



## Transcript of **Technical Conference Day 2**

Thursday, September 5, 2024

*Conference for North American Electric Reliability Corporation*

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NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION  
(NERC)

Standards Committee and NERC Ride-through  
Technical Conference

Thursday, September 5, 2024

9:01 a.m.

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

6

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.

12

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?

20

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

22

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

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

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

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

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

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

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

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

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

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

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

1 (Applause.)

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

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

11 (Pause.)

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

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

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

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

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



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

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

22 But I think software impacts are reasonable to

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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



1 hasn't been quantified yet. Does frequency Ride-  
2 through capability, ROCOF, everything, all these  
3 technical issues that have been discussed, do they need  
4 to be considered, especially moving forward?

5 Absolutely. I don't think anyone in this room saying  
6 that that's not the case. But right now, where we sit  
7 today, if the standard was to pass as written, we don't  
8 actually know what the reliability impacts of the bulk  
9 power system would be, and there's a chance that it  
10 could be a net negative. And I think that's something,  
11 when you're looking at a reliability standard, you have  
12 to take very heavy into account.

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

22 MR. GUGEL: So Howard Gugel, vice president of

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

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

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

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

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

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

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

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

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

14 Also, I'd like to add one more dimension based on  
15 a lot of the discussion we said yesterday. This  
16 question is asking about meeting PRC-029 criteria, but  
17 if you can also add whether that changes, whether it's  
18 2800-2022 criteria instead of the PRC-029 criteria. So  
19 you want to go this way?

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

22 MR. ROGERS: Yeah. Again, the technical aspects

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

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

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

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

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

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

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

22 So that whole process can take on the order of

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

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

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

22 MR. SHATTUCK: Yep. Mm-hmm.



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

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

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

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

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

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

1 much better placed to understand the system.

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

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

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

5 MR. SHATTUCK: (Off mic comment.)

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

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

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

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

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

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

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

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

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

13 Our reliability coordinators and our transmission  
14 operators need to understand predictably how units are  
15 going to occur on the system and how they'd be able to  
16 do in an emergency operation system. If they don't  
17 have that, and if what we're saying here is that we  
18 really don't understand, in general, how that's going  
19 to happen, I am concerned that they're going to be  
20 flying blind. So part of what we're doing with PRC-  
21 028, 029, and 030 is providing that predictability for  
22 them to be able to understand, at a minimum, for units

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

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

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



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

7 So that's what I was saying is, looking at this  
8 deterministically and a bit stochastically with  
9 integrated system planning saying, what do we expect  
10 when we see penetrations of renewables going out to  
11 2030, 2040, and understanding what those frequency  
12 deviations really will look like, and then what is the  
13 resource mix that needs to respond to that and be  
14 resilient against that. And that's all I'm saying is  
15 use a forward-looking view with integrated system  
16 planning to help plan out those scenarios.

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

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

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

16 (Laughter.)

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

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

6 MR. AHLSTROM: Sure. Well, yes, there are  
7 hardware impacts, and I've got the numbers here. So  
8 with the PRC-029 as drafted for the wind fleet that I'm  
9 looking at here, you know, we'll have to do a similar  
10 analysis on solar storage, but it's not quite as  
11 substantial there. We estimate that 6 gigawatts out of  
12 the 27 gigawatts would require an exemption for  
13 frequency Ride-through due to hardware limitations.  
14 That involves 9,000 turbines, all four of our window  
15 OEMs, and all 10-plus of our converters, so it's quite  
16 substantial. It's much significantly improved by  
17 moving to the IEEE 2800 curves. That would still be  
18 4.5 gigawatts out of the 27 impacted to some extent,  
19 6,400 turbines, but just two of the OEMs and two of the  
20 converters that would have to be -- have hardware  
21 upgrades. How does that change with respect -- you  
22 know, if you go to PRC-024? It's only 200 megawatts

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

3 So clearly it could be argued -- you know, I think  
4 IBRs should actually do what they reasonably can to  
5 support the grid. I'm a huge believer in grid  
6 services, reliability services, as you know, and that  
7 inverters are going to be cornerstone of the future.  
8 We, you know, so I'm not saying we shouldn't go to the  
9 2800 curves. It could certainly be argued that it's  
10 discriminatory, but I get that it's, you know, what can  
11 we get out of this technology. But the reality is, you  
12 know, with PRC-024, you know, we're basically compliant  
13 today with the wind fleet, and I think also with solar  
14 and storage, you know.

