BEFORE THE

FEDERAL ENERGY REGULATORY COMMISSION

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IN THE MATTER OF:	: Docket Number:
INTERCONNECTION FOR WIND ENERGY	: PL04-15-000
AND OTHER ALTERNATIVE TECHNOLOGIES	:
	:
STANDARDIZATION OF SMALL GENERATOR	: RM02-12-000
INTERCONNECTION AGREEMENTS AND	:
PROCEDURES	:
	:
STANDARDIZATION GENERATOR	: RM02-1-001
INTERCONNECTION AGREEMENTS AND	: RM02-1-005
PROCEDURES	:

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Commission Meeting Room
Federal Energy Regulatory
Commission
888 First Street, N.E.
Washington, D.C.
Friday, September 24, 2004

The above-entitled matter came on for technical conference, pursuant to notice, at 10:30 a.m., Bruce Poole, presiding.

APPEARANCES:

JIM CALDWELL, Director of Policy, PPM Energy on behalf of AWEA

THOMAS BASSO, Senior Scientist/Engineer, National Renewable Energy Laboratory, on behalf of IEEE

JACK HOCHHEIMER, Transmission Manager, FPL Energy, LLC

NICK MILLER, Principal Consultant, GE Energy

CRAIG QUIST, Principal Engineer, PacifiCorp, former Chair of the WECC Technical Studies Subcommittee

EDWARD TORRERO, Senior Program Manager, National Rural Electric Cooperative Association (NRECA)

STEVEN SAYLOR, Chief Electrical Engineer, Vestas Americas

DR. POUYAN POURBEIK, Principal Consultant, ABB Inc.

ERIC LAVERTY, Technical Lead, Interconnection Engineering, Midwest ISO

MIKE JACOBS, Eastern Representative, American Wind Energy Association (AWEA)

BILL WHITEHEAD, General Manager, Transmission and Interconnection Planning, PJM Interconnection LLC

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APPEARANCES CONTINUED:

PATRICIA ARONS, Manager of Transmission and Interconnection Planning, Southern California Edison

CHARLES MATTHEWS, Electrical Engineer, Bonneville Power Authority

WAYNE HAIDLE, Engineer, Montana-Dakota Utilities Co.

JEFFREY V. CONOPASK, Ph.D., Senior Economist, Public Service Commission of the District of Columbia, on behalf of The National Association of Regulatory Utility Commissioners (NARUC)

PAUL LEHMAN, Transmission Consultant, P.E., Xcel Energy, on behalf of Edison Electric Institute (EEI)

KENNETH DONOHOO, Manager, System Planning, Electric Reliability Council of Texas (ERCOT)

P R O C E E D I N G S

(10:30 a.m.)

MR. POOLE: Good morning. I'm Bruce Poole, and I've got a short introduction to talk about, and then we can have introductions.

Welcome to the Federal Energy Regulatory Commission and to this Technical Conference on Interconnection for Wind Energy and Other Alternative Technologies. Thank you all for joining us today.

The Conference was established by the Commission to discuss the Petition for Rulemaking submitted by the American Wind Energy Association that was provided on May 20, 2004 in Docket Number RM02-1-005.

Staff has established many goals for today's Conference. As an overreaching goal, the Staff is interested in learning as much as possible about wind generators and potentially other alternative generation technologies that may require interconnection standards and requirements that are different from those that were laid out in Order No. 2003 and 2003A.

When this Conferences concludes later today, the Staff hopes to have an understanding of why these technologies are different from more standard, large synchronous generation technologies. Additionally, we hope that this Conference will identify if there are other alternative generation technologies like that of wind, that may require revised interconnection standards.

Another primary goal Staff has set for this Conference is to gauge industry reaction to the AWEA petition and to understand the alternatives to AWEA's proposal or certain aspects of AWEA's proposal. We hope to identify the areas of agreement and disagreement within the regulated community regarding the interconnection of wind and other alternative technologies.

Within those broad goals, the Staff has developed several questions that we hope will be answered during today's Technical Conference. Many of these questions were provided in the Supplemental Notice to the Technical Conference that was issued September the 8th.

The Staff will focus on those questions and related questions during the course of today. Before we begin, a few housekeeping matters: While we have not built any breaks into today's agenda, because we have so much to talk about, please feel free to step in and out of the room as you need to.

Additionally, the Commission will accept written comments on the issues discussed in AWEA's petition and at today's Conference, in within approximately 30 days of today's Conference, or Monday, October 25th, we'd like to have those comments, and they should be filed in Docket

Number PL04-15-000.

And now I'm going to let Rob Gramlich make a little statement, and then we'll have introductions.

MR. GRAMLICH: I wanted to thank everybody for coming, and also thank, in particular, AWEA, for putting out a strawman that we can all work from here. About almost a year, Jay Carrier and Jim Caldwell came by and talked to Chairman Wood about some of these issues, and I just want to thank them for having such specific descriptions of the problem and specific descriptions of the possible fix.

And so, with that, it's easy to work on solutions. Since then, Mike Jacobs and Chris Ellison have been working on this. And I also want to thank transmission providers who hare here today, who are being realistic about what actually can get incorporated here, and to preserve the reliability of the grid.

I've seen some very specific comments here, and we'd like to come out at the end of the day today with some very clear, hopefully, ideas or at least principles on what could be incorporated into an amendment to Order 2003.

And just in the general spirit of compromise, I think we all need to be compromising somewhat in order to make that happen. I know the wind providers have offered to make some changes on things like low voltage ride-through, and if everybody can kind of work together and be specific, then we can get some clear rules written that I think would benefit everybody.

So, that's all I wanted to say, and I turn it back to you, Bruce.

MR. POOLE: Okay. I'd like to --

MR. GRAMLICH: I did want to say one more thing: We may be having a more general conference on wind issues in a couple of months. I don't think we've said anything publicly until now, but that's in the works, and so keep an eye out for that, and I guess with that in mind, since we will likely be covering some more general issues related to transmission service and potentially planning and things like imbalance charges and things like that, let's maybe leave those issues aside today and try to get as much done as we can on interconnection.

I think that Commissioner Kelly and Chairman Wood, in particular, have been very interested in having some more general discussions along those lines.

MR. POOLE: Okay, now I'd like to have the Staff introduce themselves. And we'll start with Jeff and go around.

MR. DENNIS: Jeff Dennis from the Office of General Counsel.

MR. DEAL: Matthew Deal.

MS. BROOKS: LaChelle Brooks, OMTR.

MR. AGARWAL: Kumar Agarwal, OMTR.

MR. GRAMLICH: Rob Gramlich, Chairman Wood's Office.

MR. ROONEY: Pat Rooney, OMTR.

MR. POOLE: And I'm Bruce Poole with OMTR, the Reliability Group.

MR. KELLY: Kevin Kelly, Policy Analysis and Rulemaking.

MS. McKINLEY: Sarah McKinley, External Affairs.

MR. THOMAS: Chris Thomas with OMTR.

MR. HINRICHS: Lance Hinrichs, Office of Market Oversight and Investigations.

MS. WHITE: Carol White, Office of Market Oversight.

MR. POOLE: Okay, to begin with, we're going to let Jim Caldwell go first. And he's going to sort of give us an overview of their petition, and then as soon as he finishes, we'll have the introductions for the rest of the panel, and then we can -- you'll each get five minutes, when it comes your turn.

Since Jim is going to talk in a little bit more detail about the petition, he gets a little more time, but everybody else will get five minutes, and then once everybody's introduced and made their statements, we'll just start questioning, to go through our questions. Jim?

MR. CALDWELL: I'm Jim Caldwell and I'm the Policy Director for PPM Energy. PPM Energy is the subsidiary of Scottish Power, and I guess we have -- we are a very large wind developer and we have aspirations, some day, of being the largest, who is now my friend, Jack Hochheimer, sitting down here, who has that mantle.

But we develop wind, both in the United States and thruogh sister organizations, mainly in the UK, but throughout Europe as well. We also have the same parent as another member of the panel down here, Craig Quist from Pacificorp, so that is my background and disclosure, however, I think the reason why I'm here and the reason why I'm starting is that when this petition was filed, I was the lead with the American Wind Energy Association for filing this petition, so I'm here, not on behalf, specifically, of PPM Energy, but more for the wind industry and the American Wind Energy Association.

(Slides.)

MR. CALDWELL: I had three slides that I wanted to go through as background for the petition. The first was sort of a history and purpose of the Grid Code, and it really came from three or four points.

The first is that there is a growing worldwide recognition of the economics of wind energy and the need to design both the grid and wind energy facilities for, quote/unquote, high penetration on the grid.

If you look at the resource base in the United States, there is about 600,000 megawatts of resource base for wind that is economic at today's natural gas prices. And that means, if you project out into the future, that conditions stay where they are, that you could be looking for wind penetration on the grid on a national basis now, somewhere between what hydroelectric does today and maybe as much as what nuclear does today, so somewhere between, say, 10 and 20 percent of the grid, looking out into the future, could be wind energy.

And because the wind energy resource is not distributed evenly throughout the country, that energy would not be distributed evenly throughout the grid, and there will be some portions of the grid where the penetration rates are very high, maybe approaching what they are today in Denmark where, on an annual average basis, it's about 30 percent of the energy that comes from wind. In many hours out of the year, more than 100 percent of the energy for the country of Denmark is produced from wind.

These facts, if you will, on the ground, of the economics and the political desirability and the environmental desirability of this resource, require a response from the technical community in order to make that happen in a way that is both economic and reliable.

The second major theme that caused us to do this was what I will call a history of poor communication among wind developers, turbine manufacturers, grid operators, and the engineering community at large. And when I say "poor communication," I don't mean any intent on anybody's part of anything about behavior; it's just a fact of life, and that is a fact, that the grid developed without considering this, that much of the wind technology developed without considering grid impacts, that this has all come about relatively quickly.

And this relatively quick development of the technology and the making of the economics of that technology, has overtaken the engineering community in a way that needs to be fixed. And one of the major things that we would like to see out of this is an acceleration of that communication and a facilitation of that communication in order to make this happen.

Throw in the mix, Order 2003, which is a standard process for standard generators. It essentially assumes that you're a combined-cycle natural gas plant, maybe even the GE Frame 7 that's being hooked up to the grid.

And all of the details, all of the underlying appendices and tables and so forth, essentially assume that as a matter of course and then proceed from there. And we simply don't fit into that definition.

And then, fourth, there's no question that the Northeast blackout of a couple of years ago, just simply highlights and says -- not that it had anything to do, specifically, with wind or anything else, but it just highlights the need for better planning, better anticipation, and clearer rules, sooner rather than later.

So the main function and the main purpose of this Grid Code was to highlight these issues, to lay down a marker in the sand to say this is where we, the wind industry, believe that we can do today and what we ought to be doing today as a good citizen on the grid, recognizing where the technology is today, where the economics are today, and where it can go in the future and what we can contribute.

And we lay that out as something that we are willing to undertake voluntarily, because we don't like the consequences of having this dictated to us over time and down the road.

The process that we used to develop the Grid Code, the first thing we did is, we assembled a critical mass of the, quote/unquote, wind industry. We got essentially all of the turbine manufacturers, all the component -- the major component suppliers, developers and operators and engineering consultants that serve our industry, and under the banner of the American Wind Energy

Association, got everybody to sit down in the same room.

We also had to have a lawyer also to worry about those kinds of discussions about standards and so forth among all these competitors. So that was not a trivial matter to get all that put together.

The second thing we did is, we examined all of the other efforts that are going on worldwide, all the Grid Code efforts. The problem that we're talking about here is not one that is confined to the United States, it's not one that's confined to the WECC; it is an issue all around the world, and there are parallel efforts going around.

We specifically looked at grid codes and draft grid codes in Germany, Spain, United Kingdom, Greece, Australia, and then the People's Republic of Texas, WECC, and the New York Independent System Operator.

We assessed near-term product development plans of turbine manufacturers and component suppliers that could result in, quote/unquote grid-friendly wind turbines and wind farms, and, finally, we tried to reach industry consensus on what that meant in terms of a set of process standards that we could live with and that we felt that we could hold up and say that we were really and truly holding up our end of the bargain in terms of contributing to the reliability on the grid.

So, that's what the Grid Code was about. I won't go into the details of what the Code contains, other than to just to sort of give you the outline, and we will come to the issues, point-by-point.

The first set of issues was a point of connection technical standard. And it's important to say that these are point-of-interconnection standards. These are not turbine manufacturer standards, these are not intended to be component standards; they are intended to be at the point of interconnection technical performance standards for, first, low-voltage ride-through.

A few words on that: Maybe two or three or four years ago, the philosophy for a grid operator looking at a wind turbine was, if there is a disturbance on the grid, I want that wind turbine off and out of the way, because I don't want to have to deal with it when everything else is all in an upset condition.

So, wind turbines were intentionally designed, essentially at the request of the grid operators, to trip off at the first sign of a problem. Well, that's fine, as long as you are some demonstration plant and you're a minuscule part of the generation mix; it does not work if you are suddenly asked to be contributing at a level that if that generation trips off during the disturbance and is not there when the disturbance clears, then leads to some sort of cascading outage, because of the lack of generation.

So, suddenly, if you will, the design philosophy had to change and all of a sudden, manufacturers were being asked to ride through and to be available, once the disturbance cleared, to be able to again generate.

The second set of technical standards was voltage support and reactive power, and we all understand that -- and, specifically, the Northeast blackout brought this home -- that all generators on the system, all consumers, all users of the common grid, have a common need and a common obligation to supply voltage support, to participate in this common good, common necessity of reactive power, and we, the wind industry, need to take our place with everyone else.

However, the way that may be expressed in terms of a tariff requirement, we feel needs to be expressed differently for a technology like ours.

The third point-of-interconnection technical standard that we tried to lay out, is some SCADA functionalities. SCADA -- I'm sorry, it just dropped out of my head, what those letters stand for -- but what it means is that the real-time communication between the wind farms and the grid operators and the ability to send signals back and forth in order to perform some of these functions in real time, as opposed to over the telephone or trying to look somebody up at their house to say, let's go out and fix it.

And we think it's an absolute necessity, going forward, that this functionality be built into and be part of the standard interconnection standard, that this two-way communication between the grid operator and the wind farm, in electronic form and in real time, be able to take place in order to capture and to be able to deal with the engineering issues of the day.

The second set of things that is contained in the Grid Code is what we call Order 2003 process considerations. And the first piece of that has to do with what we see as the need for some front-end flexibility that recognizes the fact that wind turbines are different and that there are a lot more options.

This idea that we can just come in and say, well, let's wrap all of the technical requirements with a bow and we will tell you exactly what it is that we want to interconnect with the grid, and that we need to do that and essentially complete our engineering prior to entering into the interconnection queue, simply doesn't work.

It doesn't work from a technical standpoint. Many of these issues are an output of the interconnection studies, not an input to the interconnection studies for us. And from a matter of timing, if we have to enter into the interconnection queue as much as four to five years, maybe, before the plant comes online, that's an eternity. That's maybe two product development lifetimes for the wind turbines that come up.

And so that requirement of Order 2003, that everything has to be done from our side before we get interconnection queues, simply doesn't work, and we're looking for some front-end flexibility.

Finally, a lot of these issues depend upon a shared engineering community set of models and set of procedures in order to conduct the technical studies, and that we feel it's important for the FERC to give some institutional support for this modeling and software development effort.

This is not something that the wind developers can do on their own, or the turbine manufacturers can do on their own; it is not something that the transmission providers can do on their own. We all have a shared responsibility and a shared need to participate in this, and we would like to see some institutional support from this organization, which, in effect, requires everyone to take up their piece of this pie and to participate in this modeling development software effort.

So, that's what the Grid Code says, and with that, I'll be quiet and let other people talk about the details. Thank you.

MR. POOLE: Okay, thank you, Jim. Now we'll just go down the panel, and first, why don't you just introduce yourselves and then we'll come back and start with Tom.

MR. BASSO: Good morning. My name is Tom Basso. I'm pleased to be here to participate i this conference. I'm here to offer you background on IEEE Standards Coordinating Committee 21 development of the Interconnection Standard 1547 for Distributed Resources.

I work for the National Renewable Energy Laboratory, Distributed Energy and Electric Reliability Program. Support fo me and the 1547 development has been through DOE Distributive Power Program and also the DOE Office of Electric Transmission and Distribution.

The views expressed here are my own, and they don't constitute DOE nor IEEE positions.

SCC is an industry-driven IEEE group that develops standards in an open-consensus forum. The 1547 Standard for Interconnection is the first in a series of standards documents being developed. There are five other documents currently in the series.

The first 1547.1 being developed, is the test standard, the second one is applying 1547 to real-time, real-life deployment; the 1547.3 Guide is the communications standard for information exchange, monitoring, and control and SCADA system; the 1547.4 Guide is for the operation, design, and integration of islanding systems for distributed resources.

And, finally, the latest guide being developed is the Technical Guide for Interconnection of Electric Power Sources Greater than 10 MVA to the Transmission Grid.

In addition to the 1547 series of documents, the SCC-21 Work Group members have identified the need and desire to have certification for equipment that interconnects with the grid. At NREL, we've developed a draft model program for certification that could be adopted by industry and contributing stakeholders.

The program involves a nationally recognized test lab being responsible for the certification of equipment. But now back to the 1547 documents:

The 1547 Standard was published in 2003. It's the only American national standard for interconnection. The 1547.1 test standard document is going to ballot this Fall. The 1547.2 application guide and the 1547.3 communication guide, are targeting 2005 for ballot. The guide to intentional islanding, 1547.4, held its inaugural meeting this August, and, finally, the 1547.4 guide for transmission interconnection at greater than 10 MVA, was just approved by the IEEE Standards Board this week, to start its development.

The 1547 standard defines the minimum universal mandatory requirements needed for interconnection and for testing. The requirements are functional and not prescriptive.

Functional technical requirements are statements of what the system needs to do or what behavior must be available. 1547 requirements are technology-neutral. They apply to all interconnection equipment, be it synchronous, induction, or invertor-based.

1547 realizes that there are equipment-specific requirements and there are operational requirements in addition to the technical requirements for interconnection. 1547 does not require interconnection equipment be instituted at the point of common coupling, nor does it require all the equipment to be on one side of the customer point of common coupling or on the grid side.

It's a dispersed application of equipment, be it on the grid side or the distributed generation side.

The 1547 interconnect requirements apply up to ten MVA on distribution systems, and the 1547.5 will build on that for greater than ten MVA at the transmission level.

The 1547.3 communications guide is not necessarily limited to ten MVA. I'll close here by reiterating that the development of the 1547 standard has been a major success for the work group developers as an American national standard based on the consensus, development, and balloting shown by the 444 work group and ballot group members listed in the standard.

They have developed the document of universal functional technical requirements that are technology-neutral. Thank you.

MR. POOLE: Yes, Mr. Hochheimer?

MR. HOCHHEIMER: Good morning. My name is Jack Hochheimer, and I appreciate the opportunity to represent FPL Energy's interests here today.

In my capacity as Transmission Manager for FPL Energy, I'm responsible for all transmission-related technical and contractual activities associated with FPL Energy generation projects, including interconnection of new projects and resolution of operational issues for existing assets.

I've been in the power systems engineering business for 32 years, with most of that experience in the transmission planning arena. I'm a registered Professional Engineer in Florida and New York.

FPL Energy is a leading clean energy provider with natural gas, wind, solar, hydroelectric, and nuclear power plants in operation in 14 states. More than 90 percent of FPL Energy's electricity is generated by clean fuels. We are the leading wind power producer in the world, with nearly 2750 net megawatts currently in operation in 15 states across the U.S, which represents just under 50 percent of the installed wind capacity in the country.

In 2003, FPL Energy was responsible for more than half of all new wind power projects completed in the United States. We also operate the world's two largest solar fields in the Mohave desert.

I'd like to begin with an example of one of our recent wind interconnection success stories and some of the resulting concerns that it gave rise to. In 2003, FPL Energy commissioned the New Mexico Wind Energy Center, a 204 megawatt wind farm, interconnected with the Public Service Company of New Mexico's system, which is also known as PNM.

The PNM system is relatively small, with 2150 megawatts, peak, and 1,000 megawatts, off-peak. So, depending on system load level and wind generation output, the wind farm could end up serving up to 20 percent of the PNM system load.

It was clear from the start that the relative size of the wind farm in the PNM system, may lead to some challenges not previously encountered by a wind project. PNM also imports a good deal of their power over EHV lines.

When PNM got into the system impact study, it found that faults on the PNM system, including faults on the EHV lines used to import power, would cause a voltage depression at the wind farm that would trigger the internal under-voltage protection on the generators to trip the units offline.

Were such an event to occur, PNM would lose not only the import capability of the EHV line, but also the 200 megawatts of wind generation. This would be their worst system outage, and it had to be addressed.

FPL Energy worked with PNM to define technical requirements for the wind turbines to ride through such events, and we were also able to work with the wind turbine supplier, GE Wind, to develop and implement the capability to meet such requirements.

The low-voltage ride-through requirements that PNM developed, seemed reasonable to us, because the study showed that they were necessary to maintain system reliability. The New Mexico Wind Energy Center was the first wind generation facility in North America to employ low-voltage ride-through capability.

The interconnection process for this facility, in general, was a huge success story for wind. Despite the exhaustive studies conducted for the 200 megawatt project, it was in service in less than a year from the initiation of the studies.

Once the existence of this new low-voltage ride-through capability became known in the industry, however, other transmission owners demanded that they wanted it for wind generation generators connecting to their system.

Notice that I said, "wanted," and not "needed."

