensure that you're operating as such because, otherwise, you're looking at, you know, well, let's push it a little more, let's push it a little more, let's push it a little more.

Well, now we're running risk of this equipment, and what's the bigger reliability risk now? Is it this -- you know, and especially in some pockets of the country. And maybe this is actually different in different areas, but, you know, you're looking -- you know, we're out here on where we're located, on the western edge of Eastern Interconnect, and we haven't

seen a lot of -- a lot of the same issues that maybe have been witnessed to other places. So if we're performing the best that our equipment can perform, we document our known -- our known issues, and we submit those to the relevant people, who need to perform the studies to see what is actually capable, and what we need to be looking out for, and what else we need to be mitigating, you know, I think that's where this goes. I don't think it's necessarily this grandfathering in clause.

Also, when we talk about, you know, balancing burden and retrofitting costs, and, you know, you've got the burden on the TOs and the transmission planners, and, you know, reliability coordinators, whoever the case may be, and you're trying to balance that with the cost of the GO to do stuff. Again, I think at some -- at some point, you got to look at this from a GO perspective. The cost of doing business is providing -- you know, being a reliable partner in the bulk power system. We have to do that, and we have to do that best of our ability. And with this existing equipment, as you've heard many people up here state,

that probably involves exemption criteria to some extent. I'm not sure I have much else to add. I think we'll probably get some better feedback specifically from the OEMs on some of this as well.

MR. MACDOWELL: Yeah. Thanks, Dane and Howard. I think that was really well said. I think going back to quantifying the problem we're really trying to solve, the easy answer is, you know, don't leave any performance on the table that's easy to extract. If it can, it should, right? A blanket exemption really might have the unintended consequences of leaving some performance on the table, so making sure, though, we're understanding of those plants or those resources that may have limitations. I think the bigger issue is having visibility to when they do or when they don't.

And some of the aspects of when these pieces of equipment may not be able to meet some of the requirements, especially like what we're talking about in Ride-through, are not necessarily visible in the models that we have, right? And the model -- and this is not only an IBR issue. This is an issue across power system modeling ubiquitously across the board.

Synchronous plants have the same issue. We don't model the auxiliaries in detail in synchronous plants either. We tend to look at the power system's impact of the main power circuit and have a very rough estimate of the Ride-through capability with those simple Ride-through protection curves that are overlaid, that represent a lot of the capability.

Let's talk about a thermal unit, for example. It's the protection of the auxiliaries. It's the fuel path in a gas turbine that is very complex, a lot more complex than the auxiliaries in a -- in a -- in a wind turbine or a solar inverter. Those have the same limitations, right? And I think it's that level of understanding that is very important to have in terms of what is the real reliability risk.

Another aspect that, you know, going back to the discussion you and I had, Mark, last week, really trying to quantify those conditions that we're trying to solve for, so whatever that happens to be, right? Whatever curves that you land on or whatever system conditions that you're trying to land on, do the homework with understanding what the future system

conditions look like, right? Understanding, you know, there are different scenarios of future renewable build-out, future load build-out. Those are the system conditions we're really trying to solve for. Going back to integrated system planning, again, understanding what the implications are for those future conditions, and then understanding the implications of things like Ride-through on that, and having that serve as the guide to determining what those curves really should look like.

Some of that was done, to a certain degree, in getting feedback in the process of 2800 from the regard of having a future-looking case or future-looking cases to really get to the point of the problems that we're trying to solve from a system needs point of view, right? And that's why I think the process that we went through in 2800, generally, was -- had a lot of feedback, and it was -- it really serves as a good baseline for the problems we're trying to solve going forward. But that said, I think what's missing in our planning processes today is this viewpoint of doing the system analysis on these future cases to identify all

of those system conditions that none of us really have had to plan for up to this point.

So I would say that is probably the more -- the bigger need than to really evaluating, hey, are we going to meet PRC-029 curve or not with system equipment? Do we need an exemption or not? Well, you know, that's only getting us halfway to the reliability issue and really mitigating that reliability issue at hand. That's my opinion. Thank you.

MR. AHLSTROM: Yeah. This question was added actually to the question list late last week, and my initial impression was that this is a real red herring question. You know, I think it actually applies more to conventional resources than it does to IBRs, to be quite honest. I mean, everything we said -- asked in this question applies to what about the -- you know, the thermal fleet in 2050, right?

As I pointed out, you know, we're on a very fast learning curve with IBRs. There's a lot of reasons why even though it -- they may have an engineering life of 25 years or so, we're actually replacing inverters much more frequently than that. We're doing a lot of, you

know, repowering of wind plants more frequently than that. There's lots of drivers because the technology keeps getting better, more capable, and less expensive. So when we re-contract it or whatever, we'll put in the next version of equipment to get, you know, more energy into the next contract or whatever, you know.

There's lots of drivers for this, not just incentives by the way, but other business reasons why we're actually -- like with a battery storage plant. I mean, you're -- almost the entire life of the plants, you're upgrading with additional storage in there to maintain full capacity and, you know, upgrading inverters as well. So equipment is going to be replaced/repowered much more quickly with the IBR fleet than it is with a conventional fleet. When we do replace it, we can't -- we won't be able to buy an inverter that's not compliant if we force the OEMs toward 2800 here and what we're doing here.

So without question, you know, I agree with Howard that, you know, when we repower, that we should be in full compliance with that, and I agree with Howard very much that, you know, we also have to look at balancing

resources and all that. I think we're going to see a lot of innovation on that from the IBR side as well with the longer duration storage side that we can't predict by 2050. It's not like we're going to stop looking at what new standards are becoming necessary between now and then, you know. We will probably have additional standards that apply to this and additional, you know, things we try to do to improve the fleet, both conventional and IBR.

And I must say, this concept and the question about imposing a burden on transmission owners and transmission planners, this is what TOs and TPs do is they -- the reason they get a regulated return and always have in all the decades of thermo fleet is to reliably and economically deliver the energy from the generators to the loads, right? Why would it be any different with IBRs, you know, but I have very little sympathy on this burden part of the question.

But, you know, fundamentally, I think, as I pointed out, with the technology going on here and our path toward additional capabilities and IBRs, including grid-forming capabilities. The thing to do is to build

your way past this so that the future IBR fleet, which will dwarf the size of the current legacy IBR fleet, is highly capable and will support an entire grid with the grid services and the balancing services and everything we need to maintain reliability, which is what we're all here for. And it serves the IBR interest in no way whatsoever if this creates reliability problems or has any reason why we would slow the deployment of new technologies to the grid.

So I'll leave it at that, but, you know -- you know, I don't -- I don't think -- even I don't think that it's wise to be thinking that, well, we have to have a hundred percent IBR fleet by 2050 or anything like. We have to coexist with other resources, including legacy resources, including thermal resources, you know. So I think we can do that, and I think that IBR should be expected to step up to the plate by going PRC-024 to the IEEE 2800 curves, and do what they can with the capabilities, you know, that are reasonable and cost effective, and can be -- can be deployed, and get it out there and do the right thing. So I'll leave it at that.

MR. GUGEL: Yeah, Mark, I would kind of add into that that I think that word "burden" was just a little bit misleading there also. We've talked a lot, and I'm going to stray away, I think, a little bit from the panel here, but we've talked a lot about the limitations and stress at that point. There are some really good advantages that inverter-based resources can add to reliability. And I think as we go forward and understand that, the fact that they can react much quicker to system disturbances and be able to dampen those disturbances quicker, we're going to find that there are some advantages those resources have that we could never get out of the conventional fleet.

And so I feel a little bit disappointed that, in some respects, we've concentrated on the negative yesterday and today.

MR. AHLSTROM: Yeah.

MR. GUGEL: There really are some good, positive things that are going to come out of this.

MR. AHLSTROM: Yeah, and in my comments, I alluded back to what we did on the ERSTF and so forth. You know, there are quirks of conventional resources that

we're very used to because we've been dealing with them for a hundred years, right, you know, like, after a disturbance. Do you really want a really slow responding resource where you have to inject a whole lot of energy to get it back up to 60 hertz? No, you know, that's not an advantage of inertia. The recovery is slow. It's mind-boggling is slow compared to what IBRs can do. In fact, with IBRs, now we have to worry about, well, how fast do you want us to be because we don't want to be too fast. We create instability. I get it, right? But that's what we have to work out is there's advantages of all the technologies. We have to figure out how they fit together for system benefit.

MR. MACDOWELL: One thing I'd like to just conclude with, and on a positive note, right? I think we all recognize that there are big challenges that we need to overcome. And these challenges, fundamentally, are the fact that we're a victim of our own success, right, and it's a good thing. The fact that we're seeing a lot of the change that we're seeing in the transformation really going towards meeting bigger goals, to meeting policy needs for planning,

decarbonization goals, a hundred percent of something by sometimes, somehow just go do it. Well, the do it part is actually, you know, what we're really struggling with right now. How do we actually make that happen?

And I'd like to offer maybe, you know, maybe some platforms of discussion to consider where we can help each other. And those platforms many of you are already engaged in. First of all, want to congratulate the Drafting Team, first of all, for really a job well done and understanding how to wade through all these issues, but also want to congratulate the work done by the NERC IRPS, the Inverter-Based Resource Performance Subcommittee led by Alex, led by Julia Matevosyan, led by Ryan Quinn in the past, and, you know, a lot of input and really great discussion to understand what the issues are and how do we mitigate them.

And one of the things that we're doing in ESIG in the Reliability Working Group, specifically, and I work with Mark with ESIG and lead that working group with Julia Matevosyan, is understanding the implications of the gaps today, solving the chicken/egg problem of how

do we get the technology that we need in -- not only installed in equipment, but deployed on the grid through requirement standards, markets, mechanisms that will actually get these performance characteristics in the grid, get them deployed. And oh, by the way, we need to keep everyone whole in order to do that. We can't break, you know -- the need to actually have these elements still being profitable enough so that there's investment that wants to continue going forward in these projects. Otherwise, we're going to, to go back to your point, Howard, to have a resource adequacy issue on our hands.

So that's the very tight balance, keeping all of these things together, and recognizing that when OEMs build this equipment into the capabilities, they're not building that capability to their immediate customers necessarily, right? The generator owners have a very specific need to install equipment and make money by the revenue that is given simply selling power. And in order to do that, we need to make sure that you can optimize the output and stay online, don't get curtailed.

So that's the real genesis of the KPI that the developers really need to maintain, but oh, by the way, we also need to do all of these things to keep the grid stable. So that's a very different element, a very different aspect of how OEMs need to give that new technology to the grid companies, right, which are, you know, fundamentally the customers and the constituents of -- downstream of the generator owners.

So really, having that transfer function of technology development from OEMs all the way through to grid owners, operators, developers, that's a transfer function that is becoming more difficult to have, right? But also, we need to do things, to me, in a way today that demonstrates the capabilities of the new technology. And this is where we are with ESIG and the Global Power System Transformation Consortium, where we are looking at the capabilities of implementing grid-forming capabilities and making sure that we have good, sound, robust mechanisms in place to demonstrate those capabilities of grid forming on the grid, showing the benefits through demonstrations across the grid, but also showing that we're not going to have any

unintended consequences of oscillations/interactions between the grid-forming technology to the grid-following technology, grid forming to other grid-forming resources, grid forming to synchronous.

And those are the types of things I think we need to invest in across the community, across OEMs, developers, system operators, utilities, regulators, and I really want to thank Mark for your participation in that, and, Mark Ahlstrom, for your leadership in the -- in the Council we have in order to institutionalize that. And then that feeds back into the integrated system planning work that we're doing with that as well. So we'd like to invite others that would like to know more about the ESIG and GPST activities about maybe what we can learn together and then have real foundational elements of what problems are we trying to solve and what regulatory impact do we want to have with, you know, understanding how to actually get the deployment of what we need.

MR. SHATTUCK: All right. Do we have time for questions. Yeah, I think we have a half hour for questions. We'll do the room and alternate with Slido.

Manish has already jumped up.

MR. PATEL: So this is not a question. I'm not even sure what I'm allowed to advocate or not as an EPRI employee. I'm still learning that.

(Laughter.)

MR. PATEL: So this is from -- this is from Manish Patel with couple of degrees in electrical engineering and some experience in industry. But I think -- seriously, I think some of this has been submitted as EPRI comments in writing with various drafts of the standard and all that.

But let's take a step back. Why are we here at the technical conference, right? So PRC-029, as written, allows exemption for legacy IBRs with hardware limitations, right? We don't know if that poses risk to the system or does not, yet to be determined. If it does pose a risk to the reliability of the system, then we are going to figure out a solution. It may be a solution that calls for, you know, retrofitting IBR. It may be a solution that is out on a transmission synchronous condenser, [inaudible 01:31:07], name it, right? We don't know yet.

The only reason we are talking about frequency Ride-through is for two reasons. One, PRC-029 curve, as proposed, are very stringent, and there is no exemption to legacy IBRs. I have worked in the industry for some time now. Number of times fault happens on the system are much more the number of times frequency deviates significantly. Even yesterday, I think Alex's presentation, none of the events caused the frequency to deviate by the magnitude and for the duration that we are talking about in PRC-029, right? But I was a protection engineer for living for some time, and, my god, lightning strikes and line trips, very common. Snake climb somewhere it doesn't need to climb, something trips, right? Voltage sags much more frequently than the frequency deviates from nominal.

So PRC-024 went through a revision just about couple of years ago, right? The intent at the time was to clarify that momentary cessation is not allowed. Even then that Standard Drafting Team did not think that we have to widen the frequency curves, right? Just two years ago, we went through 2800 exercise. I mentioned this. I was vice chair. We had no

justification that IEEE 2800 frequency Ride-through curve is needed. Where it ended up coming from? IEEE 1547? Where it came, 1547? I think California Rule 21.

So when we were discussing frequency Ride-through, we were thinking about future grid. We don't know. We don't have studies. We talked to a lot of solar folks, and they said, yeah because they have to comply with 1547. They will have IBRs that will comply with, you know, frequency Ride-through curves. So then we talk to wind OEMs -- some of them are in the room -- and say, well, look, we would like to keep this simple. 1547 already uses this frequency Ride-through curves. Why can't we use it for transmission? After some conversation we landed on that. That sounds like a good idea. So now, two more years go by, and then PRC-029 comes along, and we have an even stringent, right?

I tell you, I think what Mark suggested earlier, if we hold all legacy IBRs to PRC-024 Ride-through and all new IBRs to IEEE 2800 Ride-through, then this gives the certainty -- I think Howard mentioned earlier -- this gives the certainty to system planners what

equipment will be able to do based on in-service date. We have to decide what is legacy and what is not legacy. That's right. That's still -- that's still a question. But I think going forward, to me, it looks like all legacy IBRs, PRC-024, that standard was in effect anyway, right? Those plans are supposed to meet that anyhow. But one has -- even two years ago, the PRC-024 Standard Drafting Team said we need more than PRC-024 curves. IEEE 2800 landed on whatever because of 1547. I just don't see why we need to go one step further. So anyhow, I think that brings a lot of certainty.

Now, on a lighter note, IEEE 2800 and PRC-029, it's very difficult for a tongue to say. I think all the powerful people are in the room. Why don't we say IEEE 2800 and PRC 2900. Very easier, you know. Can we renumber the 029?

(Laughter.)

MR. PATEL: You know, just move zero from front to the back and add one more? It's free.

(Laughter.)

MR. AHLSTROM: Let me just say, I very much agree

with you. I think PRC-024 for legacy assets is actually just fine, and, in fact, with IBRs, right, we're actually looking at it as a Ride-through standard, more stringent than, I say, it's viewed for conventional resources, right? So I agree. I agree. That would be the simplest thing that would save NERC, and all the compliance folks, and all of the OEMs, and all of the GOs a lot of time and effort that could be better used to put, you know, IEEE 2800 into the new generation of equipment more quickly and deploy it more quickly, right? And that was the argument I actually made in my written points.