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

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

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

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

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

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

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

3             Compare that relative to what's proposed in PRC-  
4     029, that's a much bigger gap that needs to be overcome  
5     with a substantial cost -- potentially a substantial  
6     cost and a substantial timeline to that. And I go just  
7     back to my points before is, one, there is that  
8     substantial amount of effort and cost and time that's  
9     relative to what's proposed in PRC-029. We want to  
10    make sure that it's a cost that is very well understood  
11    and very well spent to understand is it really the  
12    problem that we're trying to solve, right? So going  
13    back to fleshing that out, when do we need to solve it?  
14    Is that really an issue in all systems, or is it an  
15    issue in a specific system that we're trying to scale  
16    in ways that don't -- doesn't necessarily need to be  
17    scaled across interconnections? Well, we can't answer  
18    that question yet without having the analysis done to  
19    back it up.

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

6 MS. CALDERON: We have plenty of time.

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

9 MS. CALDERON: There's plenty of time.

10 MR. YEUNG: Okay.

11 MS. CALDERON: (Off mic comment.)

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

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

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

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

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

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

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



1 models and so forth.

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

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

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

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

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

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

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

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

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

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

1 not?

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

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

19 MR. MACDOWELL: Was I last? Okay.

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

14 So the question is, many commenters have said that  
15 it would only be fair to grandfather existing  
16 facilities and those in construction facilities -- the  
17 ones that are already in the pipeline -- grant them  
18 exceptions from Ride-through requirements due to the  
19 cost of retrofitting, and we've heard a lot of that.  
20 Other commenters have said that their facilities have  
21 an expected shelf life of up to 30 years, meaning  
22 there may be facilities in place well into 2050, and at

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

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

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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

18 As I pointed out, you know, we're on a very fast  
19 learning curve with IBRs. There's a lot of reasons why  
20 even though it -- they may have an engineering life of  
21 25 years or so, we're actually replacing inverters much  
22 more frequently than that. We're doing a lot of, you

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

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

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

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

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

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

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

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



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

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

17          MR. AHLSTROM: Yeah.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1 Manish has already jumped up.

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

5 (Laughter.)

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

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

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

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



1 justification that IEEE 2800 frequency Ride-through  
2 curve is needed. Where it ended up coming from? IEEE  
3 1547? Where it came, 1547? I think California Rule  
4 21.

5 So when we were discussing frequency Ride-through,  
6 we were thinking about future grid. We don't know. We  
7 don't have studies. We talked to a lot of solar folks,  
8 and they said, yeah because they have to comply with  
9 1547. They will have IBRs that will comply with, you  
10 know, frequency Ride-through curves. So then we talk  
11 to wind OEMs -- some of them are in the room -- and  
12 say, well, look, we would like to keep this simple.  
13 1547 already uses this frequency Ride-through curves.  
14 Why can't we use it for transmission? After some  
15 conversation we landed on that. That sounds like a  
16 good idea. So now, two more years go by, and then PRC-  
17 029 comes along, and we have an even stringent, right?

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

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

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

18 (Laughter.)

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

21 (Laughter.)

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

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

13 You know, on the other hand, I think the exception  
14 process with 2800 is another good approach. It's more  
15 time consuming. It's going to slow down. It's going  
16 to create, to be honest, a lot more work for NERC,  
17 especially with the other non-IBR resources coming in,  
18 you know, under the new definitions of who's subject to  
19 compliance. That's going to be a lot of work for NERC,  
20 I think, you know. So I think you could simplify it by  
21 just sticking with PRC-024, but I'm perfectly fine with  
22 2800 plus an exemption process as well.

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

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

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

18 (Laughter.)

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

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

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

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

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

4 MR. AHLSTROM: Agreed. But I mean, couldn't you  
5 put the PRC-024 in as the legacy must comply with PRC-  
6 024 as compliance -- as a Ride-through standard into  
7 PRC-029?