PNM clearly demonstrated the reliability need for their system, and the industry responded, though it raises the cost and complexity for wind projects. Once this capability became available, we had several transmission owners decide that they wanted it as a condition to interconnect, even though they could not demonstrate a need on their particular systems.

FPL Energy's position on technical requirements for interconnection of wind generation and other alternative technologies, is that the technical requirements in Orders 2003 and 2003A, should not be the default requirements for these technologies, rather, transmission owners should only require what is necessary of wind generators to meet applicable reliability criteria.

Features such as the low-voltage ride-through and reactive capability should only be required on an as-needed basis; in other words, each technology advance by the wind industry should not become the default requirement by transmission owners, because they want it instead of need it.

We fully support the AWEA Petition for Rulemaking in this regard. To quote from this petition, with respect to low-voltage ride-through, "Nothing in this standard shall authorize the transmission provider to refuse to interconnect facilities with lesser or no such capability, where a transmission provider determines, based on interconnection studies or the requirements of a particular transmission provider's system, that this capability is not necessary to meet applicable reliability requirements."

And regarding the reactive capability provisions, the Petition also states that "If system impact studies demonstrate that reliability requirements are met..."

MR. POOLE: Do you have much more?

MR. BASSO: I'm sorry?

MR. POOLE: Do you have much more. Your time is up.

MR. BASSO: Two sentences.

MR. POOLE: Okay.

MR. BASSO: "If system impact studies demonstrate that reliability requirements are met at less than, i.e., closer to unity, 0.95 lagging power factor, then that resulting figure becomes the power factor range requirement."

I know my time is limited, so I look forward to responding to your questions about these and other issues raised in the AWEA Petition. Thank you.

MR. POOLE: Nick?

MR. MILLER: Thanks, Chris. I'm Nick Miller, a Principal Consultant for GE Energy. I have a couple of dozen years of primarily transmission planning and integration of new technologies and power system expertise. I'm relatively new to the wind business, but I'm here speaking on behalf of GE Energy in all things grid-related.

I doubt I have my talk as finely tuned as the previous two speakers to get to exactly five minutes, plus or minus. I've made a handout here that hopefully you have in front of you, that I'll talk from.

Basically, FERC is making a step forward on a critical issue by recognizing that there is a distinction between wind generation and other technologies as they relate to grid performance.

I'd like also to point out that both FERC and AWEA appear to be moving in the right direction to make functional requirements, recognizing that all wind generation technology is not equivalent, that is to say, there are differences in what can be built and offered.

And each of the previous speakers has pointed out that the technology and understanding and practice, are all evolving very rapidly. To that end, we recognize that there is a need for some standards.

We don't want to be making this up as we go along, but simultaneously, we need to recognize that this is by far, far from established standard and practice and that we need to be flexible.

To that end, finally, there is a industry motivation and clearly FERC's motivation to provide for fair adaptation to new generation technology. And, of course, "fair" is a very loaded word. We need to represent all the stakeholders, including the incumbents, but also to allow forward motion.

To that end, I'll have a couple high-level points, as speaking on behalf of GE. GE supports the provisions of the AWEA Petition, particularly with regard to low-voltage ride-through, power factor range, and voltage regulation. I'll take you into each of those very briefly.

I've said that we must allow these standards to evolve, and we've made a first good step. There are two key points, philosophically, from GE's perspective: It is reasonable to demand a high level of performance from wind generation, okay?

Wind generation need not be given a free buy because it is otherwise desirable from a social or policy point of view. Having said that, it is not reasonable to drive industry practice to force wind to be identical or indistinguishable from other generating resources. I believe that there is a certain amount of consensus in the room to that end.

Moving forward on the two specific technology aspects, low-voltage ride-through, you've heard why or what it is. It is a key point, particularly in the case, for example, of Public Service of New Mexico. It is worth noting that other countries have moved to a direction of requiring low-voltage ride-through as a provision to allow higher penetration of wind.

For example, the Spanish system is 5,000 megawatts of wind generation that is vulnerable to tripping for low voltage events. They are now moving to a low-voltage ride-through standard. To some appreciable extent, they're closing the barn door after the cow has left, and we think that it is -- we can learn from that experience and not repeat that, what could be considered a mistake.

It is also worth noting that when generation, at least the technology that I'm familiar with, has in many regards, superior dynamic performance to that of conventional generation. I don't want anybody to walk away with the notion that wind is always second-class, from the point of view of performance on the grid.

There are things that wind generation does better, and we don't want equivalents; we want the technology to take advantage of what it can offer.

And a key point is that GE is presently offering technology that meets the provisions of the proposed AWEA Grid Code.

On power factor control, we consider that to be a reasonable requirement, and we're prepared to meet that. Participation in voltage control is key to enable high penetration of wind, particularly in weak systems that are the type where there's good wind resource.

You get far away from population centers with lots of wind, the system is weak, and voltage control and reactive power range are required, and we need some good engineering, to Jack's point, to make sure that any standards are not applied without consideration to the physical reality of the specific site -- good engineering practice.

I just want to reiterate that this is a work-in-progress. There are many other technologies that are ultimately going to need to be addressed by practice and standards that aren't in the AWEA Petition, and it's probably not time to do that yet, but we need to look forward.

Finally, GE takes this very seriously, and we're investing substantially in the technology to make wind generation grid-friendly.

MR. POOLE: Thanks. Craig?

MR. QUIST: Craig Quist, Pacificorp Transmission Planning Principal Engineer. I ask the Staff's indulgence. Since we're the only transmission provider here, we may go a minute or so over your five minutes.

I primarily work with wind generation interconnection issues. We've also been involved with developing new wind turbine software models. Right now, I'm on the AWEA Grid Code Task Force and also the former Chairman of the WECC Technical Studies Subcommittee, and I'm a licensed engineer in both the states of Utah and Nevada.

We have a prepared statement. I'll try and go through this as quick as possible. You should have it in front of you.

Thanks for allowing Pacificorp to comment on the Petition for Rulemaking submitted by AWEA, seeking the adoption of certain requirements for the interconnection of wind generation, large wind generation.

We bring a fairly unique and balanced perspective to these issues, both because of wind and other renewable resources are becoming an increasingly important part of our energy portfolio, and because we operate one of the largest investor-owned, open access transmission system in the United States.

As such, Pacificorp has a proven track record of working with AWEA and its members to identify and overcome challenges of interconnecting and integrating wind facilities into the interstate electric grid, without degrading system reliability.

Speaking as the resident transmission provider conscience on the AWEA Task Force that developed the petition, I'd like to offer several observations and put forward what we hope are constructive suggestions to improve the petition.

Pacificorp believes the Commission has rightly recognized the need for standards and procedures specific to new technologies such as wind, since nonsynchronous wind generation typically differs in critical aspects from convention synchronous thermal technologies assumed in determining the interconnection requirements set forth in Order 2003-A.

By scheduling these important conferences, the Commission has hopefully begun the process of developing much needed, uniform, nondiscriminatory, yet technically sound interconnection standards for large wind generators and turbine manufacturers.

The wind industry needs a set of clear and equitable rules that can be applied in a consistent manner across the country, yet are equally responsible to the legitimate concerns of transmission providers that their safety and reliability responsibilities are not being compromised.

That said, Pacificorp would like to highlight what we believe are the strengths and weaknesses of two critical aspects of the AWEA petition, the proposed low-voltage ride-through capability and reactive power requirements.

On principle, Pacificorp appreciates that AWEA has proposed low-voltage ride-through and voltage support/reactive power standards that ensure that new wind turbines and arrays can remain online through most common power system disturbances and do their part in supporting the integrity and stability of the grid.

The lack of wind plant reactive support and resulting voltage impacts, are major concerns for electric utilities. In our view, AWEA's proposed standards are far superior to many of the blanket exemptions that the Commission provided to wind generators in Order No. 2003-A, that can be shown to be either unnecessary or inappropriate.

Like AWEA, Pacificorp believes transmission providers should be authorized to require for interconnection of non-synchronous generators, the ability to ride through low voltage events caused by power system disturbances outside the generating plant.

Since 2003, Pacificorp has been evaluating large wind plant interconnections, following best engineering practices that determine if turbine manufacturers/project developers should include these capabilities when interconnecting new plants.

Now, with these key changes, these standards will ensure that new wind turbines and arrays can remain online through most common power system disturbances, rather than trip off, which may result in low-voltage situations, making the low voltage situations even worse.

This capability will become increasingly important as the level of wind plant penetration increases. Pacificorp joins AWEA in asking the Commission to find that meeting these standards will presumptively entitle a wind facility to gain the rights to interconnect to the transmission system, unless a transmission provider can show just reason for more stringent standards.

At the same time, Pacificorp believes those proposed standard also raise several significant policy and practical implementation concerns that deserve close examination and possible reconsideration.

Pacificorp has reservations about particular voltage standards being mandated by the Commission, rather than being developed through an established standards development process of national organizations such as NERC or IEEE.

In the interest of facilitating timely wind energy integration with power systems, however, Pacificorp recommends that the Commission adopt the IEEE low-voltage ride-through capability standards, without modification, on an interim basis only.

Further, Pacificorp recommends that these standards be modified in the future to conform to any NERC or IEEE low-voltage ride-through standards developed as wind turbine technology matures. As an alternative, the Commission should direct the applicable Regional Reliability Councils to establish standards to ensure low-voltage ride-through capability for all synchronous and nonsynchronous generators.

This approach will leave the door open for Regional Reliability Councils to establish further criteria, as necessary, to meet the needs of their diverse members.

Turning to reactive power, while AWEA's proposed .95 leading/lagging power factor standards are similarly preferable to the status quo, the caveats and disclaimers that AWEA has proposed with regard to use of such standards, are inappropriate, as Pacificorp pointed out in our pre-conference comments.

Pacificorp well understands that induction wind generators which generally lack the capability of internal generating reactive power, typically must consume reactive power from external resources within their own collector systems. Naturally, this can lead to serious voltage support degradation, if left unchecked.

For this reason, Pacificorp believes that transmission providers should be allowed to require that wind generating facilities, which include generator installation and collector systems, abide by the same power factor requirements specified in Commission Order 2003-A, LGA, Section 9.61.

Ideally, in fact, the Commission should set aside the AWEA proposed standard and, instead, revise Order 2003-A, and the LGIA, so that any exemption is limited to the wind generator unit only, and the wind generating facility is still required to meet Article 9.61 of the LGIA.

Again, thank you for the chance to contribute our perspective. I look forward to your questions and drilling down further on these issues. Thank you very much.

MR. POOLE: Thank you. Ed?

MR. TERRERO: Good morning. My name is Ed Torrero. I am a Senior Program Manager with the Cooperative Research Network, the research arm of the National Rural Electric Cooperative Association.

I, too, have a prepared statement, and I would beg the Staff's indulgence to go one or two minutes over.

MR. POOLE: If we let everybody do that, we won't ever get to questions. So, please try to hold it to as close to five minutes as you can.

MR. TORRERO: So I will proceed to a logical stopping point and request that I pick up when the general discussion begins.

At CRN, I manage the power supply program that is actively seeking to advance renewables, especially wind energy, as well as to distribute generation. Over the last ten years, CRN has invested a total of $8 million in the two areas.

In addition, NRECA and its 930 members, through a democratic resolution process, encourages all rural electric cooperatives to support renewable energy. The Coops' principal mission is to provide their consumer owners with safe, reliable, and affordable power.

Coops believe that wind energy and other alternative generation options, can play an important role in that mission. Toward that end, CRN and NRECA are investigating ways that wind can be integrated effectively with electric cooperative systems, and these activities include a partnership with the Wind Power in America Program of the U.S. Department of Energy.

The partnership convenes workshops around the country in areas with high wind energy potential. It provides technical assistance to help coops develop wind projects, and it facilitates the dissemination of useful information on wind energy.

The workshops are well attended by cooperatives, and they have increased the overall interest in wind generation among our members. The partnership was built on the results of a survey of 26 wind energy projects connected to the systems of 13 electric cooperatives.

Another activity is the contribution to the development by the Utility Wind Interest Group, of a suite of software tools to evaluate the impact of distributive wind on distribution feeders. These so-called aplets (ph.) are in an advanced stage of development and could well lead to similar tools for transmission. Previously, CRN contributed to a study on the impact of wind generation on bulk power systems.

Still another activity is the analysis of the business of wind as determined from a study of insulation and O&M costs, federal and state incentives, and green power programs based on wind energy.

Finally, NRECA is an active, a very active participant in the Utility Wind Interest Group. It is with this background that we comment on the AWEA proposal, Appendix G.

There is much in the AWEA proposal to support. First, we commend AWEA for requesting this technical meeting to facilitate a broad and in-depth examination by the various stakeholders of the industry.

Likewise, we commend the Federal Energy Regulatory Commission for hosting this technical conference so promptly and simplifying the process of registration for participants. We look forward to a productive dialogue.

Second, as wind supporters with an obligation to provide consumers with safe, reliable, and affordable electric power, NRECA is pleased to see that the wind industry is working to transform wind from a niche technology to a mainstream generation resource.

As befits its emerging status, the industry is seeking to shoulder its responsibilities by developing new wind generators that are capable of providing low-voltage ride-through, voltage support, and SCADA capability.

The wind generators still have some unique challenges. These developments permit them to be integrated into the system in much the same way as large generators.

We commend AWEA and the industry it represents, for these significant developments, and we support the elements of Appendix G that recognize these developments.

Third, recognizing that wind development may require some additional design flexibility and planning assistance, we agree that wind generators should, one, have the ability to meet power factor requirements at the point of interconnection, without regard for the power factor within the wind developments own medium voltage system; and,

Two, have the ability to take an active role in the feasibility study stage, if they wish, provided that the transmission provider can take over the study process at the system impact stage, inasmuch as that is the major responsibility of the utility transmission system planner.

NRECA believes that these are reasonable accommodations to the special nature of wind generation, and I will reserve my additional comments for the next round of talks.

MR. POOLE: Thank you. Steven?

MR. SAYLORS: I'm Steve Saylors. I'm with Vestas Americas, which is a division of Vestas -- with a worldwide conglomerate of Vestas. We're a Danish owned company, a Danish founded company, and as Vestas Americas, we develop product for the North American market and now the South American and Central American markets.

As Chief Electrical Engineer with the Company, I oversee project design and installation, also integrate with our R&D in Denmark here to advance new designs here to incorporate some of the concerns that are being addressed today.

And also look to provide the interconnection information to the various entities here, so that we can move along with the interconnection agreements here.

One of the aspects I thought I might do, is define a little bit about what we're talking about with low voltage and power factor control capabilities within the machine from a manufacturer's point of view, and my statement being that as the penetration of wind energy becomes higher in relation to other generation resources on transmission grids, system operators are becoming concerned with the standard behavior of wind turbines to quickly trip offline during voltage excursions, thereby losing significant generation resources that may lead to further system instability.

Low-voltage ride-through, or what we believe to be, more accurately, voltage ride-through, because there are concerns for high-voltage events, also, is the capability for the turbine to encounter an extreme voltage event such as a fault on a transmission grid, and not disconnect or trip, due to its under- and/or over-voltage protection.

Standard designs to date have the generator disconnecting with five to six cycles to protect itself from damaging high rotor current and taking as much as 10 minutes after voltage and frequency have stabilized after fault recovery, to allow for reconnection.

By not tripping through the use of much longer protection delay settings and higher and lower voltage thresholds, the turbine is able to remain connected, maintain magnetic flux within the generator, and begin to feed real power back into the grid to help with system restabilization.

Redesign of the turbine and its controls are required to enable this capability, though. However, modifications include adding a UPS to ensure that vital components such as motor contactors, don't drop out, and controllers stay energized.

Rotor current control circuits must have components reinforced to prevent damage from the higher currents experienced during the event. Software needs to be revised, also, to prevent the turbine rotor from over-speeding during the event. It loses load and it tends to speed up, and we need to make sure that it doesn't over-speed, also, to provide reactive power control during and after the event, and provide fast, real power ramp-up after grid recovery.

The intent is to keep flux in the generator long enough to ride thruogh the event and to allow the machine to virtually resume immediate power injection to the grid.

However, this function can also be accomplished through the use of fast-acting reactive components with the wind power's collection system, or even out on the transmission system, that will hold the turbine's local voltage to an acceptable level, thus preventing the turbine's protection settings from activating.

These reactive devices are part of the FACTS class, and include SVCs and Statcoms. The static components, however, may not respond fast enough to be of much use in such events.

My screen just went black.

But reactive components also play a large part in the power factor control and voltage regulations, and there are concerns that are also expressed within the AWEA proposal here.

To enable redesign of the machine, fundamentally, it takes about two to four years to redesign the machine, so one of the things that we discussed at the beginning of this AWEA grid proposal was with the evolving standards as they are in various locations, and the multiplicity of entities in the North American market, it becomes very difficult, as a manufacturer, to gain a timeline when we can introduce new product to the market that meets ever-changing demands.

And so it was our endeavor, from Vestas, to provide input to the AWEA proposal here, that says we as manufacturers, can meet the items that are specified in the proposal here from at technical standpoint, and we are working on a technology presently. We are introducing products that do meet this standard guideline presently, and we endorse the requirements inherent in the proposal, and also the language in the proposal that was identified earlier, that really the solutions should come from the localized studies of particular installations.

This will prevent unnecessary and burdensome economic impacts to the developers here, who are our customers. So, with that, we'd like to move it on and say that we'd like -- we appreciate being here today addressing the Commission.

MR. GRAMLICH: May I ask one clarifying question, Mr. Saylors? The changes that you mention in the manufacturing to meet a different standard going forward, how many of those, if any, could be applied to units already manufactured? I mean, are all of those changes, you know, new, that would only affect units under construction or in the design phase?

MR. SAYLORS: There are products that are being redesigned for the requirements, as identified now, and the future products are looking to provide, without redesign and without modification, to meet these types of criteria here. Not all of the previous models that we have in our fleet are going to meet these requirements here, though, and so installations that are even on the design books right now, may not necessarily meet the requirements, as identified in the code here.

MR. GRAMLICH: Thanks.

MR. POOLE: Pouyan?

MR. POURBEIK: Thank you very much. My name is Pouyan Pourbeik. I'm a Principal Consultant with Electric

Systems Consulting, ABB, in Raleigh, North Carolina. It's a pleasure and honor to be here. Thank you for inviting myself.

Basically, my background is -- my Department and myself, in particular, have quite a lot of expertise in power systems analysis and modeling, and in wind, in particular, in the last three to four years.

Some of our clients have been the Midwest ISO, Alberta Electric System Operator, Public Service of New Mexico. I actually did some studies on the New Mexico Center facility there, so we've been quite heavily involved in analyzing wind facilities, both from an interconnection point of view, from a modeling perspective, from equipment studies, and so on.

So, I don't have a very organized presentation like some of the other presenters, but I'd like to just make some high-level comments and the let the floor open up with questions.

Wind generation technologies, as we've heard, are, indeed, significantly different from conventional synchronous generators. They are primarily of two types, if you will, the induction generator, which is a conventional induction machine, run supersynchronously, or there are asynchronous machines that are connected to the grid through either partial or full frequency conversion, which is achieved with power electronic equipment.

This therefore means the behavior is significantly different, dynamically, than synchronous generators, but to reiterate Nick's point, different does not mean worse or bad, it just means different.

So, from that perspective, one does, indeed, need different mathematical models for simulating these devices.

I won't explain low-voltage ride-through. I think it's been explained enough, but suffice it to say that the details of how that works, can get involved and are different, depending on the technology. For example, in the asynchronous machines, they are frequency-converted. The issue is the protection of the power electronics, whereas with induction generators, the issue is one more of ensuring that the voltage does not fall to a point where the machine cannot recover beyond its breakdown torque.

So, we can go into the details of that later, should we need to. Yes, indeed, we believe a low-voltage ride-through standard is necessary, so we commend both AWEA on their documents and their presentation of that.

As to reactive power and voltage regulation, wind turbine generators certainly can generate reactive power, depending, again, on the technology. For example, the new breed of fully-converted units where you're connecting an asynchronous machine through a full power electronic frequency converter, if those are designed with voltage source converters that have four-quadrant control, you an independently control reactive and real power.

Basically, as to Nick's point, that's perhaps as good, if not better than a synchronous machine, so, indeed, they can achieve high levels of performance.

Even with the conventional induction generators, if married with static compensating devices, they can achieve quite similar performance, just as good, so achieving these performance criteria is certainly accomplishable, technically. We won't go into price and cost issues, because that's a whole different story.

Indeed, I believe the wind farms should be required, at the very least, to provide the necessary reactive power to support their megawatt injection, and beyond, to ensure voltage regulation and thereby ensure stability, because some of these units tend to be connected in weak parts of the system, and so to be able to establish voltage stability, you need that ability to generate reactive power, dynamically and statically.

And then, finally, both the need for low-voltage ride-through and voltage regulation, does, indeed, depend on the size and point of interconnection. For example, if you are connecting a wind farm of less than ten megawatts, buried into the distribution network and it was associated with distribution load, then it may not be necessary to have low-voltage ride-through. In fact, it may be detrimental. You may want that unit to trip for severe system disturbance, so, you know, there are caveats there.

And then, finally, I want to comment to say again that it's a pleasure and honor to be here, and we certainly commend AWEA on their document, and we equally commend FERC for hosting this conference, and through constructive consultations such as this conference, we're confident that renewable energy can be fully utilized, while not compromising system reliability, so, with that said, thank you very much.

MR. POOLE: Okay, Ed, I'd like to ask you a question. How much more would you like to talk?

(Laughter.)

MR. TORRERO: A few minutes.