You know, on the other hand, I think the exception process with 2800 is another good approach. It's more time consuming. It's going to slow down. It's going to create, to be honest, a lot more work for NERC, especially with the other non-IBR resources coming in, you know, under the new definitions of who's subject to compliance. That's going to be a lot of work for NERC, I think, you know. So I think you could simplify it by just sticking with PRC-024, but I'm perfectly fine with 2800 plus an exemption process as well.

MR. GUGEL: Yeah, the only thing that I would add to that, and this point was brought up yesterday, is that 024 is not a Ride-through standard. 024 just does the set points. And so, you know, if you need requirements for Ride-through, you really do have to go a little bit different.

MR. AHLSTROM: My point Howard, I think the IBR community actually ends up interpreting it as a performance Ride-through standard, right, because with electronics, what's the difference between protection equipment and IBR is when you really get down to it, right? So all I'm saying is if you applied it as a Ride-through standard to IBR, I think the IBR community would be fine with that, and it would actually would exceed what you're doing with conventionals.

MR. GUGEL: The only -- man, I hate to put on my compliance hat.

(Laughter.)

MR. GUGEL: The only issue that we have there is you've really got two communities in the IBR area. You've got the one that is traditional generator owner/operators that are with traditional utilities and

understand NERC standards, and do that application. You've also got now into this organization, financial institutions that would just look at the letter of the law as opposed to what was actually intent behind that. And I think the issue for us is going to become enforcing PRC-024 as a Ride-through standard when it doesn't necessarily state that in the standard, but it just says that your set points and your protection need to be at a certain level.

So I agree that the curves for -- as we start to look at things and start to interpret how legacy and future things should go in, I think that, traditionally, most folks have considered PRC-024 curves where they want the operating limits to be and the constraints to be on there, other than the fact that there were some that interpreted that curve that if it was outside, it was a must trip as opposed to can, you know. And I think we've gotten that misunderstanding straightened out with most folks.

I do think there's still that learning curve, and, potentially, the concern that may be out there that folks that haven't traditionally been in the NERC realm

would not interpret PRC-024, the letter of that, to be a performance standard, but instead just a setting standard.

MR. AHLSTROM: Agreed. But I mean, couldn't you put the PRC-024 in as the legacy must comply with PRC-024 as compliance -- as a Ride-through standard into PRC-029?

MR. GUGEL: Yeah, I think that's potentially a path forward, at least looking for some of those curves and when you're talking about exemptions. I do think there's a potential there, yeah.

MR. YEUNG: Okay. We'll take the question from the room.

MR. KOERBER: Arne Koerber, GE Vernova Wind. The topic of this panel discussion was exemptions. Yesterday, we mentioned a few things that make it hard for us to sign up for not being able to do something. And to embark on a product development, even if the product is retrofitted, with the sole intent of finding a roadblock where we can't do it.

In the discussion today, we went back to a lot of -- we discussed a lot of, oh, we need documentation

that allows a -- I don't know -- I'll call it a semi-public design review of why we can't do something, and this is -- this is a real question. I'm not saying this to make a point. Any thoughts from this panel on how you would structure an exemption process that doesn't rely on OEM saying we cannot do this? Like, how would -- how would you structure an exemption process, again, that doesn't -- that doesn't go back to proving something can't be done, which we have concerns with.

MR. GUGEL: I'll start with this, and I think some others might be able to lean in on this, too. You know, we struggled through this same issue when we started talking about cold weather and design parameters for units as they get down to extreme temperatures, whether they're low or high. And basically, what it came down to was producing design parameters, what was the unit designed for and having that there. I think if you can pull out that information and say, look, this unit wasn't designed to Ride-through a particular frequency, wasn't designed to Ride-through a particular voltage because this was the

specifications for that unit at the time, that would be adequate documentation as opposed to trying to prove a negative. And I'm just speaking for Howard at this point. But I think having the design parameters and that information to lean on is probably the best documentation rather than some sort of a -- of a test that says, hey, look, I tripped, so I know that it can't do that.

MR. KOERBER: Just to make sure I understood correctly. So you would be saying all maximization always goes up to the originally-stated capability from potentially many years ago, but there would be no intent to go beyond that?

MR. GUGEL: I would say that, yes, that basically -- well, if you did modification to the plant that you knew would take it in a different way, that you'd have that documentation also, but, you know, if a -- if a plant wasn't designed to do X, you can't expect it to perform X today.

MR. ROGERS: Now, that last point you got to is kind of what I was going to get to as well, and I think that that would be very important in the documentation

process, the exemption process, is not trying to prove the negative. It's stating the positive and it's clearly communicating the positive, and there may be a whole lot of unknowns, especially when I'm talking about, you know, some of the fleets that -- you know, that OG&E owns, the stuff was put in the ground, again like 2005. It was designed in 2000, or, you know, probably '98, '99 is when the design process on a lot of that started. We don't know these things. We wouldn't be able to state these things. And even if we did some type of testing on one of these units, one, may fry the unit, that's bad, what do you do, hook it up to the next one and try the next unit? That sounds like a bad idea.

Or if you're able to perform some type of simulation, say you do get enough parameters to do something, is that representative of my fleet? You know, these things have been in the ground for 20 years, one of them's been on top of a hill in Western Oklahoma, one's been on the bottom of a hill. The one's been in the shadow of the tower, one's not, you know, I mean, and degradation of electrical components

over time is a very real thing. And I think that has to be very clearly communicated, and I'm glad that was brought up so this can go on the record for the Standards Committee and everyone else who's drafting this to understand.

It's very important that we don't try to prove the negative with this exemption process. We state the positive. We state what we can do and nothing more. If there are things maybe that the standard talks about that we're not capable of doing, address those specifically as unknowns, you know. Don't leave the fill blank, right? State, you know, this is an unknown. This was not designed with this parameter or with this capability in mind. Does that mean it can't do it? No. That means we don't know what it can do. And I think being -- stating that and being very clear about that is very important for the exemption process, one, to be something that's workable, but also be -- provide the maximum value. Thanks.

MR. YEUNG: Thanks. We'll go online.

MS. CASUSCELLI: All right Thank you. Yeah, we have a number of questions online. So the first one

is, if the protection at inverter terminals does not comply, could the GO submit an exception without dynamic analysis. Asking because of effort/availability of models.

MR. GUGEL: I want to make sure that I understand. Are you talking -- are they talking about the protection -- the protection system of the units? Are they talking about the design? I'm not sure that I understand. If you're -- if you're talking specifically about the protection system, I would struggle figuring out how a protection system couldn't be modified for that specifically if you're -- if you're just talking about that. If you're talking about how the unit actually performs, that's a different conversation.

MS. SHAH: I can probably add some color to this. This coming from one of my SMEs. What we are trying to understand is can we skip the dynamic model effort, especially for operational sites where these models are not available to us easily. That's pretty much what we are trying to understand, that can the EMT modeling part, if we don't have the models, can we skip that

when we are submitting exemptions, or we are seeking exemptions on some of those models, which we don't have, are not available from the OEMs.

MR. GUGEL: Yeah, I'd have to further understand the requirement for an EMT model in that -- in the exemption, so no. Is that requirement in there for the voltage side for the exemptions?

MS. SHAH: Yeah, frequency,

MR. GUGEL: And if it's not, I'm not sure -- nobody's talked at this point about -- at least I haven't heard anything yet -- about specifics about how that exemption would be designed for the frequency side. So, I mean, it's a good question, but nobody at this point has proposed a requirement or not a requirement for EMT studies.

MR. PATEL: May I -- may I chime in real quick?

MR. GUGEL: Yes.

MR. PATEL: So I think this question is more appropriate for voltage Ride-through capability than frequency, right. So capability frequency shouldn't change a whole lot between the terminals of inverter or wind turbine generator on the high side of the plant.

For voltage, there is actually a paper that is up for approval by RSTC, written by NERC System Protection and Control Working Group, that actually shows one method to use instead of EMT model to make sure your voltage settings at inverted terminals. And it does not -- does not require EMT. You can do basic power flow. It is a bit conservative and shows, you know, one way to evaluate your voltage settings compared to the requirements of the POM.

MR. SCHMIDT GRAU: And also to add, I think it's also important that the OEMs take accountability and provide attestations on that because certain equipment, you can maybe do it for voltage without any studies. But I also know from Vestas product, you will have to do some kind of studies because of so many dynamic factors. And you can have protection settings on voltage that is set way below the PRC-024 or 029 curves in your equipment and still compliant -- comply at plant level.

MR. GUGEL: Yeah. I think a positive that comes out of everything that we've talked about for the exceptions process is it forces communication. I mean,

you're now basically enforcing a communication between the OEMs, the generator owners, and the transmission side to make sure everybody understands the parameters on that as opposed to maybe assuming things that we've done in the past.

MR. SHATTUCK: And just to maybe add to Howard's, you know, through the alert process, we've had quite a bit of difficulty getting the extent of condition of what's out there. And an exemption process like this, again, forces it so then we know what's out there, right? And it's documented and through a really formal process, so it is a benefit. Let's maybe do one more online. We did two in a row? Sorry. You were kind of both. We'll do one more online.

MS. CASUSCELLI: All right. I'm going to ask this one. What level of time and effort might be saved by adopting the consensus developed under IEEE 2800 rather than developing new requirements under PRC-029?

MR. GUGEL: I think that's something that the Standards Committee and the Drafting Team will have to take under advisement as they go forward, but at least at this point, they've had a couple of rounds of this

going out. I think the conversations that we've had yesterday and today are providing some clarity in particular areas that have been raised for some of the questions. And so I think all of this in context is going to be something that would be helpful for them.

MR. YEUNG: Let me just -- as a moderator, that was one of our concerns, you know, trying to get some clarity because The Drafting Team will have to -- well, the Standards Committee will have to, you know, make that assessment. I think Mark has some good data, you know, comparative data. Hopefully we can get some more in our process, but that's absolutely something we're going be looking at, you know. What are the benefits of using 2800 versus 029?

MS. SHAH: Thank you. Ruchi Shah from AES Clean Energy. First of all, I want to start with some of the suggestions that were given today about PRC-029, what possibly can be done as a resolution. And in my opinion, what Manish suggested, Mark suggested are great suggestions, something that I'd highly recommend considering as an option to move forward with the standard.

A consideration or a question from my end is, as we are discussing how exemptions should be provided, a question that we have is, do we have the manpower from OEM perspective, utilities' or entities' perspective to support these exemption efforts as well, and where we draw the line with legacy. I think at this point in time, as we hear yesterday from the OEMs, if 95 percent of the OEMs cannot meet PRC-029, isn't everything right now considered legacy because we really can't meet PRC-029 with the existing technology? So that's my biggest question. Do we have the manpower? Can we consider everything legacy until we get to a technology point for frequency Ride-through?

MR. AHLSTROM: I would -- I would just say that working with the people in NextEra, who do a great job of maintaining a huge fleet, the answer is no. Even if NextEra does not have the manpower to actually do this, we'll find a way to get done what has to be done as we always do. But yeah, the pool of people that really are available to do this, the consultants that are needed to provide the models, you know, the plant models side is very limited. You know, all these

things are in very short supply, you know. So that's going to consume -- compliance with this will consume a huge amount of the resources on the OEM plant operations side for at least two years, you know, even if it's software only, right, on the best case.

So it's a big lift, but, you know, I do think that that's what has to be done. You know, we'll comply. We'll find a way to do it. But it -- I am concerned that it pulls a lot of the OEM engineering resources away from speeding up the build-your-way-past-this-with-better-equipment side, and it will delay the availability of some of the next generation of the technologies that we most want and would be used for any of the re-power's replacements, you know, to get us to a more compliant fleet more quickly. So I think we have to weigh that, what's the right balance between how much resource do we put into the old installed fleet versus accelerate the new fleet, right?

MR. GUGEL: I would provide a -- I don't want to put words in your mark -- in your mouth, Mark, but I think I'd provide a bit of a caveat. That's assuming that you use the existing curves that are provided in

PRC-029. Maybe a question back to you would be, if instead the legacy stuff looked more like PRC-024, would you have as much of a manpower issue --

MR. AHLSTROM: No.

MR. GUGEL: -- of providing that information?

MR. AHLSTROM: Oh, no. As I -- as I have documented in my comments here, you know, we have 9,000 turbines, four OEMs for the current PRC-029 draft. We have about 6,000 turbines, two OEMs if we go to 2800. And we have virtually nothing if we, say, comply with PRC-024. We got 200 megawatts. I mean, it's one plant, one OEM. It's nothing. So I think that' it's compliant.

MR. GUGEL: The caveat there is, it depends, right? Whatever curve you choose on that is going to -- is going to basically determine the amount of manpower that'd be required on the OEM side and on the generator owner side to provide that documentation.

MS. SHAH: And I agree with that. I think my question was more, if we go with the existing PRC-029 and we have to work towards exemptions, upgrades, that's where I would speak for Clean Energy as well.

We are concerned about having the skillsets and the manpower to support this, while we are also at a future looking -- forward looking, how can we ensure this risk is mitigated and we are reliable.

MR. MACDOWELL: Yeah, and I think, you know, well said, Mark. I think that the biggest impact on evaluating the capabilities on the GO and the OEM, but there's also, again, with my ESIG hat on, there's also a bigger, broader impact on capability even with the system operators and utilities that have to reevaluate this as well. So there's -- it's not only on the GOs and OEMs, but it's everyone that has to reevaluate that capability that needs to go through the interconnection process again, or even determine whether there's a material change, right?

So I think across the board, and I -- from a compliance point of view at NERC, too, there's going to be some sort of impact. So I think whatever can be done to look at what is existing on the ground that's doing well enough to support reliability, not making any changes, really relieves a lot of the stress on the entire ecosystem that we're all fighting for the right

resources to be able to do this, whether it be OEMs, developers, NERC, system operators. The pool of resources capable of doing this type of work is very small, right, and I think that that's the practical reality of the issue that we're up against is time/cost versus resources to get this stuff done.

MR. GUGEL: Yeah, and I think the good focus for maybe the team that would be developing the next draft on this is, you know, the idea is we want to establish the bar for those units going forward, and then let's figure out what should be done with the legacy. And I'm going to -- I'm going to use air quotes there because I already talked about the issues. But again, what should be done with what's in the ground right now, and let's make sure that at least from the line we draw forward, that we have an expectation that plants behave a certain way.

MS. SHAH: And that leads me to my next question about risk prioritization. As we are trying to balance between what we have, the technology challenges and the upgrades or retrofits that we are considering for existing resources, for a ban that is using a scenario

as we all learn through the conversations in these two days, that we are not sure if there are any studies to back it up. So should we focus on our efforts to really comply with that ban, or should we really focus on future forward-looking technology where we can invest our efforts and for a better, reliable grid condition, and really use the data from the other performance standards that we are also moving forward with, use that data, understand how this will impact the grid, get more factual data? So something that I'd really recommend the team to consider as we look towards redrafting PRC-029, focus on the bans, consider the exemptions for that.

And one last point that I want to recommend to the team is, as we consider the exemptions, and putting my compliance hat on, documentation for the exemptions, we do have OEMs that are not in business anymore. So getting documentation to even submit the exemptions will be a challenge if we can carve out something in the technical rationale in the standard. I know with -- it's hard to put too many caveats in the standard when we are writing it, but somewhere if we can

document this, that there could be a possibility. We may not be able to provide a lot of data to support the exemption. What we know is what we know, and that's all. We have no one to collaborate, communicate with to get additional details. That's all.

MR. GUGEL: Yeah. Thank you. Yeah, I'm not sure how much of that would be able to be codified within the standard, and I'm not sure how much comfort you're going to get from my saying "trust me." But we understand that this is an issue, and I know that as we look at compliance across the ERO, that we're going to be looking at it from a risk-based lens. So, you know, OEMs that are -- that are out of business and you can't get the documentation is one thing, but hopefully at least you have the original design parameters for the plant itself, and that would provide a lot, I think, of the information going forward.