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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

8 MS. SHAH: Yeah, frequency,

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

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

17 MR. GUGEL: Yes.

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

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

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

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

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

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

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

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

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

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

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

1           A consideration or a question from my end is, as  
2 we are discussing how exemptions should be provided, a  
3 question that we have is, do we have the manpower from  
4 OEM perspective, utilities' or entities' perspective to  
5 support these exemption efforts as well, and where we  
6 draw the line with legacy. I think at this point in  
7 time, as we hear yesterday from the OEMs, if 95 percent  
8 of the OEMs cannot meet PRC-029, isn't everything right  
9 now considered legacy because we really can't meet PRC-  
10 029 with the existing technology? So that's my biggest  
11 question. Do we have the manpower? Can we consider  
12 everything legacy until we get to a technology point  
13 for frequency Ride-through?

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



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

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

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

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

4 MR. AHLSTROM: No.

5 MR. GUGEL: -- of providing that information?

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

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

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

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

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

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

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

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

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

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

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

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

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

18 MS. SHAH: Thank you.

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

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

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

3 MR. GUGEL: That sounds like an accounting  
4 nightmare.

5 (Laughter.)

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

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

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

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

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

18 MR. DAHAL: I would like to make some comment.  
19 I'm Samir from Gamesa. When we responded to your  
20 questionnaires about can you meet PRC-029 as it is  
21 written, right, no. Can you meet -- what about IEEE  
22 2800? We operated with the assumption that those



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

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

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

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

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

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

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

8 MR. SHATTUCK: Thank you very much.

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

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

16 (Applause.)

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

19 (Break.)

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

1 excited to hear about what you have to say.

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

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

11 (Laughter.)

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

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

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

5 (Laughter.)

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

11 So if we could go forward a slide please.

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

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

6 If you could go to the next slide, please.

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

16 Next slide, please.

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

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

5 Next slide, please.

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

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

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

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



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

8 Okay. Next slide, please.

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

15 Next slide, please.

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

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

14 Next slide, please.

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

21 (Laughter.)

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

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

16 If we could go to the next page.

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

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

7 Next slide.

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

19 Next slide.

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

1 applicable reliability standards." So that one kind of  
2 adds back in the concept of within defined limits of  
3 the standards within specific operating limits. Seven,  
4 "the entire plant facility remaining connected to the  
5 bulk power system and continuing in its entirety to  
6 operate as specified through" -- oh, I can move on to  
7 8.

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

20 Next slide.

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

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

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

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

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

4 (Laughter.)

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

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

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

14 So for all these reasons, if you look at IEEE  
15 2800, it says that after a fault, when you recover, it  
16 is sufficient if you recover to 90 percent of available  
17 power because it's possible that some of the inverter-  
18 based units will -- would, would trip for some of these  
19 conditions.

20 MR. ANTHES: Yeah.

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



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

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

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

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

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

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

16 (Cross talking.)

17 MR. AL-HADIDI: It will impact.

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

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

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

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

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

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

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

16 (Off mic comment.)

17 MR. VENKITANARAYANAN: Yeah. Thank you.

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

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

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

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

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

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

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

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

1 MR. ANTHES: Well, again, as I see it, we have  
2 three reliability standards. We have PRC-028 for the  
3 data acquisition and monitoring, we have PRC-030 for  
4 the event triggers, and then we have PRC-029 for the  
5 performance. So as I understand it, the triggers for  
6 when you evaluate PRC-029 compliance and performance  
7 come from PRC-030, and the data that's necessary to  
8 evaluate that is recorded based on your recording  
9 equipment in PRC-028. You know, maybe PRC-030 and PRC-  
10 029 should've been one standard, but they're not, so  
11 without reduplicating all of the requirements, I think  
12 we tried to compromise and go, okay, these are event  
13 triggers in PRC-030.

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



1 compliance with the PRC-029. If you reduce output by  
2 10 percent or 20 megawatt over 4 second -- I think  
3 those are the numbers in PRC-030 -- all that means is  
4 you go investigate what happened. The answer could be  
5 plant did not perform as expected. The answer could be  
6 the plant performed as expected. If it did not perform  
7 as expected, out of compliance with PRC-029. I think  
8 that's where even Nath's point came in, that if one  
9 wind turbine tripped offline out of a hundred, you  
10 could be out of compliance.

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

15 MR. PATEL: Yeah.

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

22 MR. PATEL: Yeah.

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

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

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

12 MR. PATEL: The way the standard is written, PRC-  
13 030 criteria is met. You investigate what happened.  
14 The outcome of that investigation is plant failed to  
15 perform or plant performed as expected. If failed to  
16 perform, out of compliance with PRC-029, but the PRC-  
17 029 stands on itself, right?