MR. POOLE: Okay, I'll give you a few minutes.

MR. TORRERO: Thank you, thank you very much.

I pointed out that the coops' mission is to provide consumers with safe, reliable, and affordable power. And I would argue that, in fact, the entire purpose of our discussion is focused on the consumer.

We put the consumer first. They own the coops, the coops are the basis of the Association.

And in line with that objective, we've noted a number of things that are quite commendable with regard to the AWEA proposal. At the same time, NERCA is concerned that some elements would grant wind generation, special treatment, not warranted by the advanced capabilities of the technology.

We've heard several examples of how this technology has matured. The question is, is it a fully matured technology or is it not? Does one want to have the flexibility of a mature technology or have special treatment?

These elements, we think, of the proposal, would permit wind generators to escape reliability requirements to which all other forms of generators are subject, even when the wind generators are capable of meeting the additional requirements. The requirements are just and reasonable, and where the requirements are essential to preserve the reliability of the system -- for example, the proposed Appendix G would give wind generators the right not to meet the same power factor requirements to which other generators are subject, if at the time interconnection studies are performed, the full plus-or-minus 0.95 power factor is not required to preserve reliability.

We contend that that proposal is unduly discriminatory and threatens system reliability. As demonstrated by AWEA's own filing, wind technology has matured to the point, and as mentioned by several speakers, where it can readily meet the same plus-or-minus 0.95 power factor to which all other generators are subject.

There is no technological reason for special treatment. Moreover, the proposed special treatment would threaten the reliability of the system, and potentially lead to significant cost shifts.

Although a system impact study may suggest that a wind generator may not need to have the full range of voltage regulation at the time the study is conducted, that conclusion only applies to a particular point in time.

The Commission has required the full .95, plus or minus, power factor of other generators, because it has recognized that system conditions evolve and that future demands on the systems may call for the full range.

If a generator is incapable of providing the full range of voltage support when it becomes necessary, it could threaten system reliability. Certainly, the critical role of voltage regulation was recently emphasized by the August 2003 Blackout Report.

To prevent that threat, someone else, either the interconnection providers, other consumers, or other competing generators, would have to bear the cost of solving the problem caused by the wind generator's lack of flexibility.

If wind generation is truly to become a mainstream generation technology, as NRECA and all of us do hope, the wind industry cannot be permitted to duck its responsibility to the system, or to shift costs to consumers or competitors.

Thank you, sir, for this additional time to complete my statement, and I look forward to a very productive conversation.

MR. POOLE: Thank you. Okay, I'm going to open it up to some questions, and since I'm an engineer, feel free to stop me if you don't understand my question, because it may be obvious to me and the attorneys may not know what I'm talking about.

In order to try to do a rule, we've got to all understand it, and that's what we're going to try to do today.

And the panelists can ask us, if they don't understand it.

My first question goes to penetration. When we're looking at penetration from a reliability standpoint, which is what I'm going to try to look at, are we talking about megawatt percentage penetration of a control area, a reliability coordination group, or a utility? I'll just let somebody jump in and tell me.

MR. QUIST: I'll address that. When we view penetration, we view it on a control area operator standpoint, that you look at how large your generation portfolio is, and then what you do is, you look at what percentage of that is wind.

And the issues we see with penetration are actually twofold, actually: One of them is, of course, is that portion of your portfolio able to support the system during disturbances? And the other one is, as that -- as you have megawatts injected into your portfolio, what do you do when the wind isn't blowing? How do you back that up?

In outage conditions, how do you take into account, that being there and not being there? There are issues. Within WEC, there are certain requirements as to how much reserves you have to have for thermal, for hydro, and so on and so forth.

Now, how do you take into account, the reserves that you have to have for wind? So, WEC is wrestling with this, the Northwest Power Pool is wrestling with this, but it is an issue.

MR. POOLE: We had asked NERC to be here, but I guess they didn't think that they had positions, so much on wind, so they were going to leave it up to people from the various Reliability Councils who are working on it.

MR. CALDWELL: Can I make a comment on that? I think, you know, most of the issues that we're talking about here on interconnection and the technical issues we're talking about here, are, let's say, instantaneous issues. They are not really subject to the tariffs and talking about inter-hour balancing and all these sorts of things.

We feel very strongly that for these interconnection issues, that we not sort of prescribe these things by control area or by scheduling coordinator, that that's really Rob's conference a couple of months down the road.

These issues that we're focusing on here, you know, Kurkoff's Laws don't respect whose control area this is in. We are all interconnected, and we have to think of this, not so much from the individual control area responsibility, but from the grid responsibility, and the grid as a whole.

The issues really are not who's in charge, but, really, what are the transmission interconnections? How weak or how strong is the grid in that place?

And that is one of the significant problems that we have, is that dividing these tariffs up into little pieces and a lot of individual control areas is just a prescription for real problems. And at least for these standards, we would like to see them kept at the technical level and talk about the grid. It's just too fast to worry about, you know, whose fault it is or whose responsible for this or that. It's got to be something that happens, electrically, in real time.

MR. HOCHHEIMER: I think Jim is right on target. You could have a fairly small control area that's tied very stiffly into the system, so as far as reactive response or low-voltage ride-through, it doesn't really matter. I mean, it's a regulation issue as far as the control area.

MR. MILLER: I'd like to third that response, but also toss out the idea that this is part of the evolution of practice and understanding that several of us -- I know I made reference to it. We aren't quite there yet in terms of understanding which aspects of the variable output are truly important and how much of that is historical -- I'm going to use some pejorative words here -- baggage, associated with the way the system has evolved and his presently administered, and how much of that is truly a requirement related to maintaining system reliability.

Jack's point, a little control area that's tightly connected to the rest of the system, being held to very tight constraints on interchange, may not actually be -- have much to do with reliability requirements, but be historical. As an industry, we've got to move in the direction of resolving that.

MR. QUIST: Let me just put in one last comment: Within WEC and other Reliability Councils, what they do is, they lay out standards that are applied uniformly to the individual control areas within the Council.

And it doesn't matter how much wind -- I'm sorry -- how much thermal, how much hydro you have; these are the same standards that will apply in each of these control areas within the Council. So, as long as they do that, as long as everybody is applying the same standards, everything works together.

Now, what I'm hearing is, well, it doesn't really matter, because, well, this is just a little pocket over here, a little pocket over there. We really do need to come up with standards that they can apply uniformly to everybody, and then as a whole, these large groups can function properly.

MR. POOLE: Okay. Anybody else have any questions on that?

MR. GRAMLICH: I'm going to be kind of the clueless technical person on this and try to bring it back to what I can understand what would go into our rule, versus other processes. I want to make sure -- we want to sort of facilitate a process for these issues to get resolved, whether it's in a FERC process or outside of a FERC process.

Some things here would go into the interconnection rule, but I want to, I guess, ask a question about what needs to happen outside of sort of a

FERC process. Craig, you mentioned in your comments, the IEEE standards that perhaps could be used on an interim basis.

Are you -- and there are IEEE standards that Tom discussed, and there was also modeling efforts that AWEA and --

MR. QUIST: Actually, what I proposed was the adoption of the low-voltage ride-through, that FERC put those in place, without any caveats, on an interim basis, until IEEE and NERC have the ability to put those through their normal process and come up with some new standards, or as an option to that, throw this over the wall to the Reliability Councils, and say, we're going to put this in place, but now we need you to go develop your low-voltage ride-through standards, so that you feel good about them.

MR. GRAMLICH: Okay, so NERC and Reliability Councils, you would recommend, should get busy on low-voltage ride-through standards. Are there other things that you would recommend that they work on?

MR. QUIST: I think, overall, as we've heard today, synchronous generators, nonsynchronous generators are two different animals. That doesn't mean one's any worse or better than the other, but I believe that if you go and you look through the reliability criteria that are right now in place, you'll read these apply to synchronous generators, and that what they need to do is go back and revisit their criteria to see if there are some variances that need to be put in for nonsynchronous generators.

Otherwise, they will get a buy and they will say we're not synchronous generators, so this doesn't apply to us.

MR. GRAMLICH: You were on the WECC Committee on this or still are?

MR. QUIST: Yeah, I'm right now on the Technical Study Subcommittee of WECC. There's a separate committee called the Reliability Subcommittee, that actually drafts the reliability criteria and works with NERC on that, but, yeah, I do have some input.

MR. GRAMLICH: And WECC is working on this?

MR. QUIST: WECC is working on a low-voltage ride-through criteria, as we speak. It's now out -- it's been out for comment and it's going through the due process.

MR. GRAMLICH: Okay, do you know about other Reliability Councils? We don't have any others here, and we don't have somebody from NERC here.

MR. QUIST: I'm not aware of what other groups are doing. We know that within WECC, that because of Pacificorp's efforts and Public Service of New Mexico's efforts, we raised this to the surface about a year ago, that it needs to be addressed, and we've written white papers on it, so they're actively pursuing it.

MR. POOLE: We'll probably get more information on it this afternoon, because we'll have ERCOT here, which is another coordinating council, and we'll have various ISOs, so they can identify in their areas, you know, what's going on.

MR. CALDWELL: I was going to mention that ERCOT, to our knowledge, is probably as far along or maybe even further along than WECC, for a lot of reasons, here. Many of the others are playing catch-up.

I mean, I think that New York has a big study effort. It's not yet in the standards development process.

We just see a whole range of things and that, again, one of the functions of this petition was to jump-start some of those efforts and to make people do that. And if we would have waited for all of these efforts to evolve naturally, we don't believe that we would have gotten nearly as far as we already have, and we don't think that's going to work, that it's just going to take too long, and it's going to end up with too much of a hodge-podge of stuff, and that we will, as I think Nick said, we will close the barn door after the cows leave, or in the alternate, what we will do is prevent this new economic generation from making its rightful place.

And so we feel that the FERC does have this role now at this time. And that role is not necessarily in the standard purview of the FERC to set, you know, engineering standards or to try to supplant IEEE and so forth and so on, but it's -- two years ago, we couldn't even get on the agenda at an IEEE meeting.

And now there are beginning to be -- there is a committee of IEEE called Emerging Technologies, okay, which at the June IEEE meeting, for the first time, took up this issue.

There's going to be another discussion of this at the next IEEE Power Engineering Society meeting to do this, so we have started this process, and what we really need to do is to accelerate that process, and that involves laying down a marker in the sand that works, that we're not going to regret three or four years down the road.

And the perfect is the enemy of the good. If we wait for IEEE ballots, if we wait for all these things, it will be way too late. We have to take action now.

We have to tell the turbine manufactures, what it is that they need to design to. We have to jump-start this process.

MR. POOLE: And back to WECC, their standards that they're trying to develop, will they be set up with any kind of a prescreening criteria? In other words, penetration level on the size of the control area, on the amount of wind, on the voltage? You know, whether you're working at a high voltage, or a medium voltage, or a low voltage? Is there any kind of a screening that can identify how you break out the requirements?

MR. QUIST: On the WEC standard right now as it stands, they're not distinguishing synchronous from nonsynchronous, and it's going to be on a per-generation facility basis.

That is a work in progress. As it stands today, I've let them know that, as stringent as theirs is--and of course it's going through due process--as stringent as theirs is, very few if any of the wind turbines could meet their standard, how strong it is.

So what we're trying to do is to have them sit back and look at it from a reliability standpoint: What are the impacts? And are we being too hard on these? We're questioning if their standard could even be met by regular synchronous facilities is how strong it is.

So it is a work in progress. But they haven't gone through any screening in there having to do with penetration levels. I think that is something that has to do with a utility-by-utility or control area-by-control area, and what I understand on that is that the issue with penetration is you can take a strong transmission grid and, by having the penetration go too high with wind, that strong transmission grid now acts like a weak transmission grid because of lack of voltage support and other issues.

So that is the balancing act you have to have.

MR. HOCHHEIMER: Could I ask a question, being on the panel? This is for Craig. Would this standard that WEC is looking at, would that be retroactive? In other words, perhaps require retrofit of existing facilities?

MR. QUIST: That, I don't know.

MR. HOCHHEIMER: We have to be careful there.I

MR. QUIST: I would hope not. The issue we're running into is we have an area near Walla, Washington, which is a heavy wind plant there. We have wind plants on our system, on the Bonneville Power System, that are in excess of 300 megawatts. And even though it is on a strong transmission system right now, and none of the turbines have low voltage right-through, events have happened on the system where all of the wind plants within that area have been tripped nearly simultaneously. And at this point it hasn't been an issue because our single largest contingency is larger than that number, but now since it is a rich wind area we could double or triple the size of the wind plants in that area.

So now we reach a point where all of a sudden all of them trip. Oh, now we do have a problem. What do you do with the guys who were on there before? Who pays for fixing the problem? Instead of waiting until you break the back of it, as we get new turbines coming on from now on let's start putting this low voltage ride-through and some of these other capabilities on there so we don't wait until the back breaks on the camel before we have to figure out who fixes it.

MR. HOCHHEIMER: I guess an important point I want to make is we want to be careful on retrofits. I mean a lot of projects are in service today that have negotiated power purchase agreements that made the projects work financially in the first place.

If we go and add retrofits on there that no longer make that financially viable, I mean you may actually decrease the amount of wind generation. In other words, some of these may have to shut down.

Furthermore, some of the requirements. Reactive capability, you can always retrofit something that will meet just about any requirement, at a price. Low voltage ride-through, not necessarily. Not necessarily. I mean it could be impossible to meet the requirement, and therefore the plant is no longer viable.

MR. MILLER: Can I comment on the low voltage ride-through, too? Craig just hit on, you know, this is my close the door before the cow is out question, but it is also against this fairness backdrop.

You want the majority of the wind generation that the system is depending on when we start to get in enough wind generation out there to make a difference to stay active, but the fairness question of for example the most aggressive side of this debate is wind generation shall not trip no matter what happens short of disconnecting the lead from the farm to the grid. That is in our view something that somebody writes down but becomes a technically extremely challenging problem for the wind generation for everybody's technology, and it frankly may not be even meetable by existing generation.

And yet, at least--I think this has been floated at least in WECC--is effectively a nearly punitive level of requirement for thou shalt not ever disconnect. We think that---and this is our view--that that is too far on the side of protecting in a sense the incumbent system. We don't want to do anything different. We don't want to plan different. We don't want to operate differently. You know, don't make our life--don't upset the apple cart. We're going to put this requirement on the generation, regardless.

MR. QUIST: Yes, the WEC low voltage ride-through as it talks about it right now, it basically says for normal three-phase and single line-to-ground fault with delayed clearing, generation shall stay on line. It doesn't say where. Basically, on the transmission grid.

So the problem you have is that as you get closer to the wind farms, they become more and more sensitive to normal disturbances. We've seen that in studies. And now it's just a matter of what is the impact of that now on your reliability, because as you start tripping larger and larger wind farms, it's going to hurt you.

MR. HOCHHEIMER: Let me make a point on--

MR. POURBEIK: Could I--

MR. HOCHHEIMER: --the wind generation going away when there's a fault, too. There's other things that can make the wind generation go away. It's an intermittent resource. If the wind dies, it's going to go away.

MR. POOLE: That's a question. And that gets into another question we had--

MR. DENNIS: We had another comment.

MR. POOLE: Oh, I'm sorry. Go ahead.

MR. POURBEIK: I just wanted to comment on Craig's last point. That's an excellent point. Just if I may correlate that to the AWEA low voltage ride-through, let me backtrack for a second.

I think perhaps this is what we have worked with with our clients. Perhaps a sensible compromise is to say for external faults to the wind farm--and I'll explain what I mean by that in a second--then the wind farm, the majority of the generation in the wind farm should stay on line.

What I mean by "external fault" is any fault that's on the transmission system is not on any part of the collector system in the wind farm, and if the wind farm is connected to the transmission system through a radial line. And by "radial," I mean it just goes straight to a sub-station. There is no other point of interconnection on that line, that a fault on that line would still be considered internal. So anything beyond that point, you would hope that the wind farm would stay on line.

The reason being to Craig's point of if you have--and we've seen this in Midwest ISO, we've seen this in Alberta, and in WECC where you have an area that's rich in wind and you have a lot of wind farms connected to a central nodal point in the transmission system, and if you have a fault at that sub, which if these were synchronous generators they would be designed not to go unstable, whereas here you're saying without low voltage ride-through you could potentially trip hundreds of megawatts of generation.

Now to correlate that also to the AWEA standard, and maybe this is a question, my understanding of the AWEA proposed low voltage ride-through standard is that's at the point of interconnection. So that's beyond the collector system. It's at this transmission level we're talking about.

If that be the case, the lowest point on that curve is 15 percent voltage, so what that means is for a nearby three-phase fault, you're allowing the wind farm to trip. I'm not saying that's right. I'm not saying that's wrong. I'm just saying that's what it is.

So understand that. Whereas, if you are applying that low voltage ride-through curve at the turbine, then you could have a three-phase fault on the grid and still ride through because the voltage at the turbine is going to be higher than the voltage at the point of interconnection, depending on the technology, of course. But because it's provided short circuit, again depending on the technology, the voltage at the turbine will be higher than the point of interconnection.

MR. POOLE: Within the AWEA proposal, the low voltage ride-through curve that's there, that is at the point of interconnection for this farm?

MR. CALDWELL: Correct.

MR. POOLE: Okay.

MR. CALDWELL: And we feel that--I mean obviously you can get into nuances and, you know, you're trying to make some bright-line distinction over what is really a whole gray area, but certainly the philosophy that was expressed is the philosophy that we tried to do.

And we tried to say, first of all, that it ought to be a point of interconnection standard. And that how that interconnection standard is made ought to be allowed to be--alternate engineering solutions to meet that should be allowed.

And as soon as you go back to setting turbine standards, then you begin to get into significant problems. But that is the philosophy we set. Now if you're trying to say that every single fault that you can think of, you know, needs to be ridden through, then a couple of people have already made the point there isn't any generation on the grid that can meet that standard anyway.

And so trying to set some standard that says you have to go to zero and stay there, and have to ride through that, you know, that is not practical for anyone. It doesn't mean that down the road that, as things develop and so forth, that that standard that we've put forward, you know, shouldn't be modified.

I mean when you look at where that standard came from, or where that curve in our petition came from, it came from Germany, really, from the EON Standard. It was an adaptation of that.

What EON did is essentially that. They said we have to do what is technically and cost effective today, and we're trying to push the technology in a direction. And this is what we see as important for us right now. This will take care of, you name it, 95, 99, 90 percent of all of the issues we can come up with, and better to do that than to do nothing, or to try to set a standard that no one can meet.

And so that's how they came up with a standard. It is being practiced in about at least half if not more of the wind turbines around the world, and we don't see the benefit of setting some other standard that's going to go off in a direction of a single control area, or even a single reliability council can do that is going to be meaningful in the sense of from a turbine manufacturer's standpoint, or from protection of the grid.

MR. QUIST: As we were working with AWEA on developing this standard, this was thrown around: should it be 15, you know, .15 percent, should the interconnection point be at the turbines?

The way we view this is it makes a lot of sense to view this as a wind plant, and that these standards apply to the interconnection point at the wind plant.

And why that makes sense is this gives the wind plant developers the opportunity to put supplemental equipment on if they need to to keep the turbines on. Granted, we wrestled with the .15 percent versus zero. They went with the .15 percent because of--and we've looked at our studies that, yes, if we went right to the interconnection point, the high voltage bus, and we applied a fault, even with the new standards it would trip. But if you went one bus away, one substation away and had the fault, it wouldn't.

It is one of these wrestling things that the turbine manufacturers tell us that that .15 percent, to drop it down to zero, yes, it can be done; this would require significant redesign in turbines probably around the world. This would--and what they're trying to do is they're trying to come up with a standard that's uniform in this country and in Europe so that they can apply the same designs in both locations, and it makes it so they don't have to put the additional significant equipment, so that they can ride to zero.

MR. POOLE: I think we kind of understand the beginnings of low voltage ride-through, at least I think everybody has got that. Why don't we talk about voltage support and reactive power. That question is:

I see reactive power as more what you need based on the grid and where it's at, and where the plant's at. And it would be more to be done by the area and develop what you need.

Is that a right way to look at that?

MR. QUIST: On reactive power, as we viewed that, what this is is as your system is going through you've got a couple of things.

One is you've got your steady state as to what you need to control your voltages under normal system operations.

Then what you have is: What are the reactive power capabilities during a disturbance that will allow the turbines to stay on line and to provide reactive support to the transmission system.

The weakness we see in what AWEA is proposing is they want to take a standard wind farm, and there are some that have double-fed induction generators that are able to put out VARs that are a little bit different than this, but a traditional wind farm that doesn't have the GE turbines on, or some other turbines and they just want to put, merely put on shunt capacitors to change the power factor, we maintain that what's going to be needed for most wind plants is to actually put a dynamic device in; that by the time a disturbance happens, you won't even have time to switch in one capacitor bank before the disturbance is already over. That you're going to need to have dynamic VARs that when that disturbance happens, they can react immediately versus waiting for shunt capacitors to switch in.

MR. GRAMLICH: I think a couple of other transmission providers raised that, as well, in their comments.

Jim Caldwell, or somebody from--or Jack, do you have a response on dynamic reactive power?

MR. HOCHHEIMER: Well I think it depends on the point on the grid. I mean you could end up with an interconnection where--let's just talk about steady-state for a minute--you could end up with negative reactive losses because it's close to a load center, assuming that you're compensating the unity at the point of interconnection.

You could also end up with situations--and I've seen these--where you have ties to fairly weak systems. I other words, where the equivalent impedance looking back into the system is high, and you actually have typically high voltage situations where you want to absorb VARs. You never want to generate VARs there. You would end up with excessively high voltage that would cause problems, including tripping your wind turbines offline.