MS. SHAH: Thank you.

MR. SHATTUCK: Thanks, and we'll do one last question from Slido.

MS. CASUSCELLI: Thank you. How about taking all considerations from yesterday to get a set of

classes/types of entities/IBRs, each assigned a compliance threshold, incentivizing upgrading?

MR. GUGEL: That sounds like an accounting nightmare.

(Laughter.)

MR. GUGEL: So, you know, we tried something similar to this in other standards, and I know there are folks online that maybe haven't been as participatory in the standards development process as others have. We have looked at, in some of our protection standards and some of our maintenance standards, doing a percentage increase over a year as to how things are complied. And frankly, it becomes -- it becomes difficult to demonstrate X percentage of your fleet/pieces of equipment when that number calculates out to a decimal point, and it just -- it just drives me nuts, and I'm sure it drives a lot of folks nuts on that.

Instead, in my opinion, it's better to have that line in the sand that says, look, everything after this particular point needs to be at X, and prior to that, we'll be looking at, you know, the exemptions, the

facts and circumstances around that -- those units, and making sure that it fits into the parameters that are described in the standard itself. So I mean, great idea. Sounds good. It's the implementation and the practicality of those that it becomes the devil in the details.

MR. SHATTUCK: Thanks. Any other thoughts to close this out? We're at the correct time, and thanks, everyone for participating with our panel, but any closing thoughts from anyone before we all get off the stage here?

MR. YEUNG: I'm sorry. I think we heard some really good ideas, particularly the last comment about the exemptions and information. I think that's going to be real key in helping the Standards Committee determine what the exemption process looks like, so I appreciate that. Are we taking one more question?

MR. DAHAL: I would like to make some comment. I'm Samir from Gamesa. When we responded to your questionnaires about can you meet PRC-029 as it is written, right, no. Can you meet -- what about IEEE 2800? We operated with the assumption that those

curves are just curve setting. We did not dive into the performance specification like ROCOF, multiple excursion. So if you were to consider that, no, we cannot meet IEEE 2800. So your response, as Mark said, would definitely vary significantly. So that's something for the committee to take into account, right? We're just talking about those protection points and not the performance. That's the point number one.

Point number two on repowers, like I kind of mentioned yesterday, there are different type of repowers. So committee or somebody needs to take into account is the repower mainly mechanical one to increase the efficiency, or it's an electrical one where we swap out the converters. So without that distinction, it will become very convoluted on what to comply with, you know, what standard to comply with.

Third point is on software update, model update. Like, so if we said, okay, we can comply with -- for some of the legacy units, depending on the definition, we can expand the protection curve. We know we can do it, but if we have to provide models beforehand, that

will delay the implementation process because, like I mentioned, model might not have been updated, depending on what -- how back in the past we want to go. Do you want the advantage right now, or are you willing to wait couple of years for the model to get updated? And it's not just an OEM. You know, we do source our converter from other OEM that we need to reach out and ask them to give us the model that will comply with today's computational lead, right?

And then last point that I would like to bring up in the prioritization, like Mark mentioned, like he himself has 10 converter models, right? So we have certain converters on the field that we have in larger quantity than the other, right? So if there is a guidance given, either based on the number of internal capacity, or the reason that you guys from your experience say, okay, this reason is more vulnerable, so we can focus on this reason, make this a prioritize, or based on the number, then that would help us out to allocate our resources. Otherwise, learning from NOGRR, we are getting all OEM, all the operators reaching out at the same time asking for the capability

and the model update, and we have to -- we have no way to prioritize. So they would go back on the queue, and then we won't be able to, you know, help them as -- in the most beneficial way.

So those are my comments and I want -- I want Drafting Committee and the NOGRR to take -- RTOs to take those into consideration.

MR. SHATTUCK: Thank you very much.

MR. YEUNG: Okay. So I think we can close this panel. Todd, you want to make some comments?

MR. BENNETT: No, Charles, I don't think I have anything else additional, other than to thank the panel. This was a wonderful panel, a lot of great technical insights here. Give them a round of applause for all their efforts here today.

(Applause.)

MR. BENNETT: And I'm showing 11:05. Let's reconvene at 11:15. Thank you.

(Break.)

MR. BENNETT: -- portion of the technical conference. So this is last thing between us and lunch here, and that's not a please hurry up. That's a I'm

excited to hear about what you have to say.

So outlining objectives of a Ride-through definition. I believe we have a couple Drafting Team members here to come speak to us about this, but this states specifically Joel. So, Joel, take it away.

MR. ANTHES: Yes. Good morning still, and I was just telling Husam that this is the perfect time for us to present because hopefully everybody will be hungry and not want to ask us a lot of questions after our presentation.

(Laughter.)

MR. ANTHES: But my name is Joel Anthes. I'm a system protection engineer with a Pacific Gas and Electric Company. I'm from California. I'm a member of the Drafting Team for 2020-02 for PRC-029, and I have Husam Al-Hadidi with me, who's the co-chair of the Drafting Team.

So I was reading through the description of what I'm supposed to present on, and it says, "a thorough examination of the usage of the term, 'Ride-through,' within NERC reports, IEEE, currently active Ride-through, reliability standards, and other industry

usage of the term." So just to be upfront with you, I don't think we could do that in 030 minutes, and I would not be qualified to lead that discussion anyway. My middle name is not "Ride-through."

(Laughter.)

MR. ANTHES: But what I would like to give you is an overview, the history of the Drafting Team's thought process for how we got from beginning to draft to at least our Ballot Three, our latest proposed IBR Ride-through definition.

So if we could go forward a slide please.

So I reread the SAR, and the SAR directed us to consider defining the term "Ride-through" as necessary. Now, in our first ballot, we actually took the approach of not defining Ride-through. Our intention, as I understand it, was to really define "Ride-through" within the requirements of the standard itself, rather than to give a comprehensive definition of "Ride-through." But after meeting with the PRC-030 Drafting Team, which defines the triggers for when you investigate Ride-through performance within 029, it was a specific request from them that we go ahead and

define the term, "Ride-through, "so that they could index, so to speak, into the requirements of our standard and reference it within their own. So draft two, we began by putting our first attempt at a Ride-through definition.

If you could go to the next slide, please.

So some of the goals that governed our thought process on this was we wanted to have a definition that could be included in the NERC glossary of terms. We didn't want to unnecessarily tie it specifically to our standard, and then we wanted other standards to be able to refer to that definition when either indexing into our requirements or referring to our requirements. So those were just a couple of goals that we tried to keep in mind while we were drafting it.

Next slide, please.

So some of our goals were not -- we didn't want to create additional performance requirements just by defining "Ride-through." We wanted to keep the performance requirements of Ride-through within the actual requirements of PRC-029. So something to keep in mind when we look at how we kind of went through and

the evolution of our proposed definition is it wasn't intended to be an all-encompassing performance definition, only a definition, very bare bones definition, so to speak, of "Ride-through."

Next slide, please.

So our first draft, I'm just going to read it: "remaining connected" -- so this is going to be the definition of "Ride-through": remaining connected, synchronized with the transmission system, and continuing to operate in response to system conditions through the time frame of a system disturbance." And then after reading through many pages of industry comments from draft two, we ended up incorporating those comments and tweaking the definition for draft three, which is the latest that we've proposed. And that is a definition of "Ride-through": the entire plant facility remaining connected to the bulk power system and continuing in its entirety to operate through system disturbances.

So a couple of things. We ended up removing "due to industry comments were synchronized with" from draft two, and "in response to system conditions." So there

was some concern whether it was justified or not. There was some concern with us using -- applying the term and the concept, "synchronized," to inverter-based generation. And there were some who felt that it was not appropriate to use the term, "synchronized," because we weren't doing a standard for synchronous machines, and we went ahead and removed that term.

And "in response to system conditions," that had generated some comment, as I recall, of what are those conditions, what is appropriate response, all of which we weren't trying to define merely through a Ride-through definition. And then we ended up adding the concept of "entire" and "in its entirety" because there was real specific concern, as I recall, from one stakeholder, in particular, that if we -- if we didn't clarify that, then generator owners and operators may consider partial tripping of inverters when considering the R3 requirements for returning to pre-disturbance, real power levels. And so this was an attempt to clarify that. It wasn't -- I'll just leave it at that. It was an attempt to clarify that you couldn't subtract partial tripping when you were required to come back to

your pre-disturbance available power after a system disturbance. And then we replaced "transmission system" with "bulk power system," and I think the key there is that we were trying to deliberately exclude distribution-level IBRs, and bulk power system would be exclusive of distribution -- solely distribution-connected IDRs.

Okay. Next slide, please.

So another thing we attempted to do was to use, wherever possible, NERC glossary of terms, so "bulk power system" is clearly defined. It excludes the local distribution of electric energy. "Disturbance" is clearly defined. It includes abnormal system conditions, perturbations, and frequency deviations.

Next slide, please.

So one of the things that we referenced, there's this most admirable definition from IEEE 2800, and we drew from the concept of this. I'm going to read it to you. It is, "ability to withstand voltage or frequency disturbances inside defined limits and continue as specified." So I think the main reasons that we didn't directly use this definition is some of the nuances of

the language, "ability to withstand," for instance, may not necessarily mean remaining connected to the transmission system. So instead of -- instead of "ability to withstand," we used "remaining connected." "Inside defined limits," we felt that that may unnecessarily tie it to a specific standard. We were attempting to make it a more standalone definition, and similarly with "as specified." Again, that's more of like a standards requirement, a performance requirement you have to then perhaps specify along with your definition of "Ride-through." So those were at least our thought process for avoiding some of those things. That's why we didn't directly use the IEEE definition.

Next slide, please.

So in response to Ballot Three and Ballot Two, we went through, looked at the comments. Industry proposed 11 different definitions of "Ride-through," and I read through all of them again last night. And I had a headache, and so I thought I'd like to share that with you.

(Laughter.)

MR. ANTHES: So I'm not going to -- I'm not going

to comment on -- you know, rebut against each one. I think they all have some value in the way industry was thinking, but in general, three things that I saw where they kind of deviated from ours. Some of it was just word order preference. You know, maybe they were trying to say the same thing, but they didn't like the way we worded it. And then two other things that were more significant, at least in my mind, were adding in the concept of in -- adding in the concept to the definition of "Ride-through," that your response needs to be in support of grid reliability, and then also maybe adding back in the concept of your response needs to be as specified within the standard itself. So for number one here, I think that one kind of merged aspects of IEEE 2800's definition with ours.

If we could go to the next page.

This one here, it seemed to kind of add back in the concept of operation in support of grid reliability. So it says, "Facilities, including all individual dispersed power-producing resources, remaining connected to the electric system, and continuing to operate in a manner that supports grid

reliability throughout a system disturbance, including the period of recovery back to a normal operating condition." So again, these are draft comments that were proposed within the industry, comments to the Drafting Team, suggestions from industry for tweaking the Ride-through definition.

Next slide.

So this one seemed to want to remove, at least in part, the concept of the plant operating in its entirety, Riding-through in its entirety. So "Remaining connected, synchronized with the transmission system, and continuing to operate by delivering power in response to system conditions through the time frame of a system disturbance." The next one, 5, "The entire plant remaining connected to the bulk power system and continuing to operate the system disturbances," very similar, I think, in principle to what we proposed.

Next slide.

So 6 and 7 here. "The plant facility remaining connected to the bulk power system and continuing to operate through system disturbances as defined within

applicable reliability standards." So that one kind of adds back in the concept of within defined limits of the standards within specific operating limits. Seven, "the entire plant facility remaining connected to the bulk power system and continuing in its entirety to operate as specified through" -- oh, I can move on to 8.

So 8 here: "The entire plant facility remaining connected and continuing to operate through the duration of frequency and voltage disturbances, in its entirety, from the start to the return to pre-disturbance conditions," so it basically removed the reference to the bulk power system. And then 9: "The entire plant facility remaining connected to the bulk power system and continuing, in its entirety, to operate as specified through system disturbances inside defined limits." So that one kind of added back in the concept of defined limits as specified within a standard.

Next slide.

I think is our last -- second to the last. "The entire plant facility, including its dispersed power-

producing inverters, remaining connected to the electric system and continuing, in its entirety, to operate in a manner that supports grid reliability through a system disturbance, including the period of recovery back to a normal operating condition." So to me, that one also kind of added in the concept of you need to operate in support of grid reliability, maybe more of a system-level definition.

Last slide, number 11, "The plant facility shall remain connected and in service, maintaining the pre-disturbance equipment configuration in operation throughout the entirety of the system disturbance and recovery." So this one, again, kind of removed the concept of the entire plant operating.

So I think the story in my mind of this is that you could probably put a hundred different people in a room and you'd get 120 different definitions. And there's -- I'm not minimizing the input and some of the concerns and some of the things that industry has highlighted, but there -- you know, at least maybe it gives you a feel for what we went through in reviewing all of the industry comments and trying to come up with

something simple that met the goals. So I think that's it for -- do we have Q and A now? Okay. Hopefully you're all hungry.

(Laughter.)

MR. VENKITANARAYANAN: Nath Venkit from GE Vernova. Thank you for going through the background and all the different definitions. I have a comment on the "in its entirety part," and the way I read it is if you have a wind farm with about -- with a hundred turbines, and if you have an event and one of them trips, one out of a hundred trips, then the whole plant is not compliant. Now, as an OEM, I would like to say that this may be impractical. The reason is you can have -- let me give you some examples. You could have a turbine that is losing its wind resource and is in the process of gracefully shutting down. So its rotor RPM has gone below a certain threshold, and then it's counting down to shut down, and that process is a graceful shutdown.

Now, during this period, if you have a Ride-through event, then you're not going to gracefully shut down. You're going to shut down, okay? And then it's

going to take a few minutes before the turbine comes back up. That's one example. There could be other examples where turbines are -- an individual turbine may be seeing a combination of conditions -- wind gusts, turbulence, whole bunch of other things -- that is causing it to operate in what I would summarize as survival mode, right? So it's over speeding, and it's trying to control that speed. And the whole objective is to not shut down that turbine but to allow it to manage that and come out of that survival mode into normal operating mode. But if you are in that kind of a survival mode and an event happens, that turbine is very likely to trip.

So for all these reasons, if you look at IEEE 2800, it says that after a fault, when you recover, it is sufficient if you recover to 90 percent of available power because it's possible that some of the inverter-based units will -- would, would trip for some of these conditions.

MR. ANTHES: Yeah.

MR. VENKITANARAYANAN: So in my mind, requiring that not even a single inverter-based unit under

whatever conditions it's operating in -- losing its wind resource, gracefully shutting down, operating in survival mode -- under any of these conditions, if it should be able to recover, that can happen only in theory and not impact this.

MR. ANTHES: So if I could interrupt you because I'm going to forget the first part of your answer if you go too much further, but so my understanding is it was not our intention to make a standard that was -- absolutely prohibited any tripping of a unit. So as I understand it, PRC-030, our companion standard, is going to define the triggers for when you investigate PRC-029. So I think as they passed, it's a 10-percent reduction in real power, or 20 megawatts is, I think, what they have in there. So if you had a 10-percent reduction in real power or a trip of 20 megawatts, or, I think, if it's your transmission planner operator requests an investigation. So that's my understanding and how I've tried to explain it to my company is that that is the trigger for then assessing your compliance with PRC-029.