18 MR. AL-HADIDI: Right.

19 MR. PATEL: That's the debate.

20 MR. AL-HADIDI: Right.

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

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

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

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

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

22 MR. KAPPAGANTULA: Yeah. Yeah.

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

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

11 MR. ANTHERS: I think that was our thinking --

12 MR. KAPPAGANTULA: Okay. All right.

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

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

18 MR. ANTHERS: I think we did.

19 MR. KAPPAGANTULA: Okay. All right.

20 MR. ANTHERS: We should have.

21 MR. KAPPAGANTULA: Okay.

22 MR. ANTHERS: I believe "disturbance" was

1 capitalized --

2 MR. KAPPAGANTULA: Okay. Great.

3 MR. ANTHERS: -- and "bulk power system" was  
4 capitalized.

5 MR. KAPPAGANTULA: Thank you.

6 MR. ANTHERS: Yeah.

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

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

1 (Off mic comments.)

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

7 (Luncheon recess.)

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

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

1 value there.

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

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

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

18 So the slide, please.

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

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

6 Next slide, please.

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

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



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

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

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

5 Next slide, please.

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

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

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

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

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

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

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

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

3 Next slide, please.

4 So just overall, PRC-028, it's a new standard.

5 What that means is that there's not a retirement that's  
6 coming with it. It's an entirely new standard. And  
7 what's in there is "shall become effective on the first  
8 day of the first calendar quarter after the effective  
9 date of the applicable governmental authority's order  
10 approving the standard," which probably March or April  
11 1st. Probably April 1st will be the first day of the  
12 first quarter after approval, assuming it gets approved  
13 in the first quarter. That's, of course, subject to  
14 change. If it doesn't get approved in the first  
15 quarter, it'll be, of course, down in July, but these  
16 types of things become a little bit more complicated.

17 Next slide, please.

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

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

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

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

22 New BES IBRs, so those coming into commercial

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

12 Next slide.

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

1 make sure that nothing's going to be held compliant for  
2 those Category 2 generator owner assets prior to that  
3 initial cutoff date. Try to encourage early  
4 registration. Don't want to penalize people for coming  
5 on early and becoming compliant with standards early.  
6 We want to encourage early compliance, but we're not  
7 going to penalize people, you know, prior to that May  
8 2026 date.

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

15 Next slide.

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



1 authority approving the order approving the standard.

2 And on the next slide, this is where the key  
3 pieces of information is. There's capability-based  
4 requirements. This is design, the ability to do  
5 studies to demonstrate your IBR will Ride-through, have  
6 the capability of riding through. This is going to be  
7 demonstrated through studies. This is going to be  
8 demonstrated potentially through EMT evaluations being  
9 able to identify and demonstrate that you can meet the  
10 Ride-through capability. For BES IBR, it's the  
11 effective date of the standard, and the non-BES IBR,  
12 again, this is the Category 2, we're talking January  
13 2027. And that's in line with we're trying to not have  
14 everything come in all at once for Category 2 GOs, so  
15 we're staggering those out and we're working with  
16 compliance and registration to ensure that happens. So  
17 within this batch of standards, we've looked to say  
18 January 1st, 2027 is reasonable for these new -- these  
19 new -- these new generator owners coming online.

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

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

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

7 So performance-based Ride-through criteria is for  
8 both BES IBR and non-BS IBR. Nothing new here. Align  
9 it with your PRC-028 implementation plan, and that's  
10 because within PRC-028, you're installing new  
11 equipment, you're working with your vendors, you're  
12 working with supply chain, and you're getting that  
13 installed. You shouldn't be required to demonstrate  
14 performance at a generator that you haven't installed  
15 that equipment at yet. The implementation plan for 0-  
16 028's already sufficient to demonstrate that you've got  
17 the -- you've got the risk resolved by having the  
18 monitoring equipment installed and you have the  
19 capability of demonstrating what you're doing onsite,  
20 how it's performing. And at that point you become --  
21 your performance-based Ride-through criteria needs to  
22 be demonstrated.

1           And now we can go to the next slide.

2           All right. So for Project 2023-02, new standard  
3 again, PRC-030. What we're looking for is -- this is  
4 the analytics that base -- work off the same as 029.  
5 We have an IP revised and current draft for formal  
6 comments, so I actually cannot take questions on PRC-  
7 030, but this is a public forum and we can briefly talk  
8 about this because it's currently under ballot.