So I think it really depends on where you are in the grid. I don't think you can just say that there's one size fits all, and that's why we maintain that you really have to look at each individual situation.

We are really very hesitant applying a standard that is going to across the board require a lot of additional costs and complexity if it's not needed. This is going to inhibit development of wind generation.

MR. ROONEY: Jack, let me ask a question then.

Are you suggesting that the wind power should be within the range, like the .95 to .9 lead lag? Or negotiate it during the interconnection process? Or what? I mean you're saying you don't want a standard?

MR. HOCHHEIMER: Well we want a range that becomes the standard. We don't want to have to go to .9 at the point of interconnection. But we don't think that, for example if the studies show adequate performance at .98 lagging power factor, why would we have to go to .95?

MR. ROONEY: So you're saying on a case-by-case basis, then?

MR. HOCHHEIMER: That's right. I mean that's just more cost. It's going to be a higher cost. It's going to mean there are more projects that will not develop. It will kill project, and it will cause things to break that will cause the wind to come off line. And we've seen this in operation. Capacitors break. These are things that don't work all the time.

MR. ROONEY: Jim, your response to that?

MR. CALDWELL: I'll have to admit that the wording of that particular paragraph was a difficult issue for us. I don't think there's any disagreement on anyone's part on this side about the philosophy. I don't want to get hung up in another debate here about what this particular phrase means.

I mean we spent probably a week deciding whether to use lead, lag, loose BOC, and whether we were looking from the turbines going out, or the system coming back, and that this is one of those issues which is always going to be a problem.

We came up with the language that we did, recognizing that the output from these studies was an important input. I think the weakness, if I'm looking at the language now, has to do with this fairness thing, not with reliability.

I'm ont worried about the reliability of the grid or whether there's enough reactive power on the grid. We have covered that. That's covered. Where we're going to run into some problems is this idea of the first 300 megawatts on the system at that point in time gets somehow some differential treatment from the next, and that's going to always be a problem. I don't see us necessarily solving that here.

And we came up with what we think is the best language that we could. And as I say, I think the perfect is the enemy of the good, and I don't see much benefit to taking it beyond that because I think we have covered the reliability issues. We're not doing anything in these standards with any of those caveats or anything else that would say that we're going to impact the reliability of the grid, or that we're going to cause some big, huge cost shift onto someone else. It's more of an intergenerational issue among the wind farms that we're talking about.

MR. GRAMLICH: Can I just--I'm a little thick here. I can't tell if you two disagree with, let me just read PNM's comment on this point:

"Wind generators should add sufficient dynamic reactive power capability as part of the wind farm design required to mitigate any reliability criteria violations caused by the interconnection as identified in the Interconnection Study Process."

Is that language okay?

MR. CALDWELL: We don't see any, necessarily any conflict with that language and the language that's in our petition.

MR. GRAMLICH: Okay, that's helpful.

MR. DENNIS: Just generally, I think just to preface this a little bit and maybe we could explore this, but I think the purpose of 888-2003 is we're looking to eliminate--you know, we're looking to make these things nondiscriminatory. And I guess one of my questions is, when we talk about, you know, one of the things that your proposal says is that if the system impact site is demonstrated that reliability criteria are met at less than, you know, the voltage level, or the number that you have, I guess my question is: Whose reliability criteria are we talking about? Is this a potential source of dispute among transmission owners, developers, and manufacturers?

MR. CALDWELL: There will always be a role for the FERC as a dispute resolution mechanism for these issues.

(Laughter.)

MR. CALDWELL: You don't need to worry about being stranded regulators, because we have crafted--

MR. DENNIS: Oh, I don't know that that's a concern, believe me.

MR. QUIST: Let me just address a couple of things. Usually the reliability criteria, talking about each Regional Council has their own set of reliability criteria that you have to meet, so it's pretty standard. It's published. So no one is making this stuff up.

The other one is, when you're talking--I think our issue with how AWEA had versed it was, talking about the power factor, was they wanted to have the power factor correction done strictly with static devices. And we agree with PNM that if you have areas that are stability-limited and you need to have those dynamic devices, please don't strap transmission providers and say the only solution you can consider is a static fix.

Instead, there are other devices that you need to--that we have in our tool boxes that we can fix some things.

MR. TORRERO: I think there is a fairness issue here, as well. If a mature technology comes along and is exempted from the power factor requirement, one has to ask--and we're not asking for any retrofits at all; we're looking forward, not back--but one has to ask: Why would the others then be asked to make up the difference when the transmission system might need this additional flexibility?

The Blackout Report was very clear on the need for good voltage regulation. There might come a time when this flexibility might be needed. One can envision if this was to go through having to proceed to say how would you decide in the future? Who would be called upon? Who would bear the costs? Would it be the other generators? Would it be the consumer?

It certainly goes to the point that the Co-Op's principal mission is directed to of providing the consumers. We put the consumers first. It's not about generation. It's not about wind energy--although we're promoting wind energy to the maximum amount--it's consumers getting affordable, reliable, and safe power. So I think there's a real fairness issue involved.

MR. CALDWELL: And again, I just want to emphasize that we, the wind industry, are not asking for any exemptions from our responsibility to be good citizens on the grid. We are asking to be treated appropriately that ends up with an equitable apportionment of that responsibility. And that means different--at least different words, if it all means the same thing and it all means equivalency in terms of that responsibility, and there's nothing in that petition which asks for differential treatment simply because we are wind and we're asking to shift cost onto other people.

Now if what we're arguing about is some wording in there, that's one thing. But I want to make clear that there is no intention from a matter of philosophy or anything else to escape our responsibility to be good citizens on the grid.

We want to, and we know we need to in order to be considered a real generator, in order to get high penetration on the grid. So I don't think we have any disagreement.

And I would say that, again, that if that's--I don't want to ascribe any intent to anyone--there is no intent in this standard. Again, if we're going to argue about words, that's one thing, but let's not talk about the intent.

We understand our responsibility and we're willing to shoulder that responsibility. But we don't want the costs shifted onto us simply because somebody else, as somebody else said, wants it but doesn't need it, or they think they have the political power to extract it from us when they can't extract it from someone else. That, we feel, is discriminatory and that is the reason why this is before the FERC at this point in time.

MR. TERRERO: I respectfully beg to disagree. There will be, under the scenarios we've described, some kind of cost shifting. And the wind industry is apparently asking that, as the new guy on the block, or the new gal on the block, whatever, that they be exempted from equitable sharing of the basic costs.

MR. POURBEIK: Could I make one last comment on it? I tend to agree that there should be some sort of minimum requirement on the power factor capability on the farm as a whole, and there should not be any, to Jack's point, it should be studied case by case.

I don't think there should be anything that says it cannot be discrete, or it cannot be dynamic. That needs to be studied on a case-by-case basis. Because we have done studies where we see a lot of wind generating coming into a weak area of the network where there's no other generation and you just simply cannot make it work without having dynamic VAR reserves.

Yet, you have other places in the Eastern Interconnect where the system is meshed like crazy and, yes, you can put a wind farm in there with switch banks and make it work because there's enough other dynamic reserves around.

The other thing is, you could put--we've shown that you could put the dynamic VARs as a system level SVC and still make it work, but then that raises the questions of who pays for what, and does this get paid by the transmission owner and put into the rate base? Do the wind developers pay for a portion of it? And that's a whole different complicated scenario.

MR. GRAMLICH: If I could just--Mr. Terrero, you made some pretty general statements about cost shifting, and I don't have--maybe I'm just missing your papers here, but if you could just commit to provide specific information about what requirements would lead to cost shifts so that we can be comparable and equitable about this, we would really appreciate that.

MR. TORRERO: I'll be glad to provide some written comments.

MR. GRAMLICH: Thank you.

MR. ROONEY: Ed, just to follow up on that, too, and this goes back--we've been talking an awful lot about wind energy, but there's also been some references to other evolving technologies. The only one that I'm--that would be nonsynchronous, for example. Can anyone tell me what other technologies are out there, or are emerging, or whatever, at this point, that would be comparable or similar to wind energy?

MR. QUIST: You have solar, of course. And we have been doing some work with some battery technology, flow-based, which might be in conjunction with wind farms, or in remote locations, charged up, separate from the wind farms charged up in off-peak hours.

But some of those battery technologies actually do provide reactive support. Most of them do.

MR. POURBEIK: Actually, the battery energy storage units, typically the newer technologies are voltage source converters with four-quadrant capability, so basically independent control of real and reactive power. So they would meet all these sort of requirements.

MR. MILLER: One thing that might be worth exploring, based on your question though, and Pouyan raised it earlier, is the minimum-size question, because I don't think that we've completely wrestled that to the ground. Photovoltaics are coming along. GE is taking photovoltaics very seriously. There's other technologies, but for the most part we aren't talking about tens, hundreds, or thousands of megawatts connected big enough to in a sense move the system for quite some time yet.

And indeed, I think one of the things that was a little contentious even as we were writing the petition was, what's the floor below which you give any of these technologies--I don't want to use "a buy" but apply a slightly different set of standards?

Pouyan made a very important technical point that was pretty arcane even to those of us that worry about these problems, and that is: For example, low voltage ride-through is in fact probably not a desirable thing for individual wind turbines deeply imbedded in distribution systems. There's a reason why the industry sort of changed its mind within the last couple of years.

So I think--and we did address that to some extent in the petition, but that applies I think in your thinking to all these other emerging technologies because they're going to be hundreds of kilowatts, ones of megawatts for, you know, till the ends of our careers.

MR. CALDWELL: And another thing, as I say, I realized in the interest of simplicity we would all like one solution that worked for everything. It isn't going to happen. We put this petition into the Large Generator Interconnection Agreement for a very specific reason.

And, you know, Tom gave a very nice discussion of 1547, and at the end he said, well, gee, now we're beginning to look at something beyond 10 megawatts. That whole effort really belongs in a different docket.

I'm not saying it is not going to have to be addressed in that other docket, it will. And as a matter of fact, in that other docket I think what you are going to find is that the requirements that everyone is arguing about in that other docket really are in dense urban areas where the grid is very different. And that where wind is going to enter in at those size levels is a very different place, out in the NRECA Rural Electric Co-Op Grid.

There is really probably going to have to be maybe three sets of criteria, or something, to cover all of these things. It just is not going to be that simple.

We tried to make this petition specific to the Large Interconnection Agreement, 20 Megawatts and Above, tied into the transmission system. And that's what we tried to gear this to. And, yes, some of this flows over into some of these other things, but we need to be careful about taking it over there without thinking about it.

MR. ROONEY: Right. Thank you, Jim.

One comment on that, though, is that we've taken that into account of course, but we also have to consider what the technologies are that would be affecting the small gen, and that's one of the reasons why we included that in this conference as well.

So again I would like to have any comments that we could regarding the other emerging technologies, or even existing technologies, and their either differences or similarities to wind and also what we need to do as far as an Appendix G to recognize that.

MR. DENNIS: Just to follow up really quickly, Craig, were you suggesting that solar and photovoltaics have similar concerns to what we've been discussing? I guess I missed what you were saying exactly.

MR. QUIST: The question was: What are the other emerging technologies? And I was just going through the list. One other one I'd forgot was your geothermal. So he just wanted to know what are the other emerging technologies. That's what I was addressing.

MR. DENNIS: I guess my question then would be, as far as you know, do they have similar concerns in terms of the things we've talking about that something like this might address?

MR. QUIST: I believe most of the other technologies probably have the electronics built into them that this wouldn't be an issue. That's what I believe. I believe that it's because of the characteristics of the nonsynchronous machines that are typically in wind farms now and we're moving towards of course the electronics in them, but I think that's the issue.

These other ones--in fact, that was one of the issues we put in here. One of the items we brought in our comments was, instead of making this specific to wind generation, this should actually be--instead of referring to it as "nonsynchronous wind generation," it just should say "nonsynchronous generators." Don't apply it--

MR. ROONEY: That was one of the purposes--

MR. QUIST: --to only wind.

MR. ROONEY: --for the question.

MR. QUIST: Yes.

MR. ROONEY: The other one that I do know about, for example, would be the hydroelectric facilities. Some of the smaller hydroelectric facilities for example, say less than 5 megawatts, would have inductive generators.

MR. QUIST: Yes. And we have facilities like those on our system, and many of the same problems that we're seeing with wind generation we also see on those facilities.

MR. ROONEY: We would be interested in hearing about that, as well. Do others agree that it should be nonsynchronous generation, as opposed to nonsynchronous "wind" energy generation?

MR. TORRERO: Makes sense.

(General nods of agreement.)

MR. POOLE: Question. This would go back to size. Are we saying that we could not write an Appendix G that would cover small generation and large generation from a 20 megawatt cutoff standpoint? Are there going to have to be two separate devices, or schedules; that they would be so much different they couldn't be put in one?

MR. QUIST: We think that it would be nice if it would cover the full range. That way you don't have two different rule books you're applying, because people come to us and then we have to go, what rule book. It would be nice if it would cover down to the lower levels of generation.

The problem that you have, though--and we've seen this--is where we're talking, here's the Interconnection Standards at the point of interconnection of the wind plant. As you get into your lower systems and you start applying wind generators directly to distribution lines as an example, your whole concept of wind plant goes away and it's individual turbines connected to distribution systems. So it's a little bit different animal.

MR. POURBEIK: Let me just comment on that. Back to what, feeding back to what Nick and I have thrown back and forth, when you are on a distribution network let's say we're talking a very small, a half a megawatt or a megawatt wind farm on a distribution network, if under that scenario a disturbance on the transmission network were to isolate this small distribution network by itself, and that wind farm were to ride through the fault and stay on line, you could potentially get into resonant issues where you get excessively high voltages and you could damage equipment.

So actually you would want that turbine to trip under those circumstances. So why impose the added cost of a low voltage ride-through on that wind farm when you actually don't want it? I mean that's just one example, but these are the kinds of issues.

So on the smaller base asynchronous units buried into distribution networks, some of these requirements may actually be not only not necessary but detrimental.

MR. TORRERO: What I would like to point out, picking up on Jim and others' comments, is to request that the size of the utility be a consideration as the rules are drafted.

We had an example of a Wyoming Cooperative which has a peak load of 16 megawatts being asked to interconnect a wind farm of 130 megawatts, which is 8 times their peak load. Clearly this is an impossibility. It's an impossibility to handle the paperwork that goes into it, and all the rest.

So we're kind of touching on this subject, but I would like to bring this out and make it clear. We have a lot of small co-ops in diverse parts of the country. We service 75 percent of the land mass, over 80 percent of the counties in the country, and many of the co-ops are small, and the co-op service territories overlap with some of the best wind-rich areas of the country.

Forty percent of all co-ops are in states with vast wind potential, one of the reasons why we're here today.

MR. POOLE: One of the questions that is in the AWEA proposal is that they not be held to the strict standards of having your full design criteria early when you come to the interconnection request.

I guess I'm kind of confused as to exactly why that is a big problem, or why you couldn't do an evaluation, or hire somebody to do an evaluation early so you could pretty much set what you think ou want to do, so you could go ahead and get into the queue. Could somebody explain that to me?

MR. CALDWELL: Could I start on that? That is exactly what we're saying. But the problem is that you can't get into the queue until you have done, under Order 2003 as written, until your facility is--let me read from a System Impact Study dated September 10th, 2004, for a specific project:

"The results of the system impact study will be used to determine project cost allocation for facilities upgrade. The study accuracy and study results for the assessment of the system adequacy are contingent upon the accuracy of the technical data provided by the customer as shown in Figure 3 in Appendix D." Which is essentially the requirements of Order 2003.

"Any changes to the attached data invalidate the study results and will require reassessment. Note that, while the developer has provided the necessary" excise the brand name "dynamic simulation models for their proposed wind turbines, such models have not been tested by us, and" the project developer, and therefore, okay, let me see --in the interim, the transmission provider will assume that the generators are not the ones that are in the interconnection, or in Figure 3, Appendix D, but instead 20-year-old pure induction generators.

What we run into is a chicken-or-the-egg. We cannot get into the queue until we have provided every last little "i" and "t", and it has all been dotted. On the other hand, we can't, once we get into the queue, and then they do the study and they say now you can't change it, this may be four or five years before the project starts.

Okay? And in order to provide the information, we need to understand as we have said for the past two hours, we need to understand the conditions on the grid at that place and at that time in order to do these designs.

And so we end up in this Catch 22 where we have to have completed the design before we can enter the queue, but we can't get the information to do the design until we enter the queue. So all we're saying is--because the only way we get the information now is to already be in the queue, and then get access to all of the data from the transmission provider.

So what we're asking for is flexibility at the front end. This is an interactive process between the transmission provider and the project developer. If we are dealing with someone like Craig Quist who is up to speed, who understands all these things, who has those models, who hasn't, you know, who has done the validation to his effort and is understanding these issues, we can talk to a Craig.

We go to another utility, this is the first time they've ever seen it. They have no idea what we're talking about. We just have this chicken and egg and can never get off the dime.

So that's the reason why we proposed this flexibility at the front end, because it is an interactive thing and you can't require us to have completed the studies before we have access to the data to even start the studies.

MR. ROONEY: Can I just ask a naive question, I guess? Craig, what kind of models are you using, or Jim either one, what kind of models are being used? Are they the 20-year-old models that Jim is referring to? Or are they a newer version?

MR. QUIST: No. Just so you're aware, right now there's basically two modeling packages that most utilities use. They either use the PTI-PSS/E package, or they use the General Electric PSLF package.

We right now use the PTI-PSS/E package. And what we do is, when a wind plant developer comes to us and wants to connect, we right now, if we do not have specific models for that turbine that they want on our system, we then go with Power Technologies. We get the--we sign proprietary data agreements with the manufacturer. We get the information on the turbine. And as part of those agreements, we throw the information over the wall to Power Technologies.

They develop the turbine model. We then go in and we study it. Now that was our answer probably a year ago. What's happened now is--and I'll talk about Power Technologies, and then I'll talk about General Electric--Power Technologies, because of how broad their software is and how many people use it in the world, many if not all wind turbine manufacturers have had Power Technologies develop software specific for their turbines now, and they also have software that you can model wind plants at any levels. So they have done a great job. There are a few little holes, so things have improved since a year ago.

So if they were using Power Technologies software today, they should have access to most of the turbine models. General Electric has great software. It's competing. It can do the things that Power Technologies can. The problem that we are seeing is that, since General Electric not only has software, they also produce turbines, turbine manufacturers have a tendency to throw proprietary information over the wall to General Electric for specific turbines.

However, what General Electric has done--and this is a big plus for them--they've gone in and created, we call them generic models, what they've done is they've produced models for not only the GE turbines, which is an accurate model, they've come up with a pseudo model for Vestas, for Mitsubishi, and all these. That's a plus, so that now if somebody is using the GE software, they can now reach in, pull these in, and do some studies. So they have come a long way.

The down side of it is, they don't have the exact impedances of the turbines. They don't have the inertias. They don't have the aerodynamics of those turbines.

However, there are third-party vendors now available--Internex out of Knoxville--that turbine manufacturers are now going through to help develop this software for these other turbines.

So the issue that Jim is talking about now about letting them come in and do the self-study are what we have found with people coming to us and, you know, we've gone from crawling on this to walking on this, to being able to have a pretty good fast walk. We have yet to see a wind plant where, because of our studies, they've had to go out and change what turbines they put on.

Instead, when wind plant designs have changed it's because the wind plant manufacturer came to us and they said, hey, we can't bet turbine A but we can get turbine B and we're going to have to change the plant, but that didn't do anything with our studies other than we've restudied it with a different model, and here's what we have to do to interconnect.

I think the issue Jim is talking about--and he has some basis for that--is Pacific Corps is a little bit unusual, and some of the larger utilities have transmission planning groups that are now spinning up and doing pretty good on wind plants. What Jim is talking about is they walk into a utility that has never interconnected a wind plant, and they have this strict set of rules. All he is asking for is in the Commission's Order where it says: Thou shalt do the following, that there be a semicolon; or, these studies be allowed to be done by somebody, a consultant on the outside, who has this ability to go in and do this and provide the results to the utility if they don't have that technical expertise within the utility.

I think that's what you're talking about, isn't it, Jim?

MR. CALDWELL: Right. And we don't want to--but since unfortunately queue position, and timing of queue position has so much commercial significance, that what we're saying is is that we have to have a mechanism to get our place in line while all of this stuff is getting worked out. We're looking for that flexibility at the front end.

And it wasn't so much the facts on the ground that caused us to do this. It was the wording in Order 2003 which required essentially the electrical design to be complete and to be presented as a complete package with the filled-out data sheet before you could ever get into the queue.

And it was that requirement of Order 2003 which again makes sense if all you're hooking up is GE Frame 7s, or a Mitsubishi counterpart. But when you're doing this sort of thing, it just simply doesn't work to be that prescriptive.

So we're saying: For these technologies, emerging technologies, or if you wanted to make that option available for all technologies, we're not asking for anything special, we're just saying that we have to have that flexibility at the front end because of the way the Order is written for the rest of the folks.

MR. ROONEY: All right, thanks. Can I get comments from the other panel members on that?

MR. HOCHHEIMER: Yes. I would like to make a couple of comments. It has to do with the schedule on the wind farms and their distributive nature.

In order to make a wind farm work financially, there are a couple of things you need. You need a Power Purchase Agreement that makes the project work financially, typically. And you also need production tax credits.

The Power Purchase Agreement typically is going to have a fixed term. In other words, it is going to start on a particular date, and you have to be there or you pay all these liquidated damages if you're not. So you have to keep that in mind when you're developing these projects.