So I don't think it was our intention in putting

in the concept of its entirety to absolutely prohibit any tripping because that doesn't seem reasonable. However, it came -- for better or worse. So the reason it wound up in there is there were specific entities concerned that you could have a disturbance on the event. Twenty percent of your inverters might trip. You're expected to come back to your available active power after the disturbance is cleared. So their concern was, you know, unless we say something about in its entirety, they might go, okay, well, my available power is the 80 percent I have left on, so I'm totally compliant, but they might have lost a significant number of inverters due to the disturbance. So our intention with this, and maybe it wasn't clear enough. I'm thinking based on how many comments we've had like yours, it probably wasn't clear enough. But our intention wasn't to, I believe, absolutely prohibit any tripping, but it was to disallow when you return to pre-disturbance, subtracting things that tripped out from your available active power.

MR. VENKITANARAYANAN: Just to add to that to be very clear, a clarification, we don't look at the

individual unit, so really, IBR unit was not part of our scope. So really if you have hundreds of IBR unit and you are able to go to -- recover to pre-disturbance megawatt, even if you lose five, 10, 15, as long as you could maintain the pre-level disturbance after the event, you are in compliance with our standard. And we added flexibility that if the TB or RC or whoever want to give you a different level to say, no, recover to 90 percent, 95 percent, we couldn't. We said this is going to be system dependent, and we lifted an open flexibility on the standard. So you are not -- there is no requirement for every IBR. You need to recover -- the plant need to recover the pre-disturbance value. So your concern if it's one unit and it's not going to impact the plant --

(Cross talking.)

MR. AL-HADIDI: It will impact.

MR. VENKITANARAYANAN: -- then you have to bring it -- the GO owner has to bring it back to their TB or RC to see does that really need to be exempt from that or how that need to read that. But for now, the standard, it's saying that if you're able to recover

from the power, you have no issue. If you don't, there's a TPRC flexibility to provide a different level other than a hundred percent.

MR. AL-HADIDI: See, I don't see how that can happen. If you have a hundred turbines, each of them producing two megawatts, and one of them trips, okay, you're not going to recover back to 200 megawatts. You're going to recover 298 megawatts. So, again, I mean I --

MR. VENKITANARAYANAN: As I said, this is reliability question. That's why we couldn't determine this -- the number, which is it 95 percent? Is it 90? What's the value? We say the standards require you to -- require you to recover back, and the TPRC, based on their system, they can provide any criteria as needed to support their system. So flexibility is there, so there is flexibility in the standards.

MR. AL-HADIDI: Again, I mean, I don't want to argue. I think reliability is important, but having a practical solution is also important. So I think we have to draw a line that you can't have 20 percent of the units tripping, but it's okay if you have two or

three units stripping. So somewhere, you know, there should be an element for that. Thank you.

MR. ANTHES: So maybe to your, because I think you had two points in there. One thing that came to mind as you were discussing the scenario of a wind turbine ramping down due to, you know, maybe wind has ceased, and in requirement R3, we do specifically say you have to return to available active power. So if you have -- if your available active power is different because you have lost wind or because cloud cover has affected your solar production, we intended to account for that in returning to available active power. But the concept in its entirety was to not allow you to trip a whole bunch of stuff off and go, well, I only had available the stuff that didn't trip, if that makes sense.

(Off mic comment.)

MR. VENKITANARAYANAN: Yeah. Thank you.

MS. CASUSCELLI: Okay. I'll ask one of the online questions. Has the Drafting Team considered adding specific language to align the language clearly with PRC-030/defined the levels similarly?

MR. AL-HADIDI: BRCT? I don't remember.

Actually, we create this definition to align with BRCT, so that was the intent of adding the definition to the standard, so really, it was mainly -- just really the main intent. So I thought we achieved that objective.

MR. GUGEL: Hey. Howard Gugel, NERC. There was a phrase that showed up in several of the definitions that was triggering for me, so I just want to make sure that you have a lens on for it, and it was "remained connected." And sometimes when you start talking about momentary cessation, there's no mechanical disconnect that occurs there, but it's an electronic change. So somehow, as you're looking at this idea of Ride-through, make sure that you take into account it's not just a mechanical change that could occur there, but also any sort of a momentary cessation that might be taken into account.

MR. AL-HADIDI: I thought we did for that. We said to "continue exchange current," so we said it's not -- and I believe that's the reason. But reason where we did not add to support the system, it was a reason for, like, for R3. We are not required any performance requirement from the IBR. So we -- if we

said that -- if we are now saying you need to support the system, and now there'll be -- it's very hard now to say if you Ride-through or not because if you do not produce enough or change your megawatt to support the system, it could be your Ride-through, but they're not compliant because you did not meet the definition. So that's the reason sometimes we did not adapt some of the suggested language from some of the stakeholder because we felt that it may add more compliance requirement, which we try to avoid to some level.

MR. ANTHES: Yeah, and I did read through the SAR again. The concept and the specific terms of "remain connected" were used extensively. And I -- you know, for better or worse, I think a lot of people view "remain connected" as what it's intended to mean, which is you Ride-through, you continue to exchange current, you remain connected.

MS. CASUSCELLI: Okay. We've got more online questions. As stated by the panelist from the Drafting Team, it's not reasonable to prevent all tripping. However, this is not how the draft is written. Should this be explicit?

MR. ANTHES: Well, again, as I see it, we have three reliability standards. We have PRC-028 for the data acquisition and monitoring, we have PRC-030 for the event triggers, and then we have PRC-029 for the performance. So as I understand it, the triggers for when you evaluate PRC-029 compliance and performance come from PRC-030, and the data that's necessary to evaluate that is recorded based on your recording equipment in PRC-028. You know, maybe PRC-030 and PRC-029 should've been one standard, but they're not, so without reduplicating all of the requirements, I think we tried to compromise and go, okay, these are event triggers in PRC-030.

MR. PATEL: So, Joel, we have talked offline, but for everyone's benefit, I think we keep referring that PRC-029 and PRC-030 are connected. That is true, but remember, PRC-030 -- so practicality is that we cannot evaluate each and every Ride-through operation. It's just very difficult. We have other jobs to do. So the way I see this is that PRC-030 has a criteria. If it's met, then you go investigate what happened. That doesn't mean that the plant is not in compliance or in

compliance with the PRC-029. If you reduce output by 10 percent or 20 megawatt over 4 second -- I think those are the numbers in PRC-030 -- all that means is you go investigate what happened. The answer could be plant did not perform as expected. The answer could be the plant performed as expected. If it did not perform as expected, out of compliance with PRC-029. I think that's where even Nath's point came in, that if one wind turbine tripped offline out of a hundred, you could be out of compliance.

MR. AL-HADIDI: Yeah, but you have to remember we do not quantify the number because you could have now 2 giga -- 2 giga or 5 giga plant, and now the 20 percent, the 10 percent becomes significant amount of megawatt.

MR. PATEL: Yeah.

MR. AL-HADIDI: We leave that flexibility, and we were not -- there was a huge push even for us to keep that flexibility to say don't -- multiple people, you won't to recover back to the hundred percent. We say it's system dependent, and only -- we found the best compromise way to deal with it is to leave it --

MR. PATEL: Yeah.

MR. AL-HADIDI: -- leave that open for the TPRC based on their system need, to keep that exemption because the standard said, yes, they can specify different value than the hundred because we agreed sometime hundred is unachievable target.

MR. PATEL: I'm not debating that. I think you debated that enough with Nath. What I'm trying to say is that there is a criteria in PRC-030, and that determines if you're in compliance or not. It's a -- it's a -- it's a wrong understanding.

MR. AL-HADIDI: No, no, I agree.

MR. PATEL: The way the standard is written, PRC-030 criteria is met. You investigate what happened. The outcome of that investigation is plant failed to perform or plant performed as expected. If failed to perform, out of compliance with PRC-029, but the PRC-029 stands on itself, right?

MR. AL-HADIDI: Right.

MR. PATEL: That's the debate.

MR. AL-HADIDI: Right.

MR. PATEL: We can talk about Nath's questions. I have the concerns with that, too, but we are not

debating. I think let's not link incorrectly the two standards. The only reason for PRC-030 is we cannot investigate each and every Ride-through. We put together a criteria, 10 percent, 20 megawatt, 4 second. If that's met, we'll investigate. Answer could be plant fail to perform, out of compliance with PRC-029.

MR. AL-HADIDI: Yeah, absolutely right. Right now, PRC-002 is doing the setting for PRC-024, and it's all the -- all the -- all the compliance part is done with the PRC-002, but we can discuss offline. Thank you.

MR. KAPPAGANTULA: One quick question. Can you shed some light on -- oh, Srinivas Kappagantula, Arevon Energy. Can you shed some light on why doesn't the definition specify voltage and frequency disturbance like you had on one of the slides, especially when you looked at the IEEE 2800 definition? It appears to cover over-current type issues for electrically-closed faults. Any context to that would be great.

MR. ANTHES: So why we didn't explicitly say voltage and frequency disturbances?

MR. KAPPAGANTULA: Yeah. Yeah.

MR. ANTHES: Well, I think, you know, as I read the glossary of term definition for "disturbance" that I put up on one of those slides -- I don't know if we could flip back to that. It's probably 10 slides back, so maybe it's not worth the effort, but it does talk about system, perturbations changes to ACE. ACE, in my mind, frequency disturbances, system perturbations would be any electrical disturbance.

MR. KAPPAGANTULA: So you're relying on the glossary of terms definition for a disturbance.

MR. ANTHES: I think that was our thinking --

MR. KAPPAGANTULA: Okay. All right.

MR. ANTHES: -- was to lean on the defined terms and the glossary of terms as much as possible.

MR. KAPPAGANTULA: Okay. Yeah. In that case, if -- when you're making a definition, maybe capitalize the terms so it is in our glossary of terms.

MR. ANTHES: I think we did.

MR. KAPPAGANTULA: Okay. All right.

MR. ANTHES: We should have.

MR. KAPPAGANTULA: Okay.

MR. ANTHES: I believe "disturbance" was

capitalized --

MR. KAPPAGANTULA: Okay. Great.

MR. ANTHES: -- and "bulk power system" was capitalized.

MR. KAPPAGANTULA: Thank you.

MR. ANTHES: Yeah.

MR. BENNETT: Okay. So I believe we've hit lunchtime here and we've come to a stopping point for the early afternoon. So thank you to our panelists. That was a great presentation on some very technical terms that we're trying to make it through. And just in addition, I believe we're going to utilize Slido over lunch, so when you get a chance, take a -- take a look. There's a poll out there on this definition. The software will walk you through that. It'll ask you what your favorite one is and see what you support, and maybe give us a data point to see if there's some industry support that'll help foster some decisions in the near future.

So with that, I think we are scheduled to come back here at 1:00, after lunch, and we will start up again, so thank you so much.

(Off mic comments.)

MR. BENNETT: Yeah, there'll be more to come on Slido later. There's going to be some additional ones. So we've -- to make the most of our agenda, we've had to shuffle a couple things around, but there'll be some additional polling later.

(Luncheon recess.)

MR. BENNETT: Okay. It's a few minutes after 1:00 here, and I believe we're going to start to pull our panel together and move on with our afternoon session here.

I will say that the Slido poll, it was open over lunch, and we're going to be shutting that down shortly, and we'll review the results of that initial poll here later this afternoon when we get to the other Slido portion of our conference here. And just kind of a disclaimer or a heads up, as the results of those polls, those quantitative results isn't necessarily the path forward on a certain item, but it's definitely helped framing the discussion for some decisions that are going to have to be made over the next week or two. So just please continue for that, and there's a lot of

value there.

And with that I think, Jamie, I'll have you walk us through Milestone 2 of the implementation plans, and I'll turn it over to you.

MS. CALDERON: All right. So detailed, very thorough review, which will actually be a summary in about 15 minutes.

Implementation plans are incredibly important. All of the details that are within the standard are, of course, equally important to be able to say what's the measure of compliance? What do I need to do? But the implementation plan holds those details as to when, especially when we have the complication of three different standards coming together that interrelate and have phased-in implementation, compliance extensions. There's a lot to consider here when we're looking at the implementation overall.

So the slide, please.

So what is an implementation plan? So just starting from the top down, they're created for new or modified standards. They are created for retiring standards. They're created for new or modified

definitions. And it's entirely to ensure that there's no overlap or gaps in time between versions, making sure that there's a very clear definition of when something will become effective and when something will need to be complied with.

Next slide, please.

So the effective date. Key terms within the sections of the IP is that you're going to have an effective date that's listed. You may have more than one. It'll be either a specific date, say, like January 1st, 2027. It may be a time period after approval by governmental authority. So there's going to be six months after the approval by the applicable governmental authority, which, in the U.S., is generally FERC, and, of course, in Canada it's going to be the provincial territories and those governmental authorities.

So it could also be something else where you have a time period after another standard becoming effective, which adds a layer of complication. Putting together a Gantt chart of this was something I initially started to do with all three standards, and

guess what was unable to accomplish? And that's pretty much because we've got a phased-in implementation plan portion of this as well. So included within the effective dates are those. There's retirement -- a retirement date, which is generally immediately prior to the effective date. So something takes place and is effective on January 1st, retirement date's going to be December 31st, the year before. There's going to be general considerations, things that you need to keep in mind as you're going through implementation, something that might be impacted by another standard, something that needs to be, you know, adhered to or communicated with your regional entity or perhaps another entity within your footprint. All the things that could be, you know, brought into the conversation need to go into that section.

And then there's things that are just also just standard specific. In the case with PRC-028, there is actually a whole section for compliance extensions because there are things outside the entity's control: supply chain issues, you're not able to get contractors and testing engineers onsite, but you've made good-

faith efforts and you can demonstrate that. Compliance extensions are built into PRC-028's implementation plan, and that's their -- considered as other standard specific.

Next slide, please.

So phased-in implementation plans, the bane of compliance, which is -- like, Howard was alluding to earlier, where you say 20 percent of these types of units, but then, of course, the number of units you have changes after the couple years, and when do you calculate that a hundred percent benchmark? Is it based off of when the plan was originally initiated, or is it based off of your current as-of-day asset list? It can be very, very complicated, and nuances are something that compliance deal with on a routine basis.

So we still do these even despite that because we can't have your entire fleet come into effect all at once. We can, but, you know, we try to avoid that. The idea of not having everything in all at once is the whole reason for having that phased-in implementation. So it'll generally be milestones after the effective date. So within PRC-028, we have 50 percent three

years after the effective date, meaning FERC approves it. Three years later, you have to have 50 percent of that complying with PRC-028. And this is where it gets complicated because we can't give an exact date because we can't tell you exactly when it's going to be approved by FERC. Generally, we know when we're going to file it, but then it could be one quarter. It could be the first day after the first quarter. It may be delayed and end up being sometime in the second quarter.

So once we have that date, we can provide very clear guidance and a specific date, but it does become difficult to do earlier on in the process as we're seeing with the IBR registration initiative and bringing new Category 2 GOs into the mix. They want to know what and when, and so this kind of gets into the reason as to why we can't give those dates because they are subject to change based off of these trigger points within the process.

So examples of, again, of phase-in implementation, percentages facilities. There's also Requirements 1 become effective on X date, and then Requirements 2

through 7 become effective at a later date. Sometimes these are just due to the nature of how the requirements are written. One may be -- have a process, and then 2 through 7 would implement that process. And so there could be even a combination of that, which we see within the standards that we have for PRC-028, 029, and 030. It's somewhat of a gambit of it, which makes a little bit more complication, but it's why we wanted to have the discussion here today and have a quick panel discussion on as well because being able to comply with these standards is as important as being able to know what's in it and having that criteria very well understood, is being able to build out your compliance program in advance, making sure that these things that are known issues on the front end considerably with supply chain issues.

You know, that's been talked about earlier today with having access to sufficient contractors or vendors. If everyone tries to go get that done in one month just prior to the effective date or the approval -- or the -- that final compliance date, it's going to be impossible to achieve just because you're not going

to be able to get that. So we want to make sure that there's preparation in this. It's all about planning.

Next slide, please.