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

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

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

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

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

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

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

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

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

1 this now or kind of morph into your panel discussion?

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

3 MR. BENNETT: And do it all at once.

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

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

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

20 (Brief pause.)

21 MR. YEUNG: So let's start with introductions.

22 Maybe we'll start on the end, just who you are, who you

1 represent, please.

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

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

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

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

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

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

20 MR. YEUNG: Crowdstrike?

21 MS. CALDERON: Yes, probably.

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

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

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

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



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

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

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

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

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

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

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

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

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

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

18 (Laughter.)

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

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

8 MR. YEUNG: Yeah.

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

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

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

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

1 station or at the plant.

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

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

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

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



1 interpret this and what to do about it.

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

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

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

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

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

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

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

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

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

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

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

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

22           On the disturbance monitoring equipment side, we

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

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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

17           MR. YEUNG: So we should've made you chair of PRC-  
18          029, Manish. There wouldn't be a question. Jamie,  
19          anything to add?

20           MS. CALDERON: No, not on that question.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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



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

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

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

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

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

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

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

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

7 MR. YEUNG: Howard, any thoughts?

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

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

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

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

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

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

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

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

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

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

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

1 that's the case.

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

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



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

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

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

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

21 (Laughter.)

22 MR. HAKE: Exactly. Problem solved.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5 (Laughter.)

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

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

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

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

1 that?

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

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



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

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

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

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

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

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

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

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

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

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

3 MS. JONES: Right.

4 MR. MAJUMDER: Rajat from GE Vernova. So, Howard,  
5 question to you. What's the basis of that you were  
6 saying that it's not being done, that somebody's not  
7 looking into it, when you say the grid operator needs  
8 to know what the unit are going to be doing? I mean,  
9 isn't it something we are doing already? So why is it  
10 being raised as a matter of concern? There are always  
11 going to be outlier where the models did not keep up to  
12 the actual equipment behavior. And I did not made the  
13 statement when we were working in Appendix G of 2800,  
14 so I'm bringing it up again. And there has been some  
15 statement made that, oh, well, the models are not good.  
16 It's not true. Yes, there has been some exception, but  
17 rest of the thing, we are all going through Mod 26 and  
18 27, not every other 26 and 27 shows models are matched.

19 MR. GUGEL: Yeah.

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

1 equipments are going to behave.

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

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

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

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

16       MR. MAJUMDER: Yeah.

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

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

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

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

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

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

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

13 MR. YEUNG: So, Howard --

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

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

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



1 performance compliance for PRC-029?

2 MS. CALDERON: Could you say that again?

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

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

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

1 you pick up the framework, put together in that  
2 document in compliance with, I'm going to start calling  
3 2900. Maybe it will become true.

4 (Laughter.)

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

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

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

22 (Nonaudible response.)

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

5 (Applause.)

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

9 (Break.)

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

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

1 Sorry.

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

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

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

22 (Slido voting.)

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

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

10 (Slido voting.)

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

15 (Continued Slido voting.)

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

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

1 in front of it?

2 MS. CASUSCELLI: Okay. Hold on.

3 (Brief pause.)

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

10 (Off mic comment.)

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

13 (Slido voting.)

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

20 (Continued Slido voting.)

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

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

4 (Brief pause.)

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

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

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

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



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

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

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

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

12 MS. JONES: (Off mic question.)

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

20 MS. JONES: (Off mic question.)

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

1 you're referring?

2 MS. JONES: (Off mic comment.)

3 MR. BENNETT: Oh, for this conference.

4 (Off mic comments.)

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

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

1 comments were used for at this point.

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

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

15 MS. JONES: Thank you.

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

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

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

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

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

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

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

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

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

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

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

17 (Laughter.)

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

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

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

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



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

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

21 (Applause.)

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

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

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

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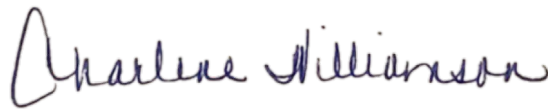
I, Charlene Williamson, do hereby certify that, to the best of my knowledge and belief, the attached transcript is a true and accurate transcription of the indicated audio recording.

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

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DATE



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Charlene Williamson  
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