The other thing is the Production Tax Credits. In order to make use of the Production Tax Credits, you have to be in service during the period in which they are effective.

I am told that last night we had the Production Tax Credits renewed and they will be valid through 2005, through year end. So what's going to happen now is there's going to be a mad dash to get projects in service before year end 2005. And it's going to be tight. I mean starting right now, it's end of September. You have holidays coming up. November, December, people have to work out Power

Purchase Agreements.

And if you want a new wind farm, for example, you have to get land where there's wind. You have to line up leases with land owners' property. You have to start permitting. All of these things determine what the ultimate layout of the wind farm will be--namely, turbine placement determines what that little grid within the collector system looks like, which also determines what the actual performance of the wind farm with respect to the system is at the point of interconnection.

It has a lot greater impact than many people would think, but due to voltage rise across the collector system, you may see more or less reactive support than you think you have, which we've seen that in actual practice.

So you have to get all these things nailed down. Now you also have to get your studies--you have to get in the queue. It's normally going to take a year or better to get your studies done. So you have to get in there. You can't wait until you have every little turbine placed, every little permit granted, every little land lease done. I mean you have to get in there.

And if you don't, you don't have a project. It's a practical matter. You know, you have to allow a little bit of leniency there on what we do up front in order to get in the grid or else we won't have any projects.

MR. MILLER: Can I just elaborate on that? Jack of course was--Jack and I were desperately in the middle of the Tieband Project that had the first low voltage ride-through. As an advocate for this evolution and the fact that the new technologies are coming out, too, there's another aspect of flexibility, which is, okay, a model isn't just a model isn't just a model. People like Craig know that.

You know, just throw it over the transom; the system planner hits a button and a nugget of wisdom pops out. The technology is evolving sufficiently that there's opportunity for some give and take and some creativity in the design of the farm, the features of the turbines, et cetera, that can be added or not in the course of the work, and there needs to be from a process point of view enough flexibility to take advantage of all the constraints to make it economic, to meet the schedule, to advance the technology, be as grid-friendly as you can, and that doesn't happen with a ka-chunk, ka-chunk, ka-chunk, then this happens, then we stop, then this happens, then we stop.

I'm a modeling guy more than a technology guy, so to Craig's point the actual models of the absolute latest hotshot GE machines are a little bit different than what's public because they've got the corner of the application envelope pushed. That's in everybody's interest in the industry, but the grid owners, the operators, the developers, everybody benefits by the technology window being pushed, and we've got to be flexible enough to let it happen.

I am absolutely appalled to hear this quote from Jim. We're going to nail you down with 20-year-old technology and that's the end of the discussion. That is the worst thing that could happen for all of us, all of us stakeholders.

MR. ROONEY: Thank you, Nick. One real quick question. When does anybody think that a model will become available that will be acceptable to the industry, for example? Anybody can answer that.

MR. CALDWELL: They are available. Just my flip answer, they are available now. ERCOT--you'll hear this afternoon--ERCOT is using, and has been using the model. I'm not saying that that's the last model that will ever get developed, it won't be done, but the appropriate models are available.T

MR. POURBEIK: They're available, but constantly being developed. I mean we see this in our studies as well. You're going through a study. You see a snag, and then you know from the equipment experience point of view the model is not doing what it should be and you go back to the software developer, you refine it.

You know, to Nick's point and to Jack's point, to everyone's point, it needs to be an iterative process. You can't just say: Here's the model. Finish the study and give me the result. Because as you're going through the study, based on your experience, you can sometimes see, well, I need to now refine this aspect of the model. We need to be able to iterate through that process.

MR. QUIST: We have gone through a paradigm shift over about the last year-and-a-half on models. Much improved. Much greater. We're smarter about it. The turbine models are getting better. The whole issue is, you can take the same turbine and each wind farm does not function the same because of a couple of things.

You could have the same turbines on three different wind farms and get three different responses because the grids are different, and the transmission systems that they hook to are different. So you just can't say here's a model, you can slap this in and this represents a wind farm.

In fact what you have to do is you have to study that, look at it, and actually to put an individual wind farm in, a large wind farm, probably takes as much or more analysis to get that integrated as a very, very large coal-fired generating plant.

MR. ROONEY: Let me make sure I understand what you're saying. There are models available out there, but given that each wind farm may be unique that you would have to have different parameters even though you have the same model?

MR. QUIST: Oh, yes. We could put a GE turbine in Wyoming versus Oklahoma versus Nevada, and you're going to get some different responses, and different solutions for each one of those just because the layout of the farms are different, and the transmission systems you're hooking onto are either stronger or weaker.

MR. HOCHHEIMER: The collector systems can be drastically different on these.

MR. ROONEY: I guess where I'm headed, though, is how does that resolve, or does it resolve Jim's problem, for example? You have a standard model, but it keeps changing. So how is he going to get some sort of uniformity?

MR. CALDWELL: Well I think that's why we're trying to say we need the flexibility at the front end in order to make this an interactive process.

And if you give the wind--if you can get into the queues so you know you are a real project, and if you want to set milestones to get into the queue, that's fine, but if you know you're a real project and there are these real studies, give the wind project developer the data from the grid so that he can do at least part of the engineering design so that when it is presented for the impact study, or for the facility study down the road, that all of this has taken place.

Let us be in control of that at the front end without prejudicing ourselves commercially that says that, well, we have this chicken and egg that we can't get in until we've done this, but we can't get the data to do this proper design until we're in. And so that's where we're at. It's not going to solve our problem. We're still going to have this problem.

You know, it's a real advantage for wind to be able to do things quickly, but it does have its downsides.

MR. POOLE: You have to realize, though--I've been through this on 2003 and 2003A, and we can get an agreement to let you do the study, but the utility is always going to come back and want to rework the study to make sure that they agree with the results before they say you're good to go.

MR. CALDWELL: Right. We didn't ask to do our own facility study. That's why we were asking for, you know, the early studies.

MR. POOLE: So what you're saying would be like a feasibility study, or an early impact study?

MR. CALDWELL: An early impact study, in a sense, yes.

MR. TORRERO: We think that makes a lot of sense because the whole purpose of the initial studies is to benefit the developer. And if they're playing a leading role, that all makes more sense, provided the transmission provider can come in at a later point and take over on the system impact.

With regard to the models, I think you're going to hear this afternoon from Bob Sabedil (phonetic) on some models they're working on for the distribution system, and that is evolving, and that could lead the way to something that could apply for transmission. But any kind of software you think of, like Microsoft you have to go through various versions before you get to the point that you want.

MR. POOLE: Before we--we're getting down toward the lunch break. I've got a question, and it goes to another idea in the AWEA proposal relative to the SCADA system, and what is going to be required or not required, and do you just set those early, and how it's going to interact with SCADA, and the data that's going in, and how they're going to use it?

MR. POURBEIK: Maybe I could start off. I guess, and Jim can comment on this if he agrees or not, but based on some of the work we've done, the kind of information you would like to have through SCADA is certainly things like wind speeds at the wind farm sites, P&Q, real power, reactor power coming from the farm, basically variables that describe the farm. Whether the turbines are off-line, on-line, that sort of information. And a lot of this may be getting away from interconnection and into the kind of issues I think Rob was leading to, like for example operation of the farm.

One of the things you see being developed now is wind forecasting tools, and a lot of those sort of tools need information from the sites to be able to do those sort of forecasts.

So what you may need to put into this is thought into variables that are not in typical plants. I mean you don't get wind direction and wind speed out of a coal-fired plant, but you may need to work that into the SCADA of a wind farm.

MR. POOLE: I guess you're looking at a control area, or a reliability coordinator. I don't know what they would do with it if they had it.

MR. POURBEIK: Just to have the tools to be able to do it.

MR. QUIST: The issue we have is the forecasting, because once you have it, how well did your plant meet your forecast. Okay?

The other thing we see, and it's an issue that Public Service New Mexico and others have run into, and that is these wind plants, unless there's something in your interconnection requirements, and somebody smart enough to put this in up front and it's been filed with FERC, these wind plants when they come on line can ramp very quickly in a very short period of time to the point that the on-control generators that a utility might have online cannot ramp downward to counteract them.

So what you're going to have is area control to area ACE violations, and you're going to have frequency problems. So if we're going to get into exactly this kind of thing where we talk about what is that interface between the utility and the wind plants, this needs to be taken into account because it truly is a reliability issue.

MR. CALDWELL: And all we're saying is, is it appropriate to include in the interconnection standard the band width and the capability to exchange this level of information, that many of those issues that you talk about belong maybe somewhere else in a transmission usage agreement or something along those lines. But what we're trying to say here is, as a matter of interconnection there needs to be the physical capability to transmit this data back and forth and to have this functionality.

Otherwise, you're not able to do those things down the road that you need to do, or want to do, in the transmission usage agreements or whatever the interconnected operating agreements look like.

So that's why the SCADA belongs here. And again, SCADA is a two-way street. I mean, you know, it's fine for the wind farm to put this, you know, to have this capability and so forth, but it has to go somewhere. And somebody has to be answering at the other end.

So there needs to be these set of standards in the interconnection agreement.

MR. POOLE: When you say "standards," are you talking about the ability to collect all the data and send it somewhere?

MR. CALDWELL: Correct.

MR. POOLE: As a maximum, everybody's got to collect all this and send it? That doesn't necessarily mean there will be somebody over there that will be able to do anything with it.

MR. CALDWELL: Well I think the one--you know, to see what these things actually look like in their full-blown thing, you might want to look at the California Independent System Operator, CAL ISO Interconnection Standards where, again, the reason why they had to develop these standards was because of the nature of the fact that the people at the other end are doing forecasting, and are sending out schedules, and they need this data in real time.

Therefore, they spend a lot of time coming up with, as an interconnection standard, the SCADA capability in order to support that functionality down the road. And that's all we're saying, and that's why we want to put it in the Interconnection Agreement that we need to think about this at the front end, not wish we'd have put in one more line, or one little bit more broad bandwidth and then prevent ourselves from doing things down the road.

MR. POOLE: But I guess my question is, in writing some sort of interconnection policy, does that mean that we need to make sure that there's a scoping meeting and all this is done early and everybody agrees on it?

MR. HOCHHEIMER: Yes.

MR. QUIST: The issue we had with the wording that AWEA had in their document was they tied all this to if the transmission provider could demonstrate through violations of the Reliability Criteria that they needed to have; that this is more of a supply-side planning issue than a reliability.

Yes, if it causes your ACE violations and frequency violations, you know, as it ramps up, then it becomes a problem with the Reliability Criteria. But the need for this is much more of a supply-side issue than it is a reliability issue.

MR. POOLE: A reliability issue would come in more once the operator begins to see how it affects his system and operation?

MR. QUIST: Exactly. And if there's not the capability in there to control the ramp rate of these facilities as they go up, then we could have reliability issues surfacing.

MR. POOLE: Does that change with the intermittency nature? Some days if you've got a lot of wind, is it going to be different than days when you've got less wind?

MR. QUIST: Typically when this happens is when you get like a front coming through, or you're at minimum generation levels and all of a sudden the wind changes. Those are the kinds of things.

We talked to Public Service New Mexico about it. They says, yes, they're seeing it. They're seeing at times within a minute, or two minutes, going from minimum generation to maximum generation much faster than any thermal units can ramp down because you have a limited number of thermal units on control.

MR. MILLER: Could I comment to make sure that we're not talking at cross purposes, though? I'd make a distinction in the SCADA question here, which is exchange of information is not the same as control actions. Okay?

Craig has just described anecdotally and correctly a looming--"looming" is too strong a word--but an operational issue that could conceivably have reliability impacts.

That is sort of my point here about we've got to recognize that this is an evolutionary thing. At some point, we're going to have to wrestle with these active power controls, which include curtailment, ramp up, ramp down, a whole bunch of other stuff. I would argue that we aren't anywhere near. We aren't there yet. And to propose a standard of performance related to ramp rates, curtailment functions, and other things is premature.

In my opinion, we are clearly going to end up there as an industry as penetration goes higher and higher, but that is next gen.

MR. QUIST: We just raised that because now that the whole issue, now that we have broached the subject of this interface, this is just one of the things that wasn't included with that interface issue.

MR. SAYLORS: These control functions, though, in areas like Denmark, have become implemented. And they've been required by the transmission authorities over there. And we've been incorporating them into our improved versions of the SCADA systems, also.

So we see it. And ultimately I think it might be a sooner rather than later situation where the desire to have these control capabilities, and it might be more limiting because of the liability issues involved of when the transmission operator wants to take control of this resource or pass that order to actually take implementation of the action here to the wind park operator.

I think it is going to be more of a legal issue that moves that along than a technical issue at this time.

MR. POOLE: Since we are getting close to the lunch hour, I am going to ask the group here. Are there any questions that we didn't get that you feel you want to ask them real quick?

MR. AGARWAL: Yes, I do have a question on power factor and low voltage ride-through capability. How expensive those capabilities are?

MR. HOCHHEIMER: They're pretty darned expensive.

MR. AGARWAL: Let's say for 100 megawatt wind farm. If you had to put in a low voltage ride-through capability, would it be 10 percent of your project cost? Would it be 50 percent of your project cost?

MR. SAYLORS: It's about 5 percent of the project cost.

MR. QUIST: The number we've heard, if you had to go back, if there was a retrofit and you guys can correct me, if there was a retrofit to a turbine, it was about $10,000 per turbine to retrofit that in there.

The power factor actually comes down to, are you able to put in shunt capacitors to fix that. Or if it's dynamic, there's a certain dollar-per-megaVAR that's higher for dynamic.

MR. SAYLORS: The difference between switch elements and dynamic elements is about five times. I mean the dynamic elements cost about five times what it takes for the material cost of the switch elements. So that's why it's very important to developers to focus and try to minimize the initial costs here for these farms and try to find out what it absolutely takes to meet the requirements here, and what can be provided by the dynamic elements to maintain system reliability, and which then we can move on and provide it with the switch elements in that manner.

Or if indeed we really need to, if we're connecting to a strong grid, we don't necessarily need to have any elements in that. It might be the case.

Also along the line there is the case of switched elements--well I hate to say I've lost my train of thought here; I've had about three hours of sleep.

MR. AGARWAL: Would it be fair to say that so far the dynamic, or the reactive voltage support is concerned for a transmission provider is a matter of quality, and for product developers it's a matter of cost? Would that be a fair characterization?

MR. HOCHHEIMER: Well for operators, too, it's a matter of cost. Now let me ask a question. $10,000 a turbine, Craig? What was that for in your mind?

MR. QUIST: What someone had told me was that if you had XYZ manufacturer's turbine and you need to go in and add on the low voltage ride-through capability on an existing platform, if the platform could be upgraded, it was about $10,000 a turbine.

MR. HOCHHEIMER: It's more than that for putting on a new turbine, so a retrofit would have to be much more than that.

MR. POURBEIK: I think the answer is--

MR. CALDWELL: Let me try. I think from your standpoint, Kumar, I think the answer depends on how the rule is written; that the more fractionated you do--and this is one where flexibility tends to run against you, and the more sort of thing where you are saying I don't have a standard, that I'm doing this thing each time I'm doing this one-off, or if I'm trying to retrofit something that's already existing, and that something that may already existing may be a turbine that is in somebody's warehouse to be done, it's not necessarily just something that's already in operation, the more you do that, it becomes hugely expensive to do that on a retrofit basis.

If you set the standard and that becomes the standard that covers 95, 99 percent of the cases, then it will be built in from the beginning in the manufacturer's factory and it will be factored into all of the product development efforts, and it will turn out to not cost very much at all.

So that again when we were writing these things, these transition rules, it has a lot to do with not only how much they cost but how effective they are.

MR. ROONEY: We need to get this cleared up, too, about what Order 2003 would be, in both rulemakings large and small. This rulemaking would be based on what is coming forward as opposed to--like existing contracts would be grandfathered, for example.

So with regards to retrofits, I'm not sure that that is as much of an issue as one might think.

MR. CALDWELL: Well as I say, it depends on what you mean by "retrofits." Because, you know, right now, I mean I was down at the GE facilities the other day and there's 126 completed turbines sitting in the yard. Now I'll guarantee you that none of those 126 turbines meet this exact low voltage ride-through standard that we're talking about here.

And so if you said that this must be taking place tomorrow, you've just thrown away $126 million worth of equipment.

MR. ROONEY: We understand that there's existing inventory out there.

MR. CALDWELL: So there are these transition rules that are not necessarily dependent upon technology as much as they are the pipeline and where things go. So a lot of the effort that went into us writing this code had to do with those transition rules and making sense out of the transition rules as it did anything else.

MR. ROONEY: Again, I'm just trying to make clear that if you've got an existing agreement it is grandfathered under the rulemakings.

We also recognize that there are some of the units, for example, in inventory and we need to be thinking about that, as well.

MR. POURBEIK: One other comment on retrofitting. I mean, understand you can't make some of the laws retroactive because the units already in service, some of them just by the shear physics of it, it's not possible to go in and put low voltage ride-through. So this $10,000 number doesn't necessarily apply to those sort of turbines.

MR. SAYLORS: This is the issue of --

MR. QUIST: Where that number came from is this had to do with a turbine that had the capability to be upgraded. Maybe it's not $10,000, maybe it's $15,000, but there was some number if somebody came to them and they said, yeah, this is what we would quote. Maybe it's changed since then.

MR. POOLE: Let's break for lunch and we will be back at two o'clock.

(Whereupon, at 1:05 p.m., the meeting was recessed, to reconvene at 2:00 p.m., this same day.)

AFTERNOON SESSION

(2:05 p.m.)

MR. POOLE: We will get started. I would just like to thank Commissioner Brownell for being here. She came down for a little while.

We will use the same format we did this morning and try to hold everybody to five minutes. So we will just start with Eric.

MR. LAVERTY: Hello. I am Eric Laverty from the Midwest ISO. I am the Technical Lead for the Interconnection Engineering Group.

I would like to thank the Commission and AWEA for working together to put this on. My comments are going to be directed at the high level towards the questions you had proposed. Specifically, the ones for the afternoon session here.

Before getting into that, just real quick, you had asked in the morning session about other technologies. We have experience with the hydro technology that works a lot like a wind farm. I would be happy to answer questions on that later, if you want.

You asked in your questions about how should any special interconnection requirements be related to the size of the facility. We would like to caution on that. We have in our old Attachment R, the original interconnection procedures, we had special requirements and procedures for smaller, under 20 megawatt facilities, and the behavior that drove was a number of 19.9 megawatt requests at roughly the same point of interconnection. When you look at them in aggregate, it's just like having a big one.

What is of equal importance is the location, voltage level, that sort of thing, as discussed earlier today. So size is important, as is the location.

The reliability and safety implications of AWEA's proposal: When we looked at the technical specs on there at the Midwest ISO, we were pretty happy with the proposal. Our concern, our biggest concern, was with the requirement to waive the requirements not deemed necessary by the study, for a lot of the reasons that were mentioned this morning.

Jim had said that, you know, if that needs to be reworded then that's fine, and we would like to see that reworded.

One thing that wasn't touched on this morning, though, is in the processing of these requests, if you leave that in just at face value, you can have a higher-queued project raise questions about each and every study assumption, practice, you know, was this really necessary, was it not, and hold up subsequent ones.

Our practice is, whenever that environment presents itself, it is invariably the smaller developers with PPAs to get harmed in that type of environment. So we have some room. We expect that that can get resolved. We would be open to something like: here's a minimum requirements; here's a maximum requirement. If the minimum doesn't work, move towards the maximum. If that doesn't work, then we have to look at a network solution to solving the issue.

As for self-study and the Feasibility Study, we already allow in our compliance with Order 2003A that a developer can elect to skip the Feasibility Study, so we have no problem with that.

As far as self-study, we do make base cases available. You can get them on our Extranet. There's a process to get certified to get them.

We do caution, though. In our experience when people have done this, the assumptions used in the self-study are different than what we would have done. And we end up in conflict there at times. So it's there. Use it with caution.

For overall enhancements, we have our planning subcommittee that's an open forum meeting and we invite any kind of developer to come, or stakeholder, state commissions, federal commissions, to come and work with us to improve the overall process.

We talked a little bit this morning about models, and I would like to echo that these are getting better over the last few years. We've even seen a case where it's really too good. The thing is so detailed that the simulation times, the actual nuts and bolts running the simulation, that time has tripled and that cascades because you have to do a number of them.

So we encourage continued work with not only the developers working with the software vendors, but also with the consultants and transmission providers and utilities that are actually using these to kind of smooth over those issues.

And then as far as special design information for models needed to conduct the interconnection studies, we have an overall kind of mindset there in MISO. We would like to ducks pretty much in a row before you enter the queue.

Now that said, we don't need exact distances between turbines. But given the models that are out there to provide a good model for stability, you need to know the size of the farm, how many feeders you're going to have, how many turbines on each feeder.

And if that changes a little bit, we can deal with that. We can go back and take a look. Do we need to re-study or not? We've been flexible on that in the past and we're continuing to do so. But we do need some of the work done before you get into the queue.

With that, I would like to again thank you for the opportunity to be here and turn it over.

MR. POOLE: Mike, did you have comments you wanted to give?

MR. JACOBS: Yes. Thank you very much, Bruce, and Commission. My name is Mike Jacobs. I'm the Eastern Representative for American Wind Energy Association. Prior to coming to the Association, I worked for six years in the wind energy with a SCADA manufacturer. So if we want to get back to that topic, I would be happy to help with it.

Let me address the proposals in general terms. The proposals that we made follow lessons learned. The first is that policy on new technology is needed now before another gigawatt of wind power is built.