So just overall, PRC-028, it's a new standard. What that means is that there's not a retirement that's coming with it. It's an entirely new standard. And what's in there is "shall become effective on the first day of the first calendar quarter after the effective date of the applicable governmental authority's order approving the standard," which probably March or April 1st. Probably April 1st will be the first day of the first quarter after approval, assuming it gets approved in the first quarter. That's, of course, subject to change. If it doesn't get approved in the first quarter, it'll be, of course, down in July, but these types of things become a little bit more complicated.

Next slide, please.

So within PRC-028 again, we have a phased-in implementation for several things. One is for your existing IBR resources, those that are in commercial operation on or before the effective dates. There are also the new BES inverter-based resources. There's

also the non-BES inverter-based resources. These are going to be the existing generators, the existing IBR that meet that new Category 2 designation. There's also going to be new ones coming online as well. So there are four sets of IBR within PRC-028 that you need to be aware of. They each meet this phased-in implementation plan of 50 percent of them by a certain date that are in -- that are in effect, but new ones have their own information.

So on the next slide we'll get into that.

So for existing IBR, your existing BES IBR, 50 percent again by three years after the effective date PRC-028, and a hundred percent of your BES IBR by January 1st, 2030, and that 2030 number is from the FERC order and is non-negotiable. We do have within PRC-028 the ability to have compliance extension, again, for the cases that are outside of your facts -- or your circumstances and/or ability to control, things like supply chain issues. Again, there's a potential to go past that 2030, but you do have to be able to demonstrate that.

New BES IBRs, so those coming into commercial

operation, but might be in the current design phase after July 1st, 2025. That's to give a little bit of buffer for things that are currently iron in the ground, going to be coming online within the next year or two. We want to make sure that we're giving enough bandwidth or lead-way for at least some of those that are currently being developed. But on or before October, 2026 entity shall comply with requirements R1 through R7 by October 1st, 2026. So that's going to be the cutoff date for new BES IBR. After that, everything needs to comply.

Next slide.

Existing non-BES IBR, a hundred percent by 2030. That's just the blanket rule, everything by 2030. But the existing non-BES IBR, within 15 months following the effective date of the standard of the commercial operation date, whichever is later. We've been looking to make sure that there's a really clear consistency on when the Category 2 generator assets are going to be applicable. We have a cutoff date for that compliance -- or I'm sorry -- for that registration date for new registrants by May 2026. So what we've done here is

make sure that nothing's going to be held compliant for those Category 2 generator owner assets prior to that initial cutoff date. Try to encourage early registration. Don't want to penalize people for coming on early and becoming compliant with standards early. We want to encourage early compliance, but we're not going to penalize people, you know, prior to that May 2026 date.

So again, there's the process for the compliance extensions built into PRC-028, and that's intentional and very important to ensuring that we have a strategy that can be implemented. You go after your highest-risk assets first, perhaps the larger units in your fleet first, and then you scale down as you're able.

Next slide.

For Project 2020-02, we're looking at PRC-029. This also is a new standard. We do have within this project a component that is PRC-024, and that PRC-024 piece will have a new version that will become effective and the old version will become retired, of course. But PRC-029 shall become effective 12 months after the effective date of the applicable governmental

authority approving the order approving the standard.

And on the next slide, this is where the key pieces of information is. There's capability-based requirements. This is design, the ability to do studies to demonstrate your IBR will Ride-through, have the capability of riding through. This is going to be demonstrated through studies. This is going to be demonstrated potentially through EMT evaluations being able to identify and demonstrate that you can meet the Ride-through capability. For BES IBR, it's the effective date of the standard, and the non-BES IBR, again, this is the Category 2, we're talking January 2027. And that's in line with we're trying to not have everything come in all at once for Category 2 GOs, so we're staggering those out and we're working with compliance and registration to ensure that happens. So within this batch of standards, we've looked to say January 1st, 2027 is reasonable for these new -- these new -- these new generator owners coming online.

So that's the capability-based Ride-through criteria, and this is a little bit of a different phased-in implementation plan where we have a single

requirement that has different aspects, one being that design base that you demonstrate through studies, and then it becomes the performance-based criteria that that becomes effective later. So we're looking at --

Oh, sorry. One slide previous. Yep. One slide before. No, before. Yeah. Thank you.

So performance-based Ride-through criteria is for both BES IBR and non-BS IBR. Nothing new here. Align it with your PRC-028 implementation plan, and that's because within PRC-028, you're installing new equipment, you're working with your vendors, you're working with supply chain, and you're getting that installed. You shouldn't be required to demonstrate performance at a generator that you haven't installed that equipment at yet. The implementation plan for 0-028's already sufficient to demonstrate that you've got the -- you've got the risk resolved by having the monitoring equipment installed and you have the capability of demonstrating what you're doing onsite, how it's performing. And at that point you become -- your performance-based Ride-through criteria needs to be demonstrated.

And now we can go to the next slide.

All right. So for Project 2023-02, new standard again, PRC-030. What we're looking for is -- this is the analytics that base -- work off the same as 029. We have an IP revised and current draft for formal comments, so I actually cannot take questions on PRC-030, but this is a public forum and we can briefly talk about this because it's currently under ballot.

But what is in the revised IP? We recently did pass ballot, but due to some necessary conforming changes to make sure that the PRC-030's implementation plan was in line as intended with PRC-029 and PRC-030, it's currently out for ballot just for those conforming changes and some small revisions within the requirements for R2. So the IP is currently out for ballot. We did remove the performance-based, capability-based language from that IP, so now it's only focused on just on the next slide when it becomes effective.

So it's later of the first day of the first calendar quarter that is 12 months after the effective dates or approving the standard or the first day of the

first calendar quarter that is 12 months after the effective date of the applicable governmental authority order approving Reliability Standard PRC-029. All that to say this is meant to align with your PRC-029 rollout, and PRC-029's rollout is meant to align with PRC-028. So these are all tied together for that -- for that same basis of performance data criteria and having the analysis that's triggering that data, and having the data installed and that equipment being installed at those sites are all in conjunction and working together. So it's that three-legged stool we talked about yesterday. It's one solution.

While there are three different IPs, they daisy chain together intentionally to make sure that we're not putting anyone into a compliance bind by having a gap. If you don't have disturbance monitoring equipment installed, you shouldn't be held accountable for performance that you can't demonstrate. So that's built into the IPs.

And at this point, I think we can go to the next slide, which should be -- okay.

I did add this in just to -- as a callback from

yesterday. We talked about how these tied together, voltage frequency excursion occurs, and so you see these two standards on the right. PRC-029 and 030 tie together, and then on the disturbance monitoring side, PRC-028 on the far left, all to say that all three of these go together, and this is just a visual representation, again, as a callback. If this didn't make sense yesterday, maybe it makes less sense today, but hopefully it makes a little bit more sense. It makes more sense to me than it did when I originally made it, so this is good.

But when it gets to making sure that you have an understanding of this, ask questions. Reach out to your regional entity. That compliance staff is there to help provide that guidance, so as these come out, don't guess, of course. I don't think any compliance officer is doing that, but if you have questions or concerns, please raise those, bring those up. The regional entities are there to help. And with that, I think we can go to the next slide and take questions.

MR. BENNETT: So, Jamie, on this one, I was just going to ask, would you prefer to have questions on

this now or kind of morph into your panel discussion?

MS. CALDERON: Let's just do the panel, yeah.

MR. BENNETT: And do it all at once.

MS. CALDERON: Yeah. Yeah, let's do the panel.

MR. BENNETT: Okay. Let's just -- let's just do that. Okay. So it looks like the panelists are starting to make their way to the stage. So this is going to be kind of continuing the conversation on implementation plans and effective dates. And Charles Yeung, our moderator from earlier, is back with us as well as Jamie to help moderate this conversation, and with that, Jamie, whenever you guys get settled up there, please start in.

MR. YEUNG: So Jamie kind of recapped where we were, and I think it'd be good to put that other slide back on, her last slide with the three standards. Is that possible? I think that's a good reference for what we're going to talk about on this panel. I need to bring up the questions. Excuse me.

(Brief pause.)

MR. YEUNG: So let's start with introductions. Maybe we'll start on the end, just who you are, who you

represent, please.

MR. HAKE: Yeah. Hey, everybody. So Sam Hake here. I'm a NERC compliance engineer with a AES Clean Energy. We're a renewable energy developer.

MS. JONES: Good afternoon, everyone. My name is Rhonda Jones, and I lead the NERC compliance efforts for Invenergy, and we're a developer and operator of many projects throughout the United States, and we're headquartered in Chicago.

MR. GUGEL: And I'm Howard Google, vice president of regulatory oversight at NERC.

MR. PATEL: Manish Patel, Electric Power Research Institute.

MR. YEUNG: Again, I'm Charles Yeung. I work for Southwest Power Pool, a member of the Standards Committee, and we know Jamie is.

MS. CALDERON: Yeah. My name's Jamie Calderon with NERC Standards Development. My computer seems to have just bricked.

MR. YEUNG: Crowdstrike?

MS. CALDERON: Yes, probably.

MR. YEUNG: Well, I think implementation's a real

important issue. I believe two of these standards have already passed. One is under a final ballot, I think the PRC-030, and hopefully as far as this conference is concerned, we'll get to passing a standard for PRC-029.

I think one of the things probably not recognized because it's still in development is the issue of exemptions. That's going to be -- yet have to be finalized exactly what that would look like, but I think that might have some bearing on this implementation. So maybe the panelists can consider some of the comments we've heard so far about exemptions and implementation because with exemptions, certainly there's different types, different impacts, and perhaps impacts on the implementation, too.

So the first question is, given the complexities of these three standards -- PRC-028-1, PRC-029-1, and PRC-031 -- what strategies would you recommend in synchronizing implementation to avoid conflicts or gaps in compliance? Again, with the explanation Jamie gave, they're all one big happy family, so we need to synchronize those together. And then what considerations are needed to prevent potential overlaps

or inconsistencies in that implementation? So you want to just start on the end?

MR. HAKE: Yeah. Yeah, absolutely. So a couple of points to make here. I think, first of all, we should expect overlap. I think that currently in the existing implementation plans, that is acknowledged, as Jamie just presented. I do think that we have some concern over the differentiation between the design portion versus their performance. Particularly for PRC-029, a lot of the challenges that we've heard discussed -- you know, OEMs being out of business, modeling information not being available -- those are really going to impact us on the design side first, right? That's the first thing that we have to do. And so I think that for our -- my personal view, I think that the link that we currently see through the performance requirements needs to be replicated also for the design. I'm not sure that we can really cleanly differentiate between those.

And then the second main point I wanted to make was also referring to some discussion that we heard yesterday about the design cycles for the equipment

capabilities here. So it was on the order of five years for the design cycle. That's five years to have the equipment available, not installed in the field, looking at another three years for deployment. So with eight years there, we're already at the very end of the -- you know, the 2030 hard date. So we're certainly confused and concerned about that, and I think that that's something that really needs to be seriously considered as the Drafting Team and NERC moves forward.

MS. JONES: Some of the things that we've done at Invenergy to kind of prepare, yes, definitely we share some of the same concerns about design with some of our equipment. But one of the things that we've done to kind of help get ahead of this is that we've already started to kind of develop, like, timelines, in specific, to the type of equipments that we have. And so we kind of map out current day, if this goes into effect, what would it look like. What would I need to do today to be ready from a design perspective, being probably proactive, and looking at equipment and who we're going to procure that from, and what does that look like? So we are really, like, starting earlier to

kind of just planning side of it to really help us to make sure that things are coordinated, and kind of almost doing a gap analysis early to just kind of see where some of those needs will be and trying to fill those in and be proactive in that regard.

Also, too, as Jamie kind of talked about early, kind of prioritizing those high-risk assets and those that we would probably need to give -- that will require the greatest need of support. Say if an OEM is no longer in business, what is our strategy or contingency to kind of come up with how do we articulate design in those cases and respond accordingly? And one of the things that we feel is just really big here is just we can't underestimate the power of kind of mapping it out almost project style. I have over 75 plants that I have to get ready for this, and by the time, you know, we have to start implementing and kind of installing equipment, I'll probably be at 85, 90 plants that I have to do this for. So just really strategizing early on a timeline and a schedule to get the different phases done.

MR. GUGEL: Yeah. I'll kind of tie this back into

the previous panel's discussion. I think it's going to depend on how the next version of PRC-029 deals with exemptions. I think the closer the exemptions and the performance expectations map to what everyone is saying that their current units can perform to, it'll be easier to demonstrate that than if it varies from it. So, you know, if there's a, an expectation by most folks that, yeah, we can meet PRC-024, maybe if that exemption is closer to that curve for existing units, it might be a little bit easier to kind of work through and demonstrate that than if all your existing units you needed to demonstrate something that's a little bit different from that, and would be different documentation that you have in place.

MR. PATEL: I don't have too much to add, but before I forget, I think we need a Ride-through standard for Jamie's laptop.

(Laughter.)

MR. PATEL: Anyhow, so I think what Howard said is absolutely right. I think it depends on how PRC-029 looks like in the next couple of weeks. But beyond that, I think credit to all three standard Drafting

Teams. I think, my personal opinion, the implementation plans were pretty synchronized. I think we can always debate is the time allowed enough or not, but I think there was great deal of effort in coordinating implementation plans of the three standards, and there is an opportunity to tweak those based on what the changes might look like.

MR. YEUNG: Yeah.

MS. CALDERON: I have a follow-up question if I may. Yeah. When it comes to the challenges with specific equipment, is there a particular type of equipment that would be perhaps more difficult to secure? And I don't know if you have this off the top of your head, but just when it comes to the installation of new monitoring equipment, is there any that are more challenging to do on the front end because, like, transformers have a long lead time. I'm just unfamiliar with the disturbance modern equipment that's being required at the plant level and the -- and the sub-plant level as well.

MR. PATEL: Right, right. So I think the PRC-028 Standard Drafting Team debated that a lot, right? It's

one thing to draw up a CT or PT distance monitoring equipment on a piece of paper, a single-line diagram. It's another thing to actually go out, get an outage, procure equipment, get the panel on which you will hook on the equipment.

So I think the 028 team did take into consideration all that, with the expectations or the directives from Order 901, right? Order 901 is very clear in terms of when those standards need to be fully enforced. But then if you remember, and some of you may have noticed that we realized that, you know, it may be challenging. I don't know how many plants we are talking about. I think when we were only writing a standard for BES IBRs, we had some idea about how many plants we were talking about. I think someone at NERC staff had pulled up some data and said about 800 to thousand BES IBR plants. But then we rolled in non BES-IBRs, and we have no clue how many of them are out there. So long story short, we have to honor the directive of the Order 901, and we have to realize that there are some practical limitations based on which, you know, equipment gets installed in the -- in the

station or at the plant.

So the framework, there is a framework in the implementation plan. If the NTT provides reasoning that beyond -- that is beyond their control, right, then there is a framework in the implementation plan of the PRC-028 standard that allows to seek exemption or seek extension -- sorry -- extension of implementation plan from the compliance enforcement authority. So anyhow, I think the PRC-028 team did as much as they could to honor the directive and realizing actual, you know, problems that might come up as industry goes installing equipment.

MR. YEUNG: Thank you, Manish. Second question, and, Panelists, if you have things to add, maybe you can elaborate with the second question because it's very related to the first one. So question is, what do you anticipate would the -- with the -- will be the most significant challenges when retrofitting or modifying the legacy IBR -- and that's kind of what Howard mentioned on the exemptions -- to comply with these new standards? And the question's kind of silent on which one of the three, it just refers to all three,

but if there is a particular one that you want to call out, I suspect there is, that's more challenging than others, that'd be helpful. So can you share any practical solutions or best practices that have proven effective? And I think we heard some things about getting started early, so thoughts on that, Panel? Go this way or start down there again?