Asynchronous generation is different, and the Commission is right to look at the interconnection needs of new technology relying on asynchronous generation.

The Commission has heard the wind industry's response to the Blackout last summer. When we went through our process to come to this point, we reviewed the range of issues that have come up in the process of interconnecting new wind farms and the potential added cost to comply with the standards that we are proposing.

We have tried to reach a balance, and we thought that a continued rulemaking on interconnection was the appropriate place to present this range of issues.

We contemplated this proposal to be for a large interconnection. We are pushing our technological capability with the standards that we have proposed here for low voltage ride-through.

As you have heard or seen, perhaps, we have policy constraints on our business that differ from other generation, and a construction cycle that is much shorter than other generation.

These cycles are actually in some synchronicity right now and we expect a big year for new wind coming up ahead. So gain, the use of standards now would be a chance to capture some of the improvements before, like I said, perhaps another 1000 megawatts is out the door.

But we seek to do this. We want to bring our product to market to meet the demand of state portfolio standards and the increasing interest in a stable energy price in this date of volatile oil prices.

We need national standardization on some basic interconnection issues. These standards will require our manufacturers to stretch what they have been doing, and implementation will have to be justified by the site conditions.

The questions asked for today reflect the bigger picture of the interconnection process and the different circumstances for wind. We propose not only the technology standards discussed earlier to improve integration and reliability with the grid, but also propose to process standards and improvements in modeling wind generation. We think those topics are ripe and appropriate for this agency.

In particular, we are confident that our proposal is an improvement in grid integration and reliability in what has been past practices, and in particular we think that interconnection studies need to have pertinent information.

We have heard some discussion already about the engineering models. The engineering models for current generation technology has been difficult in the past for transmission providers and for project proponents to obtain. There's confusion. The rapid evolution of technology and the unfamiliarity of the several parties has contributed to this confusion.

So we're hoping that by this process we will get some direction or some encouragement for all parties to seek a recognized clearinghouse for updated information on generator characteristics.

We have suggested a forum that is interested and involved in wind utility integration as a starting place, and more broadly we have proposed--or we have made our proposal with the idea that it is a starting place, with the sense that we're going to be building wind farms steadily; that we need to set up standards to begin with. And as things improve, we have a starting place rather than have no starting place.

So in this current environment, we appreciate the Commission's taking an interest in this and for helping to focus attention on our industry. I look forward to questions.

MR. POOLE: Bill.

MR. WHITEHEAD: Thank you. Bill Whitehead, General Manager for Transmission Interconnection Planning at PJM. I am responsible for all the transmission planning and interconnection activities.

I very much appreciate the opportunity to participate on this panel, in particular because wind has become a much bigger part of our interconnection queue in the last year or so. While we only have a couple hundred megawatts in service, there are over 3000 megawatts of active wind projects in the queue right now in various stages of the queue.

The evaluation of interconnections, and specifically wind, is done through our integrated regional planning process, which was a process we put in place in

1997 to integrate the reliability needs of the planning with the real-time needs of operations and the economics associated with markets to basically put together an integrated plan that looks at all the various aspects and integrates those into a single plan for the PJM region.

The interconnections are one piece of the plan. We do a number of other assessments, and we get a number of other market-based requests and public input, but the interconnection is one of many drivers that we try to integrate into the plan and that we try to balance the needs of.

The objectives of the interconnection process, and one of the things that we have been talking about during this morning's session, is really to maintain comparability among developers. But all requests are treated equally, and particularly the decisions are based in an equivalent time period that result in comparable treatment.

I'll talk a little bit about the feasibility studies. A feasibility study is not just a technical study, but it also gives the developers an idea of the location on the transmission system, is it a good location, are there other projects that may have an impact on their project, or in turn is their project going to have an impact on other projects.

So it is more than just the technical study, but there are also the needs of other projects that are involved as well. And, you know, the need to pull all this information together we feel is a pretty important part of the process, particularly as you move along through the process into the impact study stage and onto the facility study stage. It's an important point for the developer.

We have a single process for all interconnections, generation, merchant transmission, and demand-side management as well. We feel that is important because we feel that that is the best way to maintain the rights for all projects, and essentially maintain the equitability of the rights for all projects.

Generators, transmission, and demand side are actually competing for the same transmission, and in some cases limited transmission capabilities. So it is important that when we establish a queue process, and as we did through 2003A, that we keep the general queue process working the way it is because it is important again to keep the various rights of the different projects and the developers.

We have also touched a little bit on the small generation. Small generation is a part of the single interconnection process. We handle projects 20 megawatts and less through an expedited small generation process. That process recognizes the unique attributes of small projects and is able to accommodate scheduling needs and also is able to expedite projects without necessarily adversely impacting other projects, or adversely impacting the rights of other projects.

And we have just recently completed a process where we developed a subset of that process for distributed generation less than 2 megawatts, which is based on the IEEE 1547 standard, and I think it is a good example of where an industry technical standard was able to be integrated into an existing process with the right stakeholder input and with the right process in place.

And, you know, there are a few folks here that participated in that through the year this year.

Small generation, again, we feel has become almost 40 percent of the small generation requests in our queue are wind projects, so we understand the needs of the small generation wind projects as well as large generation wind developers.

Essentially in summary, we believe strongly that all potential solutions for transmission must be integrated through a single process, and that we need to maintain essentially the sanctity of the queue process in order to maintain everyone's rights, and maintain the equity between the projects.

We feel very strongly that legitimate technical differences can be accommodated within the process, and we also feel very strongly that unique attributes of either small projects or new technologies can be recognized within that process as well.

I look forward to answering the questions later, and thank you again for the opportunity to participate.

MR. POOLE: Patricia.

MS. ARONS: My name is Patricia Arons, and I am the Manager of Transmission and Interconnection Planning for Southern California Edison.

I appreciate the opportunity to participate in FERC's Technical Conference Regarding Technical Requirements For Interconnecting Wind Generation.

SCE has substantial experience in interconnecting wind generation in the Tehachapi and the San Gregorio areas of our system. Tehachapi is an area up near Bakersfield, California. The San Gregorio is down near Palm Springs. Our experience began back in the 1980s interconnecting wind generation as qualifying facilities.

In 2003, Edison's wind generation purchases were 2559 gigawatt hours. That is nearly 2.6 billion kilowatt hours. Currently, SCE is participating in the developing of a transmission plan to integrate wind generation to help meet the State of California's directive that renewables comprise 20 percent of the total investor-owned utility procurement by 2017.

I look forward to discussing reliability issues in the areas identified in AWEA's Request For Technical Conference. SCE believes it is important for FERC to hear the technical issues associated with wind generation interconnections before establishing unique interconnection requirements for wind.

For almost 10 years now, SCE has been requiring that wind generating facilities, which include generator installations and collector systems, abide by the same power factor requirements included in Order 2003A for nonwind generators.

SCE has long recognized that induction wind generators, which are typically the choice of wind generation developers, lack the capability to internally generate reactive power, and instead consume reactive power resulting in degradation of voltage support in the area.

This being the case, SCE has required that wind generation developers provide external reactive resources within their wind park facilities to accommodate their own reactive demand and compensate for losses within their own collector systems, and to be able to deliver a .95 power factor lead at the point of delivery.

Without such reactive power requirements, grid reliability is jeopardized. In the Tehachapi Wind Park, incidents of uncontrolled voltage degradation leading to widespread tripping of wind generation and occasional tripping of customer load have occurred and persisted even after SCE completed upgrades that were designed to accommodate the wind generation in Tehachapi.

Further investigation showed the lack of reactive resources within the wind facilities accounted for significant deficiencies of voltage support in the electric system.

Induction generators which have historically been the choice of wind generators for over 20 years now are by no means new technology. Power factor requirements should be imposed on the installations that are the same or equivalent to the requirements for synchronous generator installations and for all generator installations.

SCE's experience with wind generators indicate that power factor is very critical for large-scale induction generator applications. The general case for SCE is that wind generation developments are in remote areas and occur in large quantities over a wide area.

SCE has about 1000 megawatts of wind generation with about 300 megawatts on 166 kV system in particular; another 400 megawatts on 115 kV system; and about 300 megawatts connected to 220.

SCE notes that on the 166 kV system, voltage degradation had been experienced due to lack of reactive resources, and that only about a one percent reduction in the reactive resources--which is about 3 megaVARs in the wind parks relative to the power production of 300 megawatts could trigger such voltage degradation, leading to dropping of wind generation through undervoltage protection on the units.

AWEA also suggests that its proposals, if adopted by the Commission, and other aspects of Order 2003A applicable to wind facilities comprise standards that, if met, presumptively entitle a utility--a facility to be interconnected.

This does nothing more than prevent the transmission provider from addressing impacts and trying to protect its system, its customer, and other generators, leaving neighboring utility systems.

SCE notes that in the Antelope Valley and Kerden County area we have projected over 4000 megawatts of new wind generation in the State of California to be developed to meet the Renewable Portfolio Standard according to Senate Bills 1038 and 1078.

AWEA appears to be saying that, even though studies have not been completed to determine the effects of such magnitude and concentration of induction wind generation, there should be no further requirements for wind facilities, and this is of serious concern to Edison.

FERC has already specified policies covering the system upgrades and direct interconnection facilities, and all interconnections are subject to review in California by the ISO, by the developer, and require filing at FERC.

This policy should be preserved and applied to all generators. We do not agree that the power factor requirements should ever be waived because systems change, generation is added, this waiver creates problems between generators, and who bears the burden to control voltage?

Also wind generators frequently repower to increase production which can have a direct bearing on system performance. We recommend that a requirement be added indicating that generators must be able to actively control either a scheduled power factor or voltage in addition to the described power factor range.

By establishing a reduced standard for wind generators, you provide a me-too incentive for synchronous machines to reduce their performance requirements as well. This is a dangerous trend for reliability.

I see that I've run out of my time, so I will conclude my remarks. I do have some other things to say about power system stabilizers in particular that will probably come out in comments.

MR. POOLE: Chuck.

MR. MATTHEWS: Thank you. I appreciate the change to participate in this Technical Panel discussion. My name is Chuck Matthews. I work at Bonneville Power Administration. I am a process manager in network planning assigned to--I assign and direct study work for requests that are in our queue.

Of course BPA is a Federal Power Marketing Agency under the Department of Energy. We market wholesale power from 31 federal hydroelectric projects. Our territory is in the Pacific Northwest, including the States of Oregon and Washington.

We have some system in Idaho and western Montana, and in small parts of four other states.

We provide approximately 45 percent of the region's power, and approximately 75 percent of the region's high voltage transmission.

Presently, BPA has five wind projects totalling approximately 325 megawatts connected to our system. This is not as high a penetration as other systems. There's approximately 25 wind projects which constitutes over 4000 megawatts of generation in various stages of study in the BPA interconnection queue. The size of these requests in our queue are anywhere from 25 to 600 megawatts.

We do agree that there are differences in wind technology that justify convening this Technical Conference to get all the parties together to talk about the issues.

We are strongly committed to supporting wind generation. Things we have done include facilitating study work by providing feasibility information to developers sooner rather than later under the old process. In the new process we'll be following 2003A as close as possible.

BP is a little unique as a power marketing agency in the federal government that we do have to meet the National Energy Policy Act, along with the studies that are outlined in the FERC Order.

We are also investigating expanding our secondary grid management to help facilitate some interconnections. On the other hand, care needs to be taken due to locations where wind is typically integrated and the technology used as far as maintaining grid reliability.

We are learning more lessons as time goes on about the modeling and studies to better understand what the potential problems are.

We are learning more that these are dependent on the farm layout as well as the generator models, that sort of thing.

We are being more careful in analyzing requirements for voltage control. One example that we have had was generation tied into a weaker system tapping a line, and existing customers on the line, and using shunt capacitor banks to regulate the voltage because the output from the wind generation changes so quickly. The timing of course of shunt capacitors is a little slower than voltage regulators downstream, so a lot of customers' voltage regulators and other equipment are getting a lot more exercise now than they used to. So we are learning about that and trying to deal with those types of issues.

The bottom line is, we need to maintain grid reliability. To achieve this, the transmission provider through the transmission study needs to define what the system performance requires for the grid, and then applicable technology to meet this performance at the points of interconnection.

Of course the performance at the point on the grid is dependent on the size of the wind farm and the strength of the system at the point of interconnection.

As far as low voltage ride-through, there's two issues that we had with the low voltage ride-through. In the Northwest, we rely on remedial action schemes for tripping of generation to help support transmission capacity, and that stuff. And if these generators trip off inadvertently without us actually knowing about it during a major system disturbance, then we could actually over-trip generation and get into some other issues with maybe into under-frequency load shedding type of stuff.

And then of course the loss of generation in the local area causes more stress on the system, as given in the PNM example earlier today.

So BPA is strongly committed to supporting integration of wind. We are supportive of having all the entities get together to work through the complex issues at hand. That's it.

MR. POOLE: Thank you. Wayne.

MR. HAIDLE: Wayne Haidle, Engineer with Montana-Dakota Utilities, abbreviated MDU.

MDU appreciates the opportunity to provide comment at this Technical Conference. MDU is a small, vertically integrated utility serving customers in portions of North and South Dakota, Montana, and Wyoming.

MDU service territory is located in a high-wind resource area. It has been projected that more than 10,000 megawatts of wind generation can be located in North Dakota alone. Because of this MDU has frequent contact with wind developers.

MDU acknowledges that expectations of generators set forth in FERC Order 2003A may be overly comprehensive. To that end, MDU would be in favor of modifications which prescribe performance criteria in lieu of generator criteria.

If modifications were made, here is some verbiage for consideration:

"The requirements for any given generator or aggregate of generators wishing to interconnect should meet certain conditions both at the point of interconnection and the realm of direct regional impact.

"In general terms, all intended modes of operation of a generator should:

"(1) Maintain pre- and post-contingency steady-state voltage criteria:

'(2) Maintain industry standard voltage flicker criteria;

"(3) Maintain ride-through capability for disturbances which would otherwise become a regional security risk;

"(4) Implement manual and/or automatic mitigations not to exclude generator tripping;

"(5) Demonstrate appropriate benevolence to small-signal damping if the lack thereof could lead or contribute to a breakup of a transmission grid;

"(6) Provide real-time telemetry and control deemed reasonable and necessary for maintaining system reliability;

"(7) Mitigate other impacts which are not in conformance with good utility practice."

Concerning matters of self-study, the

availability of refined and comprehensively validated models are not common, especially in coordinated sets of power flow short-circuit and stability data.

Further adding to this complexity is the incredible AWEA expectation that these model sets should be available off the shelf with the implied suitability for any voltage class on any operating or planning horizon.

Parties wishing to investigate such feasibilities may have to rely on the best available modeling data and may need to tailor the models for their own purposes. In no situation should such feasibility studies be exempt from ad hoc review if the generator is seeking approvals toward an interconnection agreement, nor should a generator be absolved of their obligations to system reliability regardless of the feasibility study results and/or the expiration of the period for comment on the study results.

MDU is geographically located in a low-population area with concentrations of significant generation and long transmission lines. Reliable operation of a transmission grid currently relies on various mitigations which range from manual operating procedures to automatic generator tripping.

These mitigations are generally established for a given expected use of a transmission grid. If the utilization of a transmission grid is altered appreciably by new generation and/or market use, the outcome of such mitigations may be unpredictable without additional extensive restudy.

The transmission operating challenges of today are formidable even with dispatchable forms of generation. A proliferation of nondispatchable generation without substantial transmission upgrades will most assuredly degrade system reliability.

Any form of generation which routinely relies on real and reactive reserves of other resources certainly should not be given special concessions for interconnection. Furthermore, expectations of these intermittent forms of generation to ride through disturbances certainly should not be construed as an acknowledgement of their contribution to the system reliability.

On the contrary, these expectations should be construed as their obligation to system reliability so other dependable resources of real and reactive operating reserves are not further strained or exhausted entirely.

FERC has a responsibility to provide a nondiscriminatory access to the grid, promote reliability, and not favor a particular type of generation. The AWEA request for special exemptions must be denied.

MR. POOLE: Thank you. Jeffrey.

MR. CONOPASK: Good afternoon, ladies and gentlemen. I am Jeffrey Conopask, Senior Economist of the District of Columbia Public Service Commission, and I am representing the National Association of Regulatory Utility Commissioners, which I shall refer to as NARUC.

NARUC appreciates the opportunity to provide comments at this conference. I will also suggest that our interest here is to put our policy position forward, and we do obliquely address the questions for this afternoon's session.

We have had a long-time interest in all of the direct and indirect issues discussed here. NARUC and the States have three main areas of concern:

That the reliability of the transition system be preserved;

That a large selection of renewable resources be available to interconnect to the electric system at a reasonable cost;

And that the Interconnection Agreements for small projects be consistent with the best practices already established and in use in several states such as Texas, California, Idaho, Ohio, and New York.

On the local and sub transmission systems, the level of reliability provided to customers is directly related to the cost to provide that level of reliability. If the probability of an outage or disturbance is low enough under normal operations and the cost to avoid the problem is significant, often states have found this to be an acceptable risk to customers. This is the portion of the system where most wind generation is interconnected today.

However, the AWEA proposal is targeting interconnection rules for wind farms 50 megawatts and above. We are increasingly seeing wind farm interconnection requests for 200 to 300 megawatts and more.

This moves the interconnection point of these large facilities up to the bulk transmission system. The bulk transmission system operates, out of necessity, on a much more strict set of reliability rules.

A major outage on the bulk system cannot be allowed to trigger the outage of any additional members of the system. Consequently, reliability of the bulk transmission system is an absolute in the sense that we can only tolerate one element going down for the system's redundancy will allow the remainder of the system to continue to function. To do otherwise is to tempt blackout situations.

NARUC has demonstrated their support for both system reliability by joining NERC and FERC in the call for legislation that mandates adherence to NERC Reliability Criteria which applies to the bulk system.

That said, NARUC has repeatedly endorsed the development and interconnection of renewable resources such as wind. Renewables are good for the environment. Renewables are good for fuel diversity.

Fourteen states have established some level of renewable portfolio requirements. New York, for example, has set a target of having 25 percent of their load served by renewable resources.

California is calling for a 30 percent target. These requirements are ambitious, a challenge for system integrity, and an opportunity for developers of renewable resources.

Ambitious in that these portfolio requirements call for development of new technologies, techniques, and rules to accommodate these facilities.

A challenge in that there may be system limits as to how much wind energy, for example, can penetrate at any one time given current system control technology.

An opportunity for developers? Well, that's obvious.

We must start from the premise that new additions to the transmission system must not compromise the existing level of reliability. Developers should understand that reliability rules apply equally to all generation resources regardless of the impact on the economic feasibility of the project.

On the other hand, system planners and operators need to acknowledge that most existing reliability criteria have been drafted from the perspective of a system containing similarly designed machines.

When the new wind and other technology projects proposed to interconnect on the transmission system, the appropriate criteria should be whether at the point of interconnection the same level of reliability is being provided as would be required from a traditional plant regardless of what is taking place inside the developer's fence.

Having said that, we believe that if a wind resource generation developer can demonstrate the ability to satisfy equivalent reliability criteria, we should give them that opportunity.

Even though the AWEA's standard proposes standards to be applied to 50 megawatt plants and above, FERC has set this conference to examine the interconnection requirements for all wind and new technologies. We note that interconnection of smaller projects are handled routinely and require some customization depending on the design of the local sub, transmission, and distribution system.

The NARUC Model Interconnection Procedures and Agreement For Small Distributed Generation Resources was designed to encompass these types of installations based on the best practices currently in use in several states.

This concludes our remarks. Thank you.

MR. POOLE: Thank you. Paul.

MR. LEHMAN: Thank you. I am Paul Lehman of Xcel Energy, and I am pleased to be here today on behalf of the Edison Electric Institute to provide some perspectives on these critical safety and reliability aspects of wind interconnection.

At the outset I wish to state clearly that EEI and its member companies have as their first priority the safety and reliability of the production and delivery network. EEI member companies take this responsibility seriously, as exemplified by the round-the-clock service restoration efforts in the Southeastern States in the wake of the three major hurricanes during the past month.

Another example includes the entire electric industry's strong support for the broad range of initiatives now underway at the North American Electric Reliability Council, or NERC, and the NERC Regional Councils.

This includes the development of comprehensive reliability and planning standards through the ANSI-approved standards setting process adopted by NERC two years ago.

The EEI Board has stated its unanimous support for these initiatives as critically needed elements for maintaining grid reliability in the future. And since we've talked about NERC, EEI will be contacting NERC leadership at the conclusion of this conference to convey to them the importance of the issues we have addressed today.

EEI and its member companies all support the development of a broad range of efficient generation resources, including wind resources. As the Commission knows, several EEI member companies have made and are planning to make significant commitments to both large and small-scale wind projects. This includes Xcel Energy who is considered a leader in the receipt of wind energy resources.

EEI and its members also strongly support the Commission's interconnection initiative during the past two years. A broad range of member company personnel, including myself, labored long and hard in participating in these good-faith efforts to establish standardized procedures and agreements which will contribute to making generation interconnection more efficient and fair in the future.

In light of the current and compelling needs to satisfy both of these goals, I introduce my more detailed remarks by acknowledging that wind interconnection requires careful planning and decision making in the sense these resources impose several unique challenges in terms of ensuring network reliability.

The proposal by the American Wind Energy

Association offers specific examples of several of them. EEI has not formally responded to the proposal and does not at this time intend to take a formal position. Because of this, and because of the comprehensive comments of the panelists of this morning and the panelists here this afternoon so far, I will just hit some of the highlights as it relates to some of the issues that are identified.