MR. GUGEL: Yeah. No, I can start again. So I think that one of the huge challenges that we are concerned with, again, as been discussed previously, is resource availability both on the GO side, the OEM side, really across the board. Having a confusion and uncertainty on the path forward makes that extremely difficult, and I think it's going to hit every part of the industry. And then I think the second point I wanted to make here as far as challenging for retrofits, you know, I'm focusing on PRC-029 here, although I'm not sure I would want to opine on which is more difficult. But so specifically regarding the exemptions, I made a similar point yesterday about hardware- versus software-based exemptions, and again, this goes into planning. We're not sure how to

interpret this and what to do about it.

I do -- I just want to caution that I'm concerned that the focus on hardware- versus software-based limitations is missing part of the point. A lot of our concern, again, is on the modeling side, and as I understand it, models are very literally a software-based representation of the entire system, which includes hardware and it includes software. So again, just driving the point home that having exemptions only for hardware seems to be unnecessarily restrictive and makes the assumption that the software issues can be resolved much more simply, which I'm not entirely sure is true.

MS. JONES: Just to kind of add to that, I think for us kind of doing just that commercial/economic assessment now and being a part of, like, kind of our long-term forecasting is, these solutions, even if we, you know, do exercise exceptions, is going to require a financial -- increased financial investment, and that's just the reality of it. And I think what's hard is they're saying, hey, Rhonda, how much is it going to cost, and I'm saying, I don't know yet, but you want me

to buy it tomorrow. And just trying to figure out what does that number look like, but also, too, you know, the challenge is kind of having that conversation with the OEMs to kind of help us to get to a number that's a strong, strong estimate of that.

So understanding the commercial and financial impact, but also, too, being able to articulate the return on this possible investment that we're making. Hey, Rhonda, we're going to do this, and what does that mean for us as far as production? Hey, Rhonda, what does this mean for us as far as return, and kind of substantiating that is something, too, that's -- can be a little bit of a challenge in that regard because it needs data. Just like my neighbor here, I think modeling -- I'm happy that we do have an in-house modeling team to kind of help us with that. But that also, too, is going to really kind of increase the resource need there as we try to articulate our position in that regard.

Also, too, we worry about -- another big challenge is termination of services for the few OEMs that we have equipment for that are no longer in operation and

just trying to figure out what is that -- you know, what is that story that we tell from an engineering perspective to give our best understanding of what to expect of these devices. And then also, too, just the collateral impact to other standards. This is just not PRC, but there's a lot of other NERC standards that are going to have to be addressed once the standards are approved and kind of putting things in place to kind of address the -- I call it the collateral impact of these standards going forward. I think about my facility ratings, et cetera, and safety and also, too, and the analysis and impact there, which is of great concern.

But hey, yeah, those are the concerns, but how do you kind of address those? I kind of encourage folks that have never really talked to their OEMs, get to know them today. Establish a relationship with them. Really get to know about your fleet and about your equipment, about the type it is. Find those, those tech sheets, those specs. Sometimes if you all are in the business as we are of acquiring already existing projects, make that a part of your turnover package. To really, really learn these assets, you're probably

going to be more of an expert on the asset, and that expectation is to know it there. You can start having these conversations now even before the standards get approved to just knowing what you're working with. So those are some things to do to kind of offset it.

And then we are a big fan of the, you know, hardware exemptions, and I think that that's a good thing, but also, too, you can start now building that story and what does that look like in order to substantiate it. I don't think it's solely on the OEMs to do it alone, but, you know, when you're an operator, you're close to the action. You can tell the story about effectiveness and what your limits are.

Part of the strategy that I have in my shop is always about optimization. What is the optimization story? And that's something that's -- with or without PRC-029, we're always in a position to demonstrate is my equipment performing to the best of its ability and this is why. And I think an optimization story, even if it is used to substantiate an exemption, is something that is knowledge that can go a long way in helping you.

MR. YEUNG: So let me kind of follow up with you and Andy, Rhonda. As far as the implementation time frames, yes, there -- we have a lot of these. Is there any particular one of these standards where the implementation time frame really is just, you know, as proposed is more problematic, or are your concerns through both 028, 029 and 030 implementation?

MS. JONES: I would -- I would say that -- you know, also, too, if I could have a longer runway, I'll take it because like I said, I have about, you know, 70 to 80-plus projects to get ready for, and I just think I'm concerned because one of the biggest thing is just the bottleneck. And right now it's hard to predict if I went forth to my OEMs with what my needs and supports are, do they have the capacity to fit the timelines that are being proposed and those that we have internally at in Invenergy. And so that's one of the things, just trying to merge their availability and capacity with ours. And sometimes I do kind of predict that it may really be challenging to meet that, and so that's one of our biggest concerns.

On the disturbance monitoring equipment side, we

haven't gotten a lot of concerning feedback about the availability of that, but maybe a lot of people haven't started asking about it yet, so we don't really see a lot of big concerns there. But once everything starts to kind of get going and going out of the gates, we are concerned that just from just bottleneck of services is going to be a challenge.

MR. YEUNG: Supply chain issues. Andy, anything to add to that?

MR. HAKE: Yeah. So I think I agree with pretty much everything that was just said. We're a big fan of the phased-in implementation for PRC-028. I think that's very, very important. I made the point earlier during the first question that I personally believe that the design portion shouldn't be separated from the performance portion. I don't see that needing to be -- to be separate and should also be contingent on the PRC-028 information.

And then the last part I'll mention here is on the newly-revised PRC-038 implementation plan. Again, personally, I think that the link there to PRC-029 is important. I'm not sure how much we can discuss that

today, but just putting that out there that, again, I view all three standards as being somewhat sequential, and I'm not entirely understanding why that revision needs to be made after it was already approved.

MR. GUGEL: Yeah, Rhonda, if I could pull on a thread of something you mentioned earlier because it's not anything that I had considered. What are the things in PRC-028, 029, and 030 that would cause changes to your FAC-008 policy?

MS. JONES: Well, like, when we talk about some of the auxiliary equipment that, these changes that we're making, if PRC-029, the curves are approved as proposed, we think about some of the safety concerns with the equipment down the line. So that's where kind of that comes in when we're looking at the transformers and stuff like that. In certain events, in the scenarios that they showed, it's like, well, wow, I'm not only worried about the actual inverter itself, but worried about some of the other auxiliary equipment in that regard when you look at it from a scenario perspective.

MR. GUGEL: Okay. Yeah, I just -- I mean, the

time frames that you're talking about, let's assume that, you know, that the curves in PRC-029 stay the way that they are. You know, the thermal constraints for most of the auxiliary equipment you'd be talking about, especially when you're talking about transformers, CTs, PTs, breakers and switches, seconds is not going to be enough for that to heat up and cause any kind of -- I don't think, at least in my experience, wouldn't be enough to change a rating for any of those. Now, if it was extended, protracted, maybe, out for 15 to 20 minutes, which is not something we'd really be talking about here, then I could see how that could be affected. But I'm struggling a little bit trying to figure out where it would change a -- that short-term thing would change some sort of a rating for your facility that isn't already taken into account in your existing FAC-008 process. Yeah, that's something I'm

MS. JONES: (Off mic) probably spent years on, but definitely, that's something that came up about the safety of the equipment and its ability to react, and how it just can have that domino effect down the line.

MR. YEUNG: Okay. Manish, your comments, and if

you can throw in a joke, it'd be appreciated.

MR. PATEL: I'm running out of them. So I'm going to take a slightly different way to answer this. And so, you know, PRC-023 transmission, really loadability standard. PRC-025, generator relay loadability, standard. PRC 26, stable power swing standard. All those standards, when they were written, either concurrently or immediately after, there was a document produced either by the Standard Drafting Team or some other technical committee or working group at NERC that shows how to do calculations so that, you know, people know how to meet the requirements of the standard, right?

PRC-024, there is actually a document that -- out there that shows three methods to do calculation for converting voltage from high side of the main power transformer, the generator step of transformer, to synchronous machine terminals. And three years ago or so, some solar developers came to say, well, you have a document that shows calculations for synchronous machines, not for, you know, solar plants. So System Protection Working Group -- I work with them -- we put

together a white paper that shows one method that, as I mentioned earlier this morning, that hopefully will get approved by RSTC.

What I'm trying to say with all that back story is PRC-029, it's a Ride-through standard. There is no framework out there to show a sample method to evaluate your plan with and show that either it meets or does not meet the Ride-through requirements, right? So I think as we think about implementation plan, we need to think about the Joe Smith out there working on putting together documentation to show compliance. Does he have or she has tools and calculation methodologies to go along, right? As written the implementation plan, assuming that the standard gets filed, approved by FERC early next year, then within one year, so first quarter or second quarter of 2026, we are looking at fully enforced standard, right? Do we -- do we have -- have we provided tools, methodologies to the industry that can be followed and then that can be applied to this thousand BES and then, in another nine months or so, non-BES IBRs needs to be fully enforced. Can all these calculations be done in some of this?

You still need to go back to your OEMs, right, get some information that might be necessary to show compliance or seek exemptions and all that stuff. So I think -- I think we need to about some of those things when we talk about implementation plan. I don't have any comment on PRC-028 implementation plan. I'm a chair of the Standard Drafting Team, and as I said, we have done best possible. And I think PRC-030 is slightly different in nature, but I think when we think about PRC-029 implementation plan, we need to be very careful that we provide industry time and tools, right? There is not a single literature document out there that shows this is how you will evaluate Ride-through capability. Ride-through, this is first-of-a-kind regulatory standard, right? There is no tools in methodology out there, I think.

MR. YEUNG: So we should've made you chair of PRC-029, Manish. There wouldn't be a question. Jamie, anything to add?

MS. CALDERON: No, not on that question.

MR. YEUNG: Okay. So the next question is about new generators. As mentioned, we also now have a Sub-

Category 2 type of registration that's going to be under compliance for these standards as well. So since NERC is expanding their registration criteria for the GOs, how should companies approach the integration of new assets or changes in ownership to ensure seamless compliance, and what are there -- what are the key considerations to keep in mind? I think we already heard some of the things about, you know, tools, right, especially these new players, as you said, the plain Joes who have never been subjected to noncompliance.

MS. CALDERON: Well, if I may expand on that, the impetus for this question as well is we see a transfer in ownership much more with a lot of the smaller IBR than we're seeing with, like, conventional generation where whole companies come and go. It seems very quickly we have foreign-owned investors, and there's a lot of interchange between some of this ownership with IBR that we don't see traditionally. So there's an additional layer of complication to this question then, I think, is why we wanted to bring it up to the panel.

MR. HAKE: Yeah, so I'll start again. This is -- this is a fun challenge for sure. So I guess what I'll

do is just explain a little bit about how AES has kind of attacked this, at least very, very early stages, to be clear.

So we've come up with our list of potential new Category 2 sites, right, based on all the data that we have on our operating fleet, begun the effort of gathering data in the field. We believe that it's going to be a tremendous resource drain and constraint on us in order to get this information. It's not trivial. So even though, currently, we don't have a super firm understanding of what exactly are we going to have to do for these Category 2 sites, we figure we can at least get some stuff started. You know, we're going to need that data no matter which standards apply.

And then to more directly address the question about change of ownership for projects or how are we now treating these Category 2 projects, especially new ones that are coming up, and it might sound like a bit of a simple answer, but, essentially, what we're doing is treating them the same way that we do our Category 1 projects. So again, because we don't necessarily know

specifically which standards will apply, we are taking a conservative approach and assuming it's going to be most of them, if not all of them.

It does raise a lot of concerns and challenges in working with our contractors trying to figure out what is going to happen. You know, they don't like uncertainty just the same way that we don't, but that's essentially what AES Clean Energy, our approach has been thus far. And we're certainly eager and awaiting additional information so that we can, you know, continue to plan and make sure, again, touching on the resource availability point, that we have all the people in the right places in order to actually make this happen.

MS. JONES: I echo -- I echo that process very similar to how we do it in our shop. With any asset, we have about definitely 10 or 12 that'll come into -- under Category 2, and we just kind of stress test them under the most extreme scenario. Now, our hope is that the curves will come in a little bit, but nonetheless, we just try to, in our shop with our NERC readiness process, is try to understand now, well, what do we

need to do to get these facilities ready to be able to demonstrate compliance, and it's just starting early and trying to figure it out.

And we do have one or two cases where the vendor is no longer there and just trying to, on our own, be able to substantiate their effectiveness to the grid, which we think is most important, and being able to show how they continue to support grid reliability in the absence maybe of some of that information because the OEM is no longer around.

MR. GUGEL: I like what I'm hearing, I mean, and I think that's an excellent approach for folks to be taking. The other thing is that as assets change hands, hopefully there's a communication that occurs to let folks know, hey, by the way, are you registered with NERC if you're -- if you're selling an existing asset or changing it, and if not, you might want to reach out because the world's about to change. But yeah, raising that awareness, too, it would help -- it would help us and help them, I think, entirely to make sure that we've got awareness raised on those areas. You know, the fortunate thing is we don't register

assets, we register entities, so once you're in, you're in and, and you're in the know, if you will, so yeah, but the approach that y'all are taking I think is really good.

And then just a reminder that since these are, you know, non-BES assets, standards would only be applicable as they're changed or as, you know, definitions kind of change in that area. So it's going to be a process of standards development as each one of -- each standard is modified to see whether or not these non-BES assets are included or not.

MR. PATEL: So I don't have much to add to what Howard said. When I read this question, the raw thought that came to mind is, you know, when you sell your home, you have to -- you have to sign this disclaimer about the status of the home, what's in it. If something's broken, you have to declare it and all that stuff. I think -- I think there might be a checklist out there that someone can put together that one owner gives to another owner, then the ownership changes, and, you know, let the new owner become aware of what they're getting into. I don't have much to add

here. I think it's an administrative process, but all those entities who play in this non-BES assets world need to catch up to the reality that NERC standards would apply to those assets now.

MR. YEUNG: -- communication for the new owners, and, of course, NERC has already a plan for registering these new owners, too.

The next question is a little bit maybe kind of -- kind of going back to some of the things that already been said, so I'm going to revise it a little bit. The question is, how does supply chain issues impact the timely implementation of these new standards, particularly in terms of retrofitting existing or new installs, and what proactive measures can be taken to mitigate these potential risks?

And I think we are over these past couple of days, we've heard a lot about the PRC-029 impacts of these -- implementation and how the supply chain might impact that. So maybe kind of talk more about maybe the other two standards, 028 and 030, and, Manish, I think you already opined on that a little bit, particularly, again, this is about a lot of new Category 2 assets

that probably don't have any type of this equipment presently.

MR. PATEL: That is true for PRC-028. It is very likely that non-BES IBRs do not have all necessary equipment. They may have some that can do some recording as required by the standard, but not all recordings that the standard requires. This will require them to -- actually, if they don't have their own engineering staff, first of all, go and find an engineering consultant who can help them, right, design the DME equipment, and then go and find folks who can actually go into the substation and install it, right? So it's going to be quite a bit of work.

In some cases they will have to talk to IBR unit OEMs because the standard requires SCR data from the inverters or the wind turbine generators. So they will have to go and talk to the OEMs about the capabilities of that particular, you know, vintage of equipment that they have in their asset. So there is quite a bit of work required, and I think that's why, as I said earlier, the Standard Drafting Team, you know, respecting the directive of the Order 901 in terms of

when the standard needs to be fully enforced, still went ahead and offered a framework to seek extension, right, because again, I can draw up DME equipment right here on my notepad in matter of five minutes. It's another thing to actually go and get it installed in the substation.

MR. YEUNG: Howard, any thoughts?

MR. GUGEL: Yeah. I don't really have anything to add. I'm not sure that, from our perspective, we really understand the supply chain issue there. I do think that, as it's mentioned before, you know, volume is going to play in -- come into play here, and the fact that you've got, you know, a significant number of folks that are having to procure new equipment may bring that into play and may cause a supply chain issue.

I could be totally wet on this and some folks may be able to straighten me out on this later, but I think one advantage that these units have over maybe the traditional synchronous units are that they're already sampling a lot of information. They're already bringing a lot of data in to do all the monitoring

that's necessary internally. So it may be, you know, the fact that they don't have to install some additional inputs might be an advantage, but you're still going to have to have that external logging equipment there that would be able to pull that information in. So while one part of it may be a little bit easier, there's still a lot of stuff that has to occur and would be impacted by supply chain.

MS. JONES: Nothing new to add with supply chain. I think we've kind of talked about it with just the volume and not knowing that, and just hope that we're at the front of the line is what I strive for when we start to request this equipment. But nonetheless, you know, I think the other thing that we kind of think about with supply chain is not just equipment. But one of the things that kind of came up in our analysis is the ability for this equipment to record all this data and what does that mean for additional kind of capacity, and should we be looking at that as far as something else to kind of consider as far as managing and storing that data is something also, too, came up in some of our conversations.

MR. HAKE: Yeah, I don't have too much more to add on this one. I think that -- you know, I'll mention again that in some cases, OEMs are out of business, so, effectively, the supply chain does not exist. We're early enough in the process that we haven't encountered any specific supply chain issues with particular equipment. But, you know, we, of course, share similar concerns that there's a whole lot of companies out there that are going to be requesting the same thing, at the same time, on the same timeline. And that's very concerning, right, again, from equipment and, again, from a resource availability standpoint

I think one thing that I learned yesterday that I perhaps didn't appreciate previously is that this equipment is wildly complicated, hearing from the OEMs about how, you know, even just a single turbine is a system of systems with auxiliary equipment. It's a lot of stuff that, again, everybody is going to be requesting to upgrade and have updated at the same time on a short timeline.

MR. GUGEL: I could add just one thing because it just came to mind, too. I'm going to take an

opportunity here to put in a little bit of a plug. I think if you're not already a member of some sort of a trade organization, it would really be helpful in that -- in that aspect. So there's power in community, and so it would be good to join up with some other trade organization, get some of the collective thoughts that are there, and work together towards some of those solutions because sometimes working by yourself, you might come up with something, but as a community, if you come up with a solution, there's kind of the power that could occur there. And yeah, Mark's reminded me, you know, we've also got the Generator Forum that would be an excellent source for you also there. But, you know, between the forums and the trade organizations, I think there's a wealth of information that can be tapped there as you get involved in those things. So just -- it was kind of my opportunity to kind of say look for those also.

MS. CALDERON: So we've talked a bit about installation of equipment, supply chain issues, testing, and all of that. PRC-030 also has that piece about root cause analysis and being able to diagnose

the fault recorder data to be able to diagnose root cause. And that's an entirely different form of analysis that needs to be proactively addressed as well. I would suggest making sure that you've got either onsite engineer or contractors, like, set up or consultants set up to be able to do that type of analysis because there will be a time limit once it's being triggered and that request for the analysis is being triggered, and it's a very specialized skillset. So that's something else to keep in mind.

MS. JONES: And that's a good point that you bring up, Jamie, because part of our -- in our planning efforts is kind of being able to design and how do we maximize the filtering of that data to help us quickly support a root cause analysis. And to be just transparent, you know, we've kind of recommended we need to build a program just around root cause evaluation. It's its own program in and of itself. It's not just this casual task of someone just flips through the paper and says what's happened, but you actually have to tell the story and substantiate it, and then talk through remediation and mitigation if

that's the case.

And so in our shop, we've talked about the need to maybe carve out, for PRC-030, its own program. We work a lot with our data analytics team, we work a lot with our engineering team and our compliance professionals to kind of bring that together, but we look at the volume and the number of faults that's happened. Also, too, you have to think about your workforce and the FTEs that are going to be needed to kind of support that, also.

MR. HAKE: Yeah, that's a really good point there, and I would like to add, also, that the way that we're currently interpreting PRC-029, in some of the measures, it talks about retention of actual performance data to demonstrate compliance with these performance requirements. So, in effect, we are going to have to do a similar type of effort every single time an inverter trips offline. I know there was discussion earlier about the Ride-through definition, and we're optimistic that that can be clarified to try and mitigate some of those concerns. But I think similar to your point on PRC-030, there's also going to

be a substantial amount of expertise and resources and effort involved with that, right? Every time something trips, we have to evaluate it versus the Ride-through requirements.

MR. GUGEL: Yeah. The only thing I would add is I think if you've already got a team looking at PRC-024 and any mis-operations, they're already kind of involved in that RCA thought. And if you can draw on them to maybe provide some information or some help to look into your inverter trips, that would be really good, too.

MR. HAKE: Yeah, I think that's a really good point, Howard. The one distinction I would draw is, currently, we're looking at a significantly larger volume than we would for PRC-024, so PRC-024 mis-operations. Again, not speaking just for AES, just personally, they don't happen very often, so it's much easier to deal with.

MR. GUGEL: Yeah. You just need to clone them, right?

(Laughter.)

MR. HAKE: Exactly. Problem solved.

MR. YEUNG: We have one more question for this panel. I'm just going to dig a little bit deeper into some of the things we've mentioned earlier about testing and verification to whether or not you meet these requirements, particularly 029 requirements. So what are some of the most challenging aspects of testing and verification in the context of these new standards -- 028, 029, or 030 -- probably you're going to be talking about 029 -- and especially in the case that you're going to have this mix, right, of existing, new retrofitted, it's going to be a changing landscape in your fleet. So what's going to be some of those challenges to testing and verification, and how do you ensure that testing protocols are robust now to meet these requirements and avoid, as little as possible, delays?

MR. HAKE: So I'm not sure I have the answer for that one. The first thing that comes to mind, though, are the -- some of the challenges we've talked about in modeling, right? So when we -- when we talk about verifying performance on the design side, the model has to come first. And, you know, as discussed at length

here the last couple of days, getting all of that information is a major challenge, particularly for legacy products. But even moving forward, again, going back to the design cycle comment, in the short to medium, even long term, we're going to have a similar challenge. And if we don't have the model in order to run the tests, we can't demonstrate performance requirements or compliance with them.

MS. JONES: Just add to that, you know, definitely trying to nail down the modeling is going to be a -- you know, a work in process. But one of the things that came up in our shop was, is there just like this consensus testing standard that exists on how testing should be performed? And if that kind of a standard was to be developed, who is best to develop it that we can have a shared approach at how we do testing, if not just defining testing.

If I was a regulator and everybody had to define their own testing, it could really get kind of squirrely there. But we don't have the answer to it, but that's one of the questions that we're -- that we've been talking about internally, what is that

consistent standard of testing that we can adopt and apply across the board and across equipment type? And that's something that we are still looking to kind of learn more of, and we think that would help to simplify things versus developing our own, this other entity develops their own, and it's just everybody has their own way of testing it, and do we -- are we achieving the same objectives? But that's one of our recommendations is to get that kind of consistent standard of testing.

MR. GUGEL: Yeah, I would agree. I think that's a -- that's an area to concentrate on. The synchronous machines all struggled through that when we first went through the MOD standards to try to figure out how to do their real and reactive power output verifications and their model verifications. And I think that these -- that the inverter-based resources have such an additional complexity to their operation, that it is going to take some specialized folks to set up those testing procedures. I agree.

MR. PATEL: So this is also kind of only a question for really PRC-029 disturbance monitoring

equipment. We have been installing for a long time. We know how to commission tests. PRC-030 is kind of unique, very specific criteria in R1. I think we can come up with process, you know, to honor that.

So then PRC-029, we are not going to apply a 230 kV fault for 160 millisecond to test plant is able to Ride-through or not, right? So this begins from lab testing, solar inverter, or container testing wind turbine generator. I don't even know what to think about HVDC terminals. They're a thousand megawatt in capacity. But there has to be some sort of guidance out there that says these are some of the tests that you need to run on your IBR units, right -- the solar inverters, the wind turbine generators, the HVDC converters. Somehow convert those tests into models and then use the models at the plant level, and then a simulation engineer like me can apply 230 kV fault all day every day of whatever time duration, right?

But this is what I meant earlier that -- we wrote the standard. It will get done in one form or another here in next couple of months, and then how to show compliance with the standard, it's a big task. It

begins with lab testing of equipment and then, you know, some sort of model-based verifications. And there is a -- there is a need to develop framework for all this work. Some of that, I know we're all tired of listening "IEEE," but some of that work is being carried out in IEEE 2800.2 Working Group. It takes time to develop some of those things.

We have been talking with some OEMs, you know. Testing for MVA battery energy storage inverter is very different than testing a 12-megawatt wind turbine generator in a container which is actually connected to the system, right? There are many different ways of testing. Now, I'm talking about things that I don't understand well, but, you know, a lot of things go on what can be tested, what cannot be tested, and then somehow bring it all into a simulation world and show that the plant was designed. If I was a GO, I want to have a confidence before we go commercial operation that the plant will Ride-through, right? All system disturbances, right? So I think there is a lot of work remains in putting together a framework for test and verification of Ride-through standard.

MR. YEUNG: Okay. Well, thank you. Go ahead.

MR. GUGEL: If only there was a research institute for the electric power area, there might be a way for this to happen.

(Laughter.)

MR. GUGEL: That was my attempt at humor, by the way.

MR. YEUNG: -- some questions. We're going to start in the room for this panel. Any questions? Scott?

MR. KARPIEL: Scott Karpiel of SMA America. Just curious to understand, considering some of the hurdles and issues, concerns with supply chain costs, transfer of ownership -- let's see -- the costing of upgrades, testing, modeling, you know, it all kind of stacks up. At some point, there's diminishing returns on that investment. Curious to understand if there's a possibility that a plant or an asset would be decommissioned, and, if so, how would that affect transmission in planning?

MR. GUGEL: I'm not sure I understand the question. Can you elaborate just a little bit more on

that?

MR. KARPIEL: Sure. So if I'm an owner, which I'm not, right, there's a financial commitment. There's a return on the investment that I'm going to have to make to bring this asset up to current code and standard. If I were to deem that it wasn't worth my investment to do that and I decided to shut the plant down, decommission the plant, curious to understand how that would affect the network from a planning standpoint, from an operational standpoint. You know, I think there's a real possibility, especially for some of the smaller asset owners, that they may decide to just throw their hands up and close down the plant or decommission the plant.

MR. GUGEL: Yeah, that goes back to something we had mentioned earlier that definitely do not want that perverse incentive there. You know, the last thing we need is a retirement of additional capacity that's out there, but we do need the capacity that's there to act reliably. So, you know, the reliability coordinators will be the ones that will be looking at this, in my opinion, and if there's a decision made to retire, they

would be able to look at that and see what the overall reaction to the system would be on that. But again, you know, that's going to be a decision that's based on the owner of that asset and then, you know, the reliability coordinator, looking at all the reliability for the area. Just my thoughts on that.

MS. CALDERON: I would -- I would add that there's substantial precedent for this type of business decision just when retrofitting units, like carbon capture, that was putting baghouses on coal units. There's a whole lot of history with having to do some form of retrofitting or upgrades. That's just part of the business of having generation.

MR. HAKE: Yeah. So I guess what I would add here is, putting my personal opinion hat on, I don't know that AES Clean Energy, we have not gone through a detailed analysis to say X number of our plants will be decommissioned. What I would say, though, is I think it's a very valid and real concern, especially for plants that are older, right? The older the plant, potentially the less ROI we're getting, the more we have to spend on, it begins to not make sense very

quickly. So I -- so I appreciate the question. I think it's a -- it's a really good point to make.

MS. JONES: This is Rhonda's, not Invenergy's. I feel that the -- there's still a very strong argument that the IBRs, even the ones that are, you know, quite seasoned, still have an effective role in grid stability, even not being upgraded to the latest and greatest, that they still play a role. And it would be an interesting argument to hear that them being prematurely decommissioned is better for the grid than them staying on and still helping grid reliability, and I just -- I don't really -- I don't -- I don't really see that case.

Definitely the goal is to optimize performance. Definitely that's an ever-changing responsibility based on grid conditions and dynamics, and you should be in a position to optimize performance and how we're kind of defining that now. But I do still feel there is a stronger case, personally, for proving with data that the role that they serve now on the grid is still very helpful overall to reliability versus not being on it. And with some of the queue positions getting backed up

and things taking longer to come online, you can't even say, oh yeah, you're out of here, we have somebody ready to replace you right away. The timing doesn't happen exactly like that. So I appreciate the question.

MR. HAKE: And I would agree with, I think, your premise at a high level. The one thing that I'd leaned back onto a comment that I made earlier is, if the grid operators don't understand how that unit is going to react and actually, you know, how during disturbances or during extreme situations on the system what they can expect to be on or off, there may be negative reliability impacts in those areas as opposed to the steady state issue. So that -- all of that needs to be taken into account. And if an entity chooses to not want to look into that issue, I'm not sure that that's a benefit to reliability for them to hang on just for the sake of hanging on, but I do think that somebody does need to analyze that information.

MR. HAKE: Yeah, I agree, and if I could just offer one mitigating factor. I think that, at least for existing BES units, they would already comply with

PRC-020. So we're not talking about units that are totally off the wall doing crazy things, right?

MS. JONES: Right.

MR. MAJUMDER: Rajat from GE Vernova. So, Howard, question to you. What's the basis of that you were saying that it's not being done, that somebody's not looking into it, when you say the grid operator needs to know what the unit are going to be doing? I mean, isn't it something we are doing already? So why is it being raised as a matter of concern? There are always going to be outlier where the models did not keep up to the actual equipment behavior. And I did not made the statement when we were working in Appendix G of 2800, so I'm bringing it up again. And there has been some statement made that, oh, well, the models are not good. It's not true. Yes, there has been some exception, but rest of the thing, we are all going through Mod 26 and 27, not every other 26 and 27 shows models are matched.

MR. GUGEL: Yeah.

MR. MAJUMDER: So I'm just trying to sense your concern that when you say that it's a reliability risk, flagging that grid operator does not know how these

equipments are going to behave.

MR. GUGEL: So I would point to all of the reports that we have on our system. If you look at each of the events that we've analyzed, we pointed back to grid components that reacted in ways that both the reliability coordinator, the transmission operator, and, in many instances, the generator owner/operator did not expect that to happen. After a root cause analysis was done into that, it was found out that there were maybe some additional controls that were installed on the plant that nobody was aware of, or that the generator owner might've been aware of it, but that information had not been translated to the transmission operator or to the reliability coordinator.

So if you -- if you look through all of -- that's why I'm saying that our experience has been, over the last seven to eight years, that disturbances that are occurring on the grid are happening, and the reliability coordinator and the transmission operator is seeing things happen that they're not expecting. And it's because these units, each time they come up,

they're behaving in a little bit of a different way than they have in the past. So we'll fix -- what's happening is we'll fix one problem, you know, let's, let's take Blue Cut Fire. We had an issue with three phase fault, bunch of units tripped out, found out that that was an issue with sampling on frequency, got that fixed. A year later, had a bunch of other units trip out on a single line-to-ground fault for a different control system that was in the same plant.

Until we do a deep dive and try to figure out what those scenarios are, we're going to continue to see grid perturbations that occur that are reliability concerns that are small at this point, but when we get to a 50-percent penetration, they're not going to be small anymore, is my concern.

MR. MAJUMDER: Yeah.

MR. GUGEL: So that's why I'm raising --

MR. MAJUMDER: I fully agree with that, and that's what I'm saying, that things has happened and even there were repeat offender. I know that. I mean, Odessa even not specifying anything when ERCOT went ahead, and, you know, published the report, there were

plans/manufacturer who made a commitment to fix it, and the second one came up and it was saying that it's there. So I fully understand.

But at the same time, let's not -- I'm just trying to say that let's not think -- that thing has also happened with synchronous machine. There are so many synchronous machine out in the -- in the field, but the excitation system model, if you look at it, there's still rotation, you know, the slow rotary excitation system. In real field, it's completely different. So the issue is not only in IBR, so let's not think that how it's going to be -- I'm not at all undermining the necessity that you are establishing. I fully agree with that, but I'm just trying to say that please let us not flag IBR fleets specifically for this issue. This issue exists.