First is with respect to power factor. Dynamic voltage control is an important part of generation operation, and the level of need will change over time. The ability to control voltage through varying the power factor dynamically is more important than a specific power factor setpoint.

Being able to operate at any and all points within the .95 leading/lagging range as needed dictated by voltage control is the important part of the standard, as opposed to just being able to meet a point within that range.

With respect to the low voltage ride-through capability, the growing high concentrations of wind energy are reaching levels where lack of voltage ride-through result in these farms becoming the largest outage in the region, requiring more spinning reserve and more supplemental voltage control equipment.

For any transmission interconnected generation, ride-through capability is important when significant blocks of wind energy are being installed.

We have touched on, or several panelists have touched on small wind issues, and I just want to re-emphasize a couple of those.

Due to the radial nature of the distribution system where these small wind generators tend to be interconnected, there is the risk of islanding of the load with generation connected to it. And damage hazards to consumer equipment from voltage swings and/or frequency deviations and safety hazards to utility personnel and other customers are of concern.

A few other issues:

It is important to analyze transmission capabilities on a regional basis versus the one-generation interconnection request at a time.

Wind generation should not receive any special treatment or relaxing of standards just because of the technology being used to generate electricity.

All generation should have similar standards regardless of the technology or fuel type.

Thank you.

MR. POOLE: Thank you. Ken.

MR. DONOHOO: Good afternoon. My name is Ken Donohoo. I am Manager of System Planning with ERCOT. I have been with them since 1996. I have a little bit over 22 years' experience in the industry.

It is very interesting hearing all the comments from all the panelists here today. I would like to compliment you on receiving all of this input. I think that is a key to you solving what is happening. That is what we have done in ERCOT. We maintain an open, fair, and honest process to incorporate all these opinions and viewpoints both in transmission planning and hooking up generators.

We have several examples of that:

Our open planning process that's on a regional basis;

Our generation interconnection procedures that's fair to all generators and clearly lined out;

Our reactor standards that were recently approved last year that was a culmination of over four years' worth of effort.

The biggest thing I think we've got to do is, rather than focusing on the problem I think we need to focus on the solution. There are many options to solving all of these problems.

The big key is: Is it cost effective and fair to all parties? That's a big factor. Plus, maintaining reliable service to load.

We have a significant portion of wind generation.

Back before 2000, we didn't have a whole lot. In 2000 it got very exciting in West Texas, and we have significant growth. Right now we have over $150 million of transmission underway to incorporate the wind generation that is there in place.

We also have another $150 million of capital planned if we have any more additions within that area. The plan is already in place. We are still having people come to request interconnection at various locations. It is good. It is still healthy. All types of generation are still coming to ERCOT to request generation interconnection.

We have a healthy reserve margin, and wind energy is an important part of that. Some of our major concerns that we've had over the past years, which we are working through with the stakeholders, with the customers, and with the wind generation owners are:

How much peak capacity do we plan for? That's a big problem. It's a seasonal production. The diversity, the time of day that it peaks. Most times it peaks early in the morning in the spring. We don't have a whole lot of load out in West Texas at that time.

Another big concern is trying to build in advance of known need. That is a big factor and a big discussion right now. That is a public policy question. That is not really a technical question. We can come up with a plan that will solve the levels. I think the big key is getting the cost recovery back to the people who are building the transmission and also serving the public good.

Another key thing that I think everybody has brought out is the stability effects of wind turbines. They are changing. They change quite often. We have a Blue Northern come in in West Texas, they all peak at one time. We've had as high as 200 megawatts in six minutes' ramp up of wind turbines when that affects. That is going to increase the need for regulation in ancillary services. That is a factor, but there may be cost-effective solutions.

Voltage control seems to be a big concern. It has been a problem in ERCOT. We've worked through that. We now have the Implementation and Compliance of Reactive Standards. There are some specific items there for the wind turbines. There were nobel generators in those standards which includes installing many SVC statCOMs or some type of dynamic devices to solve that, and they can contribute to pay for part of that.

One of our biggest things is it may be critical for keeping the renewable in service. You don't get the benefit of the green power unless it's in service serving load. So we want to keep them on time and try to optimize the power output from those wind turbines.

High voltage is still, during off-peak

conditions, is still a major concern. Fault ride-through capability--in other words, voltage sustainability. Another factor you may need to consider is what happens during under-frequency events?

I think you heard a lot about our Model Development Project that was started several years ago. It's going very well and we're continuing with it with NIREL.

Some of the other big factors:

Getting and maintaining data from the turbine manufacturers and the owners of the wind farms. These things do change. New turbines do come out. Keeping those factors and keeping those data points correct in our models is a key to having good development of planning.

Also, developing and maintaining the stability models. We started with a set. There's no technologies. We're going to need new models. Essentially, we have joined the utility wind interest group's effort and are supporting their effort on the technical basis as continuing model development. It's a collaborative and open process. We think it is a very good process with all parties, including the manufacturers in it.

We are also coordinating with other RTOs and ISOs in these efforts now.

That essentially concludes my comments.

MR. POOLE: Thank you.

Does anybody have some questions to start off with?

(No response.)

MR. POOLE: Well I will just, then, get into the ones we had identified for this afternoon. Most of them were relative to reliability. That goes again to the discussion I guess of the low voltage ride-through, the SCADA connections, and data taking and reactive.

I guess I would just like to know from the people representing the ISOs and the Coordinating Councils who all has detailed requirements set for those specific areas? And are they specific for wind?

MR. LAVERTY: We are still in the process of developing that stuff. We haven't--you know, SCADA, we had some stuff down here--you know, what's required is we own reactive power, open and close status of the breaker, and megawatt hours delivered, megawatt hours received on the load side, and that's independent of the tied to generator.

MR. POOLE: You don't have anything special for the wind units?

MR. LAVERTY: (Nods in the negative.)

MR. POOLE: Do you think you will have? Are you planning on it?

MR. LAVERTY: If our stakeholders come to us with a need for it, yes, we'll work towards that.

MR. WHITEHEAD: We've got, as far as the SCADA goes, anything larger than 10 megawatts regardless of what fuel or wind or otherwise, anything larger than 10 megawatts is required to have SCADA.

The information similar to MISO, the megawatts, megaVARs, you know, status, that type of stuff is telemetered back to, sometimes to the transmission owners, or sometimes directly through the transmission owners directly to PJM, or directly to PJM.

We don't have any real specific other requirements for wind. We have started to talk about the low voltage ride-through. That is part of an effort to look at a couple of areas where we have concerns about losing large amounts of generation where we haven't typically planned before.

Low voltage ride-through is one of them. We really haven't had a problem up till now because the wind hasn't been as concentrated and we haven't had as much, but it's coming. Even to the extent of, you know, like loss of a gas pipeline effecting a large amount of generation, you know, that's fed off the same pipeline.

So those types of things are kind of on the horizon for some discussion within PJM, but not necessarily specifically related to wind but just to events that could take a large amount of generation off at one time.

MR. LAVERTY: If I could jump back in on the low voltage ride-through, our experiences on that have been varying. We do have the density. Of the 51 active projects we have right now, I believe 35 of them are in Minnesota. I know well over 30 are in the MAPP Region and are highly concentrated in the southwest corner of Minnesota.

But what we also ran into is comparability factor, but this time in the other direction. If you already have generation in the area that have remedial action schemes, can you require the wind generation to stay on line when the coal, or the gas, or what have you, is not required, or under certain circumstances can trip off? So, you know, we hit that.

In the Maine Region, you know, we do run into NERC Category B where for a single outage you're not supposed to trip a generator. I mean if it's hanging on a radial line, clearly, you know, the generator will go much the same as if you fault a step-up transformer. But there to comply with NERC Category B you do often need some low voltage ride-through capability, and that varies, you know, on the system.

MR. MATTHEWS: Chuck Matthews, BPA. I'm a member of the WECC Reliability Subcommittee and they're in the process right now of developing a low voltage ride-through standard to include in the WECC Standards. It is currently in the due process phase, and so we're collecting comments right now on what our proposal is.

I believe that we've tried to contact industry experts, and AWEA, and others to try and solicit comments from them on the proposal. So mainly looking at the low voltage ride-through from system standpoint and meeting criteria for outages and that sort of stuff. I just wanted to make that comment.

MR. POOLE: Ken.

MR. DONOHOO: We don't really have anything specific for wind farms on voltage ride-through. We do have some general ones in our reactive standards. We are actually watching the WECC effort right now and the AWEA effort to see how that comes together.

So far it has not been a problem. We haven't had a whole lot of faults out in the area to cause it. But again we're monitoring and watching to see what the effect is. We may have to develop one, but we are kind of seeing what is going to happen to WECC and the AWEA effort here.

MR. POOLE: Patricia, does CAL ISO have anything specific for wind?

MS. ARONS: What the CAL ISO has done is they have taken the interconnection requirements of the three main participating transmission owners and they did so with the intent of creating a single interconnection document. But they haven't really proceeded far enough down that path to get to the issues associated with wind. But I believe that that will eventually be a part of what they see them doing, which is a single interconnection requirements' document.

MR. AGARWAL: Some of you said that you do have a reactive standard. Do those standards go beyond plus-minus .95? To the entire panel, some of you said that you do have reactive standards--oh, you don't?

MR. DONOHOO: One thing I would like to clarify, on ours we do plus-or-minus .95 but it's at the transmission bus, not at the generation terminals.

MR. AGARWAL: Oh, it's the transmission high side of the transformer?

MR. DONOHOO: Right. The interconnection to the grid.

MR. AGARWAL: Okay. And do you also specify the static versus the dynamic VAR, or is it silent about that?

MR. DONOHOO: Right now on generators we assume that they're going to have some dynamic capability available.

MR. AGARWAL: Okay.

MR. DONOHOO: Now for wind farms, a little bit different nature. It could be a mix of that. We have various options that could provide that capability. We have certain reactive reserve margins that we have to meet in the area. So that's how we address that.

MR. AGARWAL: Okay.

MS. ARONS: If I could comment on that question. Another thing that WECC is working on right now is a voltage stability methodology that would go in and assess kind of a breakdown between what can be affixed, a switchable type of device, and what has to be dynamic because of the nature of the dynamic voltage performance issues.

So they are developing a methodology from which they will eventually develop a performance criteria requirement.

MR. POOLE: If I were to put out the question and just let everybody give me an answer, on low voltage ride-through I guess I don't have a good feeling yet. Is the AWEA petition the right format? Do we need it? Do we not need it? Do we need something different? How should we find out those answers?

MR. WHITEHEAD: From our viewpoint, to a certain extent that is a characteristic or something that a wind developer could offer, right now could offer to PJM. We don't require it. What form it takes, you know, we don't really have anything to base it on other than what we've seen through the AWEA proposal.

So at this point that's the best thing we have to go on. But I think how we look at it right now, it would certainly be a voluntary thing, not a mandatory thing.

MR. POOLE: Do you think that that would be then more of a situation of the local area where they're getting the interconnection, what kind of penetration you would have, and the operational characteristics of whether you would require that or not?

MR. WHITEHEAD: Well I think as we go forward and as we see how wind starts to develop in the region, in our region, it may become a requirement if we see an area that has a problem. Again, we're looking at some kind of maximum disturbances where you might lose a lot of generation in an area for various reasons, and one of them might be the loss of a lot of wind generation. So I think it might become a standard if we get to that point where we think it's a problem in a certain area.

We try to take the approach that we look at the system and we try to determine the needs for the specific areas. Certain areas obviously, you know, need more reactive support than other areas. Certain areas need, you know, other types of support more than others. So we try to take a look at the system and determine the needs based on, you know, sub areas within the system, and then use the right criteria in the sub areas within the system, rather than, you know, than just to sort of apply a standard across the whole system.

MR. POOLE: Well PJM covers quite a few Coordinating Councils and NERC. Do you see any efforts in any of those that would be leading to try to come up with some of these specifics?

MR. WHITEHEAD: Off the top of my head, I don't see any--no real active--I mean, again, there's been discussion of it. I don't know that there's any real active efforts to determine anything right now.

MR. POOLE: No other people have suggestions?

MR. LAVERTY: In MISO, in some areas, particularly in the Maine Region, we found the low voltage ride-through to be more of a de facto requirement. You know, you say there's criteria violation, we don't want you tripping off. If you stay on, it's resolved. We could install a FACTS device, or you could put on low voltage ride-through, and the low voltage ride-through makes more sense on the system for economics.

So required or not, it's been the best idea in a number of our situations.

MR. POOLE: Other comments? Patricia?

MS. ARONS: We definitely support the idea of a low voltage ride-through standard. In the example I think that was provided this morning, it is not the situation that

Edison faces. That is, that it isn't important in an area where you have a small control area in a tightly coupled system.

Our area is a very large geographic area. In fact, all of California is largely under a single control area. And the areas where we have a lot of wind generations are really two main wind generation regimes, and we currently do not have the amount of megawatts connected in those wind regimes that exceed what we call our single largest spinning reserve.

But with the projected development of procurement of renewable generation in particular, the potential for 4000 megawatts of wind generation in Tehachapi, it's very feasible that we could potentially create a single contingency that could drop that amount of generation because it would all be likely on at the same time when the wind is blowing, and electrically tightly interconnected to the network so the default affecting one generator would likely affect all generators in the Tehachapi area.

So the studies that we currently do on our transmission grid, we have a standard where we're not going to trip generation, or we plan our system around a single largest contingency that is no greater than the amount of spinning reserve that you carry on the system. So there is a limit there that has to be met.

And until you get into wind regimes where you exceed that spinning reserve, it really is not a requirement. However, you might be at 999 megawatts but that next 1 megawatt comes on that's larger than your spinning reserve and all of a sudden you have a requirement that you haven't met on 999 megawatts and the 1000th megawatt that you have that standard on may not necessarily preserve your system performance as you interconnect additional wind generation as time goes by.

So I think to me I believe it's a standard that should be applied to all generators at the outset.

MR. POOLE: Wayne, did you have a comment?

MR. HAIDLE: The only thing that comes to my mind here is sometimes whole area of depression can be a transient stability issue which can be far from the source of his turbines itself and may not even be fault-related on an AC grid.

In the case of North Dakota, maybe it's not MDU's transmission but two DC lines leaving the state going to Minnesota, the larger of which trips a large coal-fired plant. Even so, the way that is designed is to allow the DC to restart. However, if it fails to restart, there's been an awful lot of inertia on the system in the meantime in a short, you know, 280 milliseconds.

So consequently, all the power trying to move out of the area is going across the remaining AC grid, and the transient undervoltages occur far from the DC--or the station which it was tripped.

And incidentally, if where that transient undervoltage occurs happens to be right in the prime area of wind development, or desired development, if there was lots, hundreds, thousands, whatever, megawatts in that area which tripped off as a result, well now you've lost not only a huge coal plant, you've also lost hundreds, whatever, of megawatts of generation otherwise.

So now you suddenly have perhaps thousands of megawatts' deficiency on the grid. Hopefully it won't cascade any further. So, anyway--and if it does have voltage support, and it's going to hold that transient voltage, undervoltage up, I mean if the wind farm does, so it would be strictly a benefit to keep it on in circumstances like that.

However, there might be cases where you want to trip it off if it was causing thermal overloads and things of that sort. So it depends on the situation. And it doesn't necessarily pertain to the voltage class, either. Every situation is unique.

MR. POOLE: Would you get all that out of your studies? Would you have to do enough studies of all different contingencies to figure out whether you would want it or not?

MR. HAIDLE: Yeah, there's quite an extensive fault library, disturbance library, up in northern MAPP and coordinated between North Dakota, Manitoba, and Minnesota. The Minnesota-Wisconsin interface is also involved. And that's, if I recall correctly, and Ron Major from Manitoba is in the room and he can probably correct me if I'm wrong, but it seems to me that that is limited by small signal instability. So there's all kinds of damping issues. In northern Minnesota there's SVCs that I think has recently been retuned for small signal instability.

So the amount of studies that go on in the operating review working groups are extensive to keep the system in a reliable state. And sometimes there's numerous operating guides that come out on a weekly basis which are dealt with by the area utilities, and it sometimes takes the joint efforts of the area utilities, because the security center may not have all the vital facts to decide how things are going to behave on certain equipment for certain prior outages and that sort of thing.

So there's a great deal of expertise retained in the field, so it's very important that we work together on these things. And if proliferation of wind farms--I mean if we get run over, steamrolled, I'm just afraid of what's going to fall out of it. It needs to be looked at very carefully.

MR. POOLE: Bill?

MR. WHITEHEAD: Just to expand a little bit. I think obviously when we do planning studies, and we're doing planning studies five years out, you know we have the benefit of being able to sort of create the perfect world. So the planning studies, particularly where voltages and reactive are concerned may not be the best measure of how much reactive you need on a particular day.

You know, you go to an operating day and certain units are out of service, or certain conditions exist on the system, they have to deal with the conditions that exist on that particular day.

So I think what we're wrestling with and, you know, what I think are one of the reasons that we prefer a range of power factor requirement rather than any specific power factor requirement is that on a particular day you may need additional reactive, or you may need actually someone to absorb reactive because you have high voltages on the system. So the concept of a range of power factors, or some of the other concepts we talked about this morning, I think it's not necessarily that it's on a particular--you know, that you need a particular power factor, but you need the ability to operate over a range of power factors to take into account things that happen on a day-to-day basis.

So I think that is the difference between. You know, we can certainly create a single power factor for a planning study, but from the standpoint of integrating that with real-time operations that may not be the best way to integrate it with real-time operations.

MR. POOLE: Mike, when AWEA was developing their petition, a gentleman said you mainly took it from a German standard, or pretty close to a German standard. Could you explain the rationale for why that was done?

MR. JACOBS: Sure. First, let me explain that the standard we looked at from the various overseas wind development areas, or grids for that matter, is the low voltage ride-through standard.

What we were seeking to do was, to a large extent, provide some stability to the manufacturing sector in our industry so that if they were trying to meet an existing standard that it would be useful in other markets.

In particular, the German E.ON, E.ON standard, is one utility standard that's being adopted across the European Union. So this was a large market, and it was something we looked at and considered other alternatives but this seemed to satisfy the various requirements that we had both for the sort of international standardization but also for the, you know, finding something that could feasibly be done but with emerging technology and would be a great contribution to the grid requirements that people have been describing here.

But let me just follow up. It was a little bit unclear actually from what Bill just said about a single point of reactive, or a range. What I understand we're talking about is an upper limit of leading and lagging, and in between those limits we would operate, that we wouldn't be stuck or rigid at a single point. Perhaps I misspeak.

MR. AGARWAL: As I understand your proposal, you are saying you want a standard for low voltage ride-through capability, but at the same time you're saying that it should be studied in every single case. So is that really a standard?

MR. JACOBS: Well that is a reasonable question. What we are trying to establish is a presumptive level that our manufacturers can build to.

If the utility can demonstrate that something beyond that is required, that is going to become a special case that would be outside what the manufacturer would have ready and available.

We aren't trying to limit the utility's ability to make that finding, or make that requirement; only that we shift the burden to them to demonstrate that there is such a need.

MR. AGARWAL: Well let's say there are ten wind projects that were allowed to get installed without any low voltage ride-through capability, and we go all the way up to 999 megawatt and then we hit the last 1 megawatt as in Patricia's example, and lo and behold it becomes a contingency and the spinning reserve isn't enough on the system to carry the loss of that 1000 megawatts. So there are only two ways to do it.

Either we go back and require all of them to install a low voltage ride-through capability, or carry some kind of backup generation or reserve. So which solution would work better?

MR. JACOBS: I would prefer that we try to answer that in writing after I confer with the members, because the question you asked essentially asks us sort of between the first round of installations and the second round of installations, and you can imagine for our members that would be a contentious point.

MR. LEHMAN: One thought that you should keep in mind is that part of the reason why the system is able to--potentially able to add a resource without the need for a certain performance characteristic as I understand the proposal is asking studies to determine whether those performance characteristics are needed.

One of the reasons that you might find that today you don't need that is because of the standards being met for a series of resources being added over the years. And so a given resource added today may be able to piggyback on all those standards being met by all of the resources that preceded them. And to exempt that one and let them utilize the capability of the system is probably not a wise thing to do because we know that down the road, even though there may not be a need for it today, it will be needed.

MR. AGARWAL: Thank you.

MR. JACOBS: If I could ask for a little bit of clarification, there's a certain element, at least in the areas I'm familiar with, where the study sets the interconnection requirement for that generator and conditions changing after that point are not brought back to the generators that have already passed through their interconnection process.

Conditions always will change on the system, and all of this is a forecast of future needs, but there is a different allocation of costs when conditions change after the interconnection.

MR. AGARWAL: You're asking me a question?

MR. JACOBS: I'm sorry, I guess I was responding to the man from Xcel.

MR. AGARWAL: Actually, I think he clarified your question already that somehow the newer generators can piggyback because there's excess reserve. So the first few ones can piggyback on the existing systems. We have to ensure that the new ones that would come would meet their fair share.

MR. JACOBS: And one thing is that's always the case in the interconnection queue, that the consumption of thermal capacity is consumed by the people who come first, and it is never assigned--a cost for upgrade of transmission capacity is never assigned to the parties who have already interconnected just because conditions change later and more capacity is needed either for new generation or a new load.

MR. AGARWAL: I guess your answer is probably to the terminal capacity and our answer is more to the voltage and the N minus 1 contingency.

MR. JACOBS: Right. The N minus 1 is something different. I mean when you do interconnection studies, when you do the voltage as part of the interconnection study along with thermal, my understanding is the idea of the queue is to allocate the costs in some sequence. So you normally through the queue process manage this problem of who comes first, and those who come later may have a different set of costs because the conditions are different.