MR. GUGEL: So my qualification was just the specific question that you asked me: Why, Howard, are you calling out and saying that grid operators don't know what's going on, and so that's why I was pointing to the reports there. Do we see issues happening with synchronous generators? Yes. Have we modified

generation standards over the years to basically react to that? Yes. But from a synchronous generator standpoint, a lot of the technology that's behind that and the basis behind it is something that's been around for 50, 60 years. We've had the ability to kind of go through that, understand the issues, and basically know how that reacts on the grid.

We're now introducing some new components at a fascinating, incredibly fast rate of equipment that has some great reliability benefits. It has a potential for that, but also has a potential to give us some unknowns and put us in unknown operating states.

MR. YEUNG: So, Howard --

MR. GUGEL: We need to be in front of that as opposed to --

MR. YEUNG: Howard, I'm going to interrupt a little bit. I think those are probably basis of the order, you know, so we need to move forward, and, you know, implement the order, so absolutely important arguments, but any more questions about implementation?

MS. CASUSCELLI: We have one online. Is there an effort underway for the design compliance and further

performance compliance for PRC-029?

MS. CALDERON: Could you say that again?

MS. CASUSCELLI: I can repeat it. Mentioned in the panel was a technical document. Is there a way -- is there any effort underway for the design compliance and for the performance compliance for PRC-029?

MR. PATEL: Yeah. So I think -- I think that's where I mentioned IEEE 2800.2, where we are trying to put the framework where, you know, the equipment actually gets tested, right? IBR units, individual inverters, the wind turbine generators, we understand their capability. We build the plant model, and then we run the simulations on plant model to verify that the plan will be able to Ride-through what the standard requires. There is no effort at the NERC level.

I think that was my point when I gave all the examples of different PRC standards, right? There is a companion NERC document that shows how to do calculations for 023, 025, 026, et cetera, standards, and I think there is equal need. I'm not advocating here for a companion NERC document to PRC-029, but maybe IEEE 2800.2 can serve that role where, you know,

you pick up the framework, put together in that document in compliance with, I'm going to start calling 2900. Maybe it will become true.

(Laughter.)

MS. CALDERON: Well, and to add in on that as well, there's ongoing work within the IRPS and within the RSTC work tackling those types of engineering questions. They've had power plant model validation guidelines put out. There's ongoing discussions within those groups, and it seems like an opportune place to bring those up. When it comes to performance, it's really just did it or did it not meet the criteria based off of the measured data. So there'll be a pretty big distinction between those two and how you approach compliance with those.

MR. YEUNG: Any more questions? Any more questions on the internet or Slido? Todd, do you have a question or do you have a comment?

MR. BENNETT: I don't think I have a question or necessarily a comment. I wasn't seeing it either in the room, and, Amy, are we wrapped up online?

(Nonaudible response.)

MR. BENNETT: Okay. So with that, thank you to our panel. Very in-depth discussion here. Many thanks to you. So anyway, how about a round of applause? That's our last panel of this Technical Committee.

(Applause.)

MR. BENNETT: And why don't we get back together here in 15 minutes, and we will review some Slido polls and have some additional polls on PRC-2900.

(Break.)

MR. BENNETT: Okay. So it looks like we're getting ready to start back up here for our last session of the Technical Conference today. I think this should go fairly quickly, but we have three questions to poll to all the participants through Slido, so if you need to, go ahead and join back in on there. I don't know if we can put the QR code back up here real quick just in case anybody needs to join. I'm not sure, but I believe -- yes, Amy's going to have three questions here, and here's the results of our -- of our previous one. Oh, this is actually new, so, okay. So yeah.

MS. CASUSCELLI: Yeah, Todd, that's the new one.

Sorry.

MR. BENNETT: So there's three questions here, and I'm going to hand it over to Amy to kind of lead us through this for the next few minutes.

MS. CASUSCELLI: All right. Yeah, thanks Todd. So as Todd mentioned earlier, you know, we have a series of questions. I believe there's three of them, and, you know, this is not a formal voting mechanism. This is just meant to inform the Standards Committee members' decisions in the next couple of days here on the path forward for all of the things that we've been talking about for the last day and a half.

So for this initial question here, based on the conversation you heard today, and I want to make sure that we differentiate here. This question is related to legacy assets. So what should the PRC-029 voltage and frequency criteria follow that assures reliability assets? So just note that that is for legacy assets. So I'm going to not narrate the entire -- the entire moment here and just let us sit in silence as you all consider and cast your votes.

(Slido voting.)

MS. CASUSCELLI: All right. So I think that we've pretty well slowed down with our votes cast, so looks like we've got an overwhelming response for that question. Thanks for -- everybody, for your input. I think we can move on to the next question.

All right. So this question is the -- identical, with the exception of this is for assets being brought online in the future. So only two options for this one, and this is future assets.

(Slido voting.)

MS. CASUSCELLI: Oh, okay. So I think the -- for those of you who are looking on the screen here in the room, the bottom option is cut off, but it says, "adopt voltage and frequency bands proposed in IEEE 2800."

(Continued Slido voting.)

MS. CASUSCELLI: All right. So it looks like we have a -- an overwhelming opinion on that one as well. So with that, I think we can -- we're ready to move on to our next question, and this one is related to the implementation plans.

UNIDENTIFIED SPEAKER: Amy, I don't think we have a presentation for this. Are we putting the question

in front of it?

MS. CASUSCELLI: Okay. Hold on.

(Brief pause.)

MS. CASUSCELLI: All right. It's coming. I see it in Slido. There we go. All right. So regarding the implementation for these new standards, in 25 words or less, what should NERC provide more information on to assist industry in preparation? I don't think there's any penalty for going over 25 words, but --

(Off mic comment.)

MS. CASUSCELLI: Oh, really? Oh, it does cap. Okay. Okay.

(Slido voting.)

MS. CALDERON: All right. Just a quick point of clarity that, of course, that is 25 characters or less. What we're going to do here is when this closes, we're going to close it and reopen it with that image removed, just so it's easier to see for -- at least for the folks in the room.

(Continued Slido voting.)

MS. CASUSCELLI: All right. I think we've seen a slowdown in responses, so I think we're ready to close

it. And if you could, yeah, Jamie, like you said, display the image, I think that would be helpful for folks.

(Brief pause.)

MR. BENNETT: Okay. So while we wait on the results to be posted up here on the screen for everyone to see, at least something that jumped out at me on this was the term "compliance guidance." So it was larger in the middle. That that means it got mentioned a bit more than some of the other items. So, you know, one thing that I am glad about on compliance guidance is there's not only one path. So there's multiple organizations that have been approved to put documents like that together and can be endorsed by NERC. So o it's -- I don't think that's a deviation from the past, so I think there's some real promise there. Another word that I saw that wasn't quite as big as "compliance guidance," but it makes me think of certainty, but it was "implementation timing," you know, what to expect.

So with that, maybe I can kind of segue into the next part of what to expect after this technical conference concludes. So after we wrap up today, we'll

take the feedback from these polls from the -- from the conversations over the last couple days, and the NERC Standards Committee, in conjunction with members from NERC as well as some of the Drafting Team members that are available, we'll get together and start redlining the standard based on what we've learned. So there's not an infinite time to do that. It's pretty compressed. So I would expect, you know, that to probably conclude by the end of next week, you know. So it's going to be a busy next six or seven days for a group of people, but at that time, I believe that we'll be able to have a revised standard that captures maybe a slightly different path forward. But then also part of that is an implementation plan that is with that, and I believe that will help with the certainty.

You know, both of these documents, I can't for foretell what will be on them at this current point in time. But they will be out there and I believe that the implementation plan will help with that, what to expect, and, based on certain scenarios, what companies should try to plan on, given that the standard's approved. If it's not approved, that's a whole

different -- that's a different story. That's not our conversation for today. So anyway, I think that that might help with what to approve and implementation guidance. Based on the conversations that I've heard today, and some of the -- you know, the history with the multiple ballots going out to industry and struggling to find consensus, this does seem like an ideal candidate for some type of implementation guidance.

So with this in front of us here, these are the most popular feedback words from today. So there's "compliance guidance" in this poll, "timelines," "we've anticipated timeline," "priorities." So there's a lot of things that we've already touched on, but then I see several words up there that we need to consider over the next week. So with that, I don't have anything else to add, but are there any other questions in here about the path forward and what to expect over the next few weeks?

Maybe something I can -- that I didn't touch on is, I believe the draft standard as well as the implementation plan posting to industry, we don't have

a specific date yet, but be on the lookout for mid-September, so somewhere in there. We still have some processes to make it through for quality review and drafting. After that, it also has not been agreed upon the amount of time for comment and ballot. However, we do have to have it concluded by the 30th, so the end of the month. So one thing that I'm trying to commit to is to give industry as much time as we possibly can but still get the best product that we can with the limited time that we have. So with that, any parting questions on this?

MS. JONES: (Off mic question.)

MR. BENNETT: So the question is balloting will happen this month. So that's what I'm -- that's what I'm hearing. This will be posted for ballot in mid-September, and then the timeline has not been released, whether that will be five days, seven days, 10 days, but, you know, somewhere kind of in there, but we have to have it concluded by the 30th.

MS. JONES: (Off mic question.)

MR. BENNETT: So the question is about comments previously provided. So the previous ballot is what

you're referring?

MS. JONES: (Off mic comment.)

MR. BENNETT: Oh, for this conference.

(Off mic comments.)

MS. JONES: So for the comments that were provided or testimonies to support this Technical Conference, if the team that's working on drafting the new ballot decide to use some of that or borrow from it, if they borrow it, will there be citations related to who they borrowed it from?

MR. BENNETT: So on that, and my NERC friends here, correct me if I'm wrong, I have not heard any response to responding to the comments that were provided to support this Technical Conference. The comments and testimony that was provided to help with this Technical Conference was for learning, for the building of a -- an official record of what happened with this for, you know, a potential future filing with FERC, but then also to provide some metrics and inform and to help us develop the agenda for today as well as some of the follow-up questions for the agenda today. So that's what that comment -- that's what those formal

comments were used for at this point.

MS. JONES: Okay. So they won't be probably used with the Drafting Team. I thought they would possibly be.

MS. CALDERON: Yeah. So the next steps is with the Standards Committee. We actually do have the Drafting Team and NERC staff to make revisions to the standard, working together, putting together the official memo. All of it's going to be used for the record of development as well for the filings, so decisions made that were based off of information that was provided. We got a lot of substantial information from the OEM, will be used to substantiate decisions made in the filing with FERC.

MS. JONES: Thank you.

MR. BENNETT: Okay. Thank you, Jamie. I'm looking around the room. I don't see any final questions here. Okay. With that -- oops, sorry. We have one more.

MR. CONWAY: Yeah, Kevin Conway, Western Power Pool. More of a comment about this forum. We've talked, I think, in the hallway quite a bit about it.

It would be nice if through our standards process we engage in this type of process earlier, right? Too many times, just like in this case here, we're already down the road so far. There's no course corrections of any major impact that we can make, but our -- with the intent of trying to accelerate the development of these standards based on Board direction or FERC direction, these are helpful and these move the Drafting Team faster, farther, and more effectively down the road.

MS. CALDERON: -- going to speak on your behalf, Soo Jin, on just everything you've been doing for getting more of these, so I'll let you go ahead.

MS. KIM: Probably to Levetra and Tiffany and Kelsey's chagrin, I do think we're going to have a lot more technical conferences, not just for the next couple of milestones, but as you all know, there are several other projects on the horizon. We have an extreme hot and cold weather temperature project that is another directive that is due in December. There's a webinar next Tuesday, so I'm going to put a little plug in for that for all of the utility stakeholders who are participating in that. I think the team has

made some tremendous progress. I think they would like to present that. They're going to borrow some of the tools from today that was very effective, and so they're going to try to solicit a lot of technical input next Tuesday for extreme hot, cold -- hot and cold temperatures. I do believe for the next directives after that, as many of you know, we have some directives with regards to extreme cold weather. That one is also probably going to require some type of technical input.

We will have more of these events. We did commit to doing that. I cannot promise that every project will have that. But for some of the major projects that we see on the horizon, high-priority projects, things that require a lot of coordination where there's major gaps in information that the team just did not have at its fingertips, I do think that these events are much more fruitful than I think many people imagine when we first started down this path.

So thank you again for your participation. I will commit that the Department is going to not just look at this just from the standards perspective, but also on

the engineering side. We have talked about doing more technical conferences generally, even before we get to some of the standards development steps.

MR. BENNETT: Okay. Thank you Soo Jin. And I just wanted to say, I'm going to have -- I'm going to ask Sue to say a few words here at the end, but I just wanted to mention to everybody that, you know, this was kind of a first of its kind, so thanks for bearing with this as we made it through this. We did learn that some things worked really well, some probably could've worked a little better, but it sounds like there'll be more of this, and this was a learning event for everybody, so thank you. And Sue, do you have any parting words?

MS. KELLY: I do. I have been designated to give the benediction.

(Laughter.)

MS. KELLY: So on behalf of the Board, I want to thank everyone who participated in this technical conference, both in person and online. It has been a content rich experience, especially for, you know, a laywoman like me, and I think I've learned a lot. I

also know a lot more about what I don't know which is, I guess, also good. I think we all have a better idea of some of the pressure points and the fault lines regarding the current draft of this standard, and I think we have some ideas about how we might be able to address those, which is great.

I want to thank NERC staff and the Standards Committee, not only for what you've already done, but the mission which you are about to undertake, effort you're going to have to undertake to prepare the next draft of this standard for ballot in an extremely accelerated time frame as Todd just reviewed with you. As Soo Jin noted this morning, we're operating under tight time frames that were set both by FERC and by Rule 321 if you care to go review that. We have to finish the balloting by September 30th, so everyone involved is going to need to put their shoulder to the wheel to make sure this happens.

And we do need to get it done. I would note that FERC has instructed us to get it done by a date certain, and the Board intends -- we're going to do that, but the need to finish this effort goes well

beyond the administrative imperatives that we face. NERC produced its first reliability guideline on these issues back in 2018. I was reviewing that this morning. This drafting project commenced in 2020. As Howard pointed out this morning, we already have hours in some regions where energy from embroider-based resources are producing virtually all the energy on the grid. And the projections are that by the end of the decade, it could be 50 percent of our capacity might be IBR based. If the lead time estimates for the needed software and hardware changes that we heard about from the OEMs yesterday are indeed accurate, then we need to move swiftly now to establish new standards that will ensure reliability going forward as we have many more of these devices on our grid.

So again, thank you for your time and attention so far, and thank you for the additional work that you are going to undertake to bring us to the finish line by September 30th, and may you all have safe travel home. Thank you.

(Applause.)

MR. BENNETT: Okay. So with that, I believe that

we are adjourned for the day, so thanks again for everyone's participation. Safe travels, and more to come.

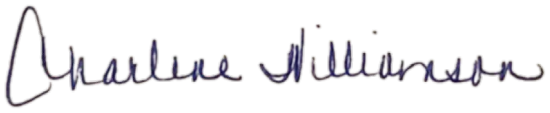
(Whereupon, at 3:23 p.m., the Technical Conference was concluded.)

CERTIFICATE OF TRANSCRIBER

I, Charlene Williamson, do hereby certify that, to the best of my knowledge and belief, the attached transcript is a true and accurate transcription of the indicated audio recording.

I further certify that I am neither attorney nor counsel for nor related nor employed by any of the parties to the action; further, that I am not a relative or employee of any attorney or counsel employed by the parties hereto or financially interested in this action.

9/9/2024
DATE



Charlene Williamson
TRANSCRIBER

< **Z** >