MR. AGARWAL: I guess that's why we are here to discuss this and find ways to do that.

MR. POOLE: Ken?

MR. DONOHOO: I think another option here is you may have 1000 megawatts there that doesn't have low voltage ride-through capability. You could put a stat COM or some type of dynamic device to keep them on line during that voltage event. That's another options.

These are all options that we deal with every day. This is part of planning. This is part of analysis. They key is how do you allocate the costs, and who pays? There are technical solutions for all of these problems, and that is just the planning environment. And it is constantly changing. It will never be static. And that is the environment we are in today, and we have been in for many years.

MR. JACOBS: And, Ken, can you clarify? Is that special to wind, or is that the circumstances we all face?

MR. DONOHOO: It could be for other generators, also. Right now we're looking at it for wind. We've got some statCOMs in other places around the grid that maintain voltage for other reasons. So that's just part of the planning environment, and the studies we do, and the technical options we have available to solve those issues.

MR. LAVERTY: You know, I'd like to kind of echo something Bill said earlier, and Paul said just a few minutes ago, and maybe put it a little more explicitly than has been done.

When we do these studies which are supposed to determine the need for this requirement, we're looking at two, three, maybe four snapshots in time, specific snapshots in time, over the next say five-year period. And these facilities are being installed with, what, a 20-, 30-, 40-year life span.

So to say well you didn't need it in these three specific instances, which we do try to look at the worst cases but that's not an exhaustive list of cases, and when you get into an off-peak day with some maintenance outages, you know, yeah, you're checking the thermal capability and you redispatch accordingly, but you can monitor that in a steady-state type study in real-time. It's a lot more involved to go in and look at the transient voltage response of each generator for every possible fault under that specific set of conditions for the upcoming day, or half day, or what have you. So I just wanted to make that statement with regards to this.

MR. ROONEY: But that's for synchronous and nonsynchronous, as well, isn't it?

MR. LAVERTY: Oh, true, true.

MR. ROONEY: I mean that's not just wind--

MR. LAVERTY: Right.

MR. ROONEY: --or any other set or types of generation.

MR. LAVERTY: Right, and that's--yes, exactly.

MR. POOLE: Here's a general question. If we require that the low voltage ride-through characteristics that are in the AWEA proposal must be able to be met by all equipment, and then we provide though that the transmission provider as a result of the studies will identify whether you use it or not in the local area, would that be an onerous position?

MR. JACOBS: I can't really speak for the members on this kind of thing at this point. In some sense, you know, we had to go through quite a bit to come to this point and I need to go back to really give you an answer.

MR. WHITEHEAD: I think that is one of the things that we typically do now in many other studies, is we determine what the system needs are, and I think that's one of the bases of IEEE, the IEEE 1547 Standard is there's kind of a standard package of things that gets applied, and you may not need every single one of them, but it's a standard package every time. So from the manufacturer's standpoint, you know, it's more standard so therefore it's cheaper to produce.

We will through the studies determine what needs to be used out of that package. So I think it's similar to that. I mean I think it's a similar kind of thing. You know, that's kind of what the whole purpose of the interconnection studies is is to determine the needs.

MR. POOLE: Further comments? I saw Jack shaking his head back there. Am I getting it all wrong?

MR. HOCHHEIMER: Well these things are going to cost extra if you order them, because they're add-ons.

MR. POOLE: Can you give us an idea of what kind of dollars we're talking about?

MR. HOCHHEIMER: I'm sorry, I don't have a current price proposal in front of me, and they do change frequently. I guess if we wanted to put Vestas or GE on the spot, maybe they could give us some price quotes, but they're fairly expensive. I mean it's not a trivial couple of thousand bucks per turbine. On a new turbine, it's probably $15,000, plus an extra cost per park, per wind park. So on a large project, you're talking several million dollars.

MR. SAYLORS: The question was asked in the morning about maybe a 100 megawatt farm. You're going to need about plus or minus sixty megaVAR capacity there, so you're talking about $3 million for a one-project solution. Those are the kinds of dollars you're talking about. So when we say it's not trivial dollars we're talking about-- and again, this is a very large impact on the overall cost of the project.

For a hundred megawatts, it's roughly a million dollars per megawatt installed, so there's a hundred megawatts to put in three, four million dollars, it's getting to be a significant percentage of the overall cost of the project.

MR. POOLE: But again, if we're looking to the future and we know that there's going to be a lot more wind coming on, do we need to go ahead and set the standard?

MR. QUIST: I'm Craig Quist, again. A comment was made that jeeze, if we don't put the low voltage ride-through standard into a turbine that we can come along later on and put in a statCOM and fix it. That won't happen.

That won't fix it. Studies we've done and Public Service of New Mexico did indicated that if there's a problem with low voltage ride-through tripping a turbine, that the only way you're going to fix that is to go fix the turbine problem; that we've gone in with our technical studies and put in large statCOMs and they're still going to trip.

So you've got to go in and you've got to fix the problem at the turbine if you want that problem to go away. You can't just go put a bandaid on it later on. It's not that easy. This is very complex, very technical. We've seen them go off in studies, and we talked to Public Service New Mexico about they saw the exact thing in their studies.

MR. ROONEY: Are you saying, is that for retrofitting existing?

MR. QUIST: No, what we're saying is that if-- it's fine if you have existing turbines and you can retrofit them with a low voltage ride-through, great, you're fixing it in the turbine. But if you turn a blind eye to fixing it at the turbine and think you can come on later on and put a statCOM device someplace in your system to stop these low-voltage depressions, we've seen many situations where that will not stop the tripping; that you actually had to go back in and fix the problem at the turbine.

They saw this at Tieband Mesa in New Mexico, that it was so bad that they had to bring GE back in and they had to fix the problem. We've seen it in Wyoming.

MR. SAYLORS: Just adding the low voltage ride-through package may not solve your problem. Adding the statCOM may not solve it. It may be a combination of the two. Certainly a combination of the two can reduce the size of the reactive solution here, a statCOM on the SVC to the point where it may become much more economically justifiable for the project to move ahead then.

MR. POURBEIK: Pouyan Pourbeik, ABB. To comment on both what Craig and Steve said, we studied both those cases. The issue with Tieband Mesa was you're talking about the doubly fed units. There the issue with low voltage ride-through is protecting the power electronics on the converters. You cannot protect power electronics with statCOM and SVC. You have to make turbine control modifications.

With technologies like conventional induction generators, the issue again, the physics behind that, is not allowing the unit to go beyond this breakdown. So it is a combination of low voltage ride-through and dynamic VARs. So you need the combination of two sometimes. Sometimes one is enough. Sometimes you need both. It depends on the weakness of the system.

So I agree with Craig that you can't go backwards in time and fix the problem. And I also agree with Steve that it's not just one or the other; it's sometimes a combination of both.

MR. MILLER: I'll try and mention the other manufacturer in the room. Jack's right. It's extra cost. From the perspective of a manufacturer, we would like to see a level playing field and not a proliferation of different offerings in different markets. That drives the net cost down. It's very unlikely that adopting this standard will result in turbines that end up in exactly the same price level as if we didn't have it, but you can bet, speaking for GE, that the difference in price between having it and not having it when we have two model winds will be noticeable and somewhat painful.

I guess the flip side of this, too, is that one of the things that we're talking about is the floor of this low voltage ride-through requirement. That came out from lots of work in Europe on E.ON, a lot of head-banging together with all the manufacturers on the Continent to set a floor below which becomes a real steep curve.

We, GE, are not particularly enthused about the notion of having the standard get ratcheted to something even tighter, which is 'you shall not trip no matter what we do on the transmission system, including a voltage fault at the point of interconnection.'

That last little bit is a doozy, and this comes back to an earlier point about comparing alternatives. You can reduce the level of impact by putting the standard as recommended by AWEA so that way down the road with high penetration the area impacted by a single event is tolerated. So there is a bit of compromise going on here.

I guess the only other point I wanted to make, too, is one I made earlier: Don't lose sight of the fact that in many of these applications the dynamic performance is better from these nasty faults than it is for the generation that you've got now.

So, yes, maybe not quite so good for these faults, but better for other aspects. So let's have a little flexibility.

MR. POOLE: Are there other comments?

MR. WHITEHEAD: Just to clarify my earlier comment. The Appendix G, the proposed language in the Appendix G that's attached to this request for rule making says nonsynchronous wind generators shall demonstrate the ability to remain online during normal nominal voltage disturbances. So I was just taking from that language that the proposal was to require everything going forward to have the low voltage ride-through capability.

And again from our standpoint, from the standpoint of the transmission provider, we will do as we do with all other interconnections. We will determine what is necessary to make the system reliable. And if that is necessary, you know, we can certainly indicate that it's necessary. Again, I was just reacting to what was proposed in the standard, which is 'it shall demonstrate the ability'.

But, you know, that's not unlike what they did with the IEEE 1547 Standard.

MR. POOLE: Are there any other questions for the panel on the details of this, or something else?

MR. DENNIS: Bruce, I don't know--this is the lawyer who is going to ask sort of an engineering question--

MR. POOLE: There are no dumb questions here.

(Laughter.)

MR. DENNIS: We heard a lot this morning about low voltage ride-through perhaps being more harmful than good in certain situations. I think distribution level was one of them.

I don't know if MISO or PJM or even ERCOT can maybe just address that a little bit. I think that it would just be another perspective on that. I don't know, and I can't say off the top of my head how much distribution level is under your control, even.

MR. LAVERTY: We've had applications in our queue of the 115 total wind requests that we've had over the last three years, we've had from less than a megawatt on the distribution system up to the 300 or so on the transmission, and I would tend to agree with the comments this morning that at times low voltage ride-through is not desirable if it's down there.

And, you know, getting to the comment I made earlier about size and location with the interconnection requirements, if you've got a single turbine being located down on the distribution system, I don't really see a need to do transient stability studies on that, especially if you're on a radial distribution system, because the fault that it's going to trip off for is probably going to knock off the whole distribution feeder.

So I would tend to say that, yeah, I agree with the comments this morning.

MR. WHITEHEAD: I will also agree with that, that the needs on the transmission system are much different than the needs on the distribution system, and particularly where you have a unit connected to radial distribution, the likelihood of it--you know, the possibility of it staying online may actually be worse than having it, you know, trip off and then put the system back. So I think I would agree with that.

And it is a much different situation than the transmission system.

MR. CALDWELL: Let me just make the comment that we're not talking about a reliability problem here. Just because you have low voltage ride-through capability doesn't mean that you actually have to use it. You can certainly set your voltage trips wherever they needed to be for the particular circumstances.

So the issue is, there are many circumstances where it is not a reliability question but where that extra cost to the extent there is an extra cost for the low voltage ride-through, it doesn't make any sense to have incurred that cost. That may be very well one of the places where you may want to set some of the turbines that are in inventory now that don't have that capability and then not have either any economic or reliability impact. But it's an economic question; it's not a reliability question from that standpoint.

MR. POOLE: Can some of the other panel members address that same question?

MR. DONOHOO: The one thing I think I agree with everybody else here, distribution is a completely different environment. It's also a much smaller level of generation than what we're dealing with with transmission interconnections, much smaller. So it tends to be more diverse. It is radial in nature. That's the big factor there; it's a different environment.

I also agree with Jim. We've got it there. Set a standard. We can always turn it off or change it. Again, it's more studies, more environment.

I also agree, we don't have to do training stability studies for a one megawatt wind turbine connected up to distribution. It's not going to make a big factor. So again, we tend to look in ERCOT about the 20 MVA level is where we start considering stability effects. But most distribution is usually 10 megawatts or less because that's about all that a distribution feeder can handle.

MS. ARONS: I'm not entirely convinced that it's a real problem that's being identified. On a radial distribution circuit where you have a fault, it's hard to imagine that you can have a wind generator down the line with a load where it's not going to see very, very low voltage. So I think that your floor is going to be violated in that situation, but as Jim pointed out if you can disable that low voltage ride-through capability in that particular instance, I wouldn't have a problem with that.

The problem is that when you get a lot of wind generators in a single regime where you don't get a--you can't discriminate between what's on a distribution circuit versus what's on a transmission because all of a sudden you're going to drive everybody to a desired distribution interconnection. So I think you've got to have some kind of a rationale on how you're going to coordinate this standard. Because a distribution circuit is not really going to distinguish between a fault on a 66 that caused a low voltage condition versus a fault on a distribution circuit that maybe caused the same low voltage problem, but if those turbines are in the same wind regime and that's a very large wind regime, they really all--you know, you've got to find a way of coordinating that problem.

My thinking is that because you have so many developers that have an incentive to develop large wind parks, that if they're going into like the Tehachapi area you're not going to give them a distribution connection; you make them go to a higher voltage connection, and that's the way that you can manage that particular problem. You don't allow a 12 kV or a distribution feeder circuit when you're in a very large wind regime because they're trying to avoid the expense and cost of meeting a distribution ride-through, or the low voltage ride-through standard.

So I think there's common sense. But as an isolated turbine out at the end of a distribution circuit, I'm not sure that I can see it as a real problem.

MR. SAYLORS: I would just say that these low voltage options are that, just options, and they are something you have to order with the turbine because we put in things, like I said this morning, at UPS we harden the rotor converter system and that sort of thing.

So the standard machine will be designed to set up for it, but it will take the customer to order these as optional. So they won't come--every one of them is not going to come with the low voltage option already. So it's not something you will turn off necessarily here. You will order it when you need it.

We think that most likely the large part of the market will--large connections to the bulk system here is definitely going to embrace the concept.

MR. ROONEY: Just to make sure I understand, then, if you have a wind project with a low voltage capability, that's less of a problem on both transmission and distribution? Does everybody agree with that, or disagree?

MR. JACOBS: No, I think if it's on a radial feeder you don't want to have that low voltage ride-through active and working if the line is tripped. You would have islanding.

MR. ROONEY: No, I understand. All I'm saying is if you had that option. You don't have to turn it on, but if you have that option. That was my question.

MR. JACOBS: You wouldn't want to pay for it if you were never going to use it.

MR. POOLE: You can't have it both ways.

(Laughter.)

MR. SAYLORS: You have to pay for the option when you purchase the turbine. That's the point.

MR. MATTHEWS: I wanted just to mention and reiterate the islanding. If they're online and with load with enough capacitors, you get this self-excitation problem. So there could be other issues on the distribution system that you need to worry about.

MR. JACOBS: Bruce, I have to follow through because I'm not sure we're talking about the same thing now. When we talk about a standard for low voltage ride-through and we talk about feeders, we would not be installing equipment that we knew (a) was never going to be used; and (b) if it were used would create a safety problem.

So I think the idea the standard is there doesn't mean it's going to be installed.

MR. POOLE: I guess what I was understanding--and maybe I misunderstood--was that we were looking for a standard for the manufacturers, and that if we said you're going to be on a transmission system at a certain voltage, each machine has to be able to do this. You can turn it off or turn it on, but it has to be designed to do this. And that would mean that they all have to be made that way.

MR. JACOBS: And I'm not contesting that.

MR. POOLE: Okay. But that's where the money then would come in, right, at the manufacturers? And that would be priced down to the people who buy the machines?

MR. JACOBS: Where we ran into each other was with lower--

MR. POOLE: I'm not saying that you would have to use it. You know, you would turn it off on the distribution machine, okay, if you don't want it to do that.

MR. SAYLORS: You could order the optional package.

MR. POOLE: Okay. Okay.

MR. POOLE: Patricia? And we are being webcast, so please try to use the microphones.

MR. KELLY: So if you speak from the audience and you think you can be heard, unless you speak real loud they won't hear you in Oregon.

(Laughter.)

MS. ARONS: We have a distribution system in Tehachapi, and we have some small wind parks that are connected to distribution voltage levels. The majority of the wind parks in Tehachapi are connected at what we call sub transmission voltages, 66 kV.

A 66 kV fault that would affect that entire area, both the 66 kV connected as well as the 12 kV connected, if you don't have low voltage ride-through all of the machines in that area, irrespective of how they're connected, could potentially be simultaneously lost without low voltage ride-through.

If you say, well, if you want to connect up to a distribution voltage and you won't have to buy low voltage ride-through capability, all of a sudden in Tehachapi you've created a stampede for connection and distribution, yet the entire area is subject to potential low voltage problems.

So you have to be very thoughtful in how you create the standard so that you're not creating an incentive to connect at one voltage or another, but you recognize that there are wind regimes, and there are large wind parks, and there are small wind parks, and that a single uniform standard may not necessarily apply in all instances.

I happen to think that you can avoid and set up a distribution circuit in such a way that you are not isolating customer load with distribution connected wind generators. You try to avoid that co-mingling of customer and wind turbine.

Distribution circuits tend to be relatively shorter than transmission lines, so you might be able to require a connection back to a sub station and then require that wind turbine to have low voltage ride-through capability. But, you know, just be thoughtful in terms of how you set up this standard, because what is required as a result could potentially create a movement or a desire to avoid costs, and I think that is an undesired outcome, as well.

MR. POOLE: I guess I would think that that would be caught by these studies that the transmission provider would do, and so they would do those and if they need it they would have it; if they don't want it, they could not have it. Is that right?

MS. ARONS: Yes.

MR. KELLY: Earlier, Ken Donohoo, you made the point that your requirement for the dynamic reactive power capability plus or minus .95 was imposed at the point of interconnection but not for each generator, and that's a distinction I didn't make in my mind during the discussions this morning where some people said you ought to have a requirement, you ought not have a requirement. I was just wondering if, first of all, Ken, if you had anything to add to that to elaborate. But then if other panelists found that would be adequate for their needs on the one hand, or on the other hand still too onerous if it increases your investment cost?

MR. DONOHOO: And where that .95 of the transmission level came out from was originally we had a requirement at the generator terminals. We had people putting in very low-cost transformers. It actually took more reactive to serve the plant, and this was not a wind farm, this was actually a regular plant. So that's when we brought it forward to the transmission interconnection point rather than the plant.

He can do anything he wants behind the transmission interconnection point, but he's got to meet that requirement. And if the requirement was at the generation terminals, there were some cases where we wouldn't have .95 at all. In some cases we wouldn't have .98 even because of what he put in in between, or even the load that might be connected to his auxiliary bus. So that's why we put it back.

We really don't care what he does behind the scenes, or behind the interconnection; it's now at the transmission level that we measure that .95.

MR. KELLY: Thank you. And I was wondering if that was a standard that others would find a nice compromise, or if there are still objections to that approach for both sides. Comments from anybody who cares to.

MR. LAVERTY: Our requirements before Order 2003 were .9 lagging to .95 leading at the generator terminals, and we worked with the wind developers to the extent we could because that wasn't always possible.

In the 2003 stakeholder process, at one of the meetings, we sat down with pencil and paper and drew out the circuit, and said, look, if we require .9 lagging at the generator terminals, with some standard-size GSUs that we'd seen, does it really make a difference to requiring .95 lagging at the point of interconnection?

And we found that -- not to be glib here, but close enough. And we said, okay, we said in our filing, unless the transmission owner has a consistently-applied criteria that's more stringent, we would accept that. We thought it worked well.

MS. ARONS: Edison has gone through something similar, historically, over the last 20 years. In fact, there was a point in time that we had a great deal of fear of self-excitation, and what that would do to customer load, so we were limiting installation of switchable capacitors within the wind park to no-load requirements.

And what we concluded over the years is that it's really a better standard to establish it at the point of connection to the utility, because then it imposes responsibility on the wind developer to look at the efficiency of how they distribute their power codes within their collector system.

So they can do loss compensation; they can study how their voltage profiles -- they can do what they need to do to avoid the risks of self-excitation on the equipment, and we found it works good enough. At one point in time, we had a standard that was applied to the terminals; now we are simply focused on the point of interconnection.

I think that we've seen developers become much more sophisticated about how they manage their VAR resources within their wind park, and so I think today we see it working out pretty well.

MR. WHITEHEAD: We apply everything at the point of interconnection, as well, all the requirements at the point of interconnection, again, so that regardless of wind or any other type of generation -- and essentially that lets the developer of the project to do what they need to behind the point of interconnection to make their system work for them, things like the auxiliary equipment, you know, what they do with the auxiliary equipment and how they power the auxiliary equipment and everything.

So, you know, we use the point of interconnection.

MR. POOLE: Nick?

MR. MILLER: Nick Miller, GE. We also agree with this point of interconnection. It's functional, drives the ability to do things within the plant.

There is one nuance that I made reference to in my handout this morning that I want to bring up, because I didn't say it very well.

And that is, we worry, as designers of wind farms and builders of equipment, about what we refer to as the corners. Interconnection normally requires the ability of your power plant to operate anywhere between, say, plus or minus five percent voltage as your normal on your grid at the point of interconnection.

Also, if you overlay that with plus or minus .95 power factor, you get to a condition, if you are strictly interpreting the requirement, to say the wind farm must be able to deliver .95 over-excited, into the grid when the voltage is high.

And that creates a real problem on the collection system and on the individual machines. It's crazy; it's not something that is good for the grid or good for operations, but it's a nuance that needs to be, if we're going to adopt this standard as something that's cast in concrete, we've got to cut those corners off. Both delivery VARs to very high-voltage condition, and consuming VARs at very low voltage condition, aren't good for anybody and they could drive lots of costs to no one's benefit.

So, it's not a box; it's a box with the corners cut off.

MR. JACOBS: Nick, can you put that in writing, so that it gets filed?

MR. MILLER: That it's a box with the corners cut off?

(Laughter.)

MR. JACOBS: Only you know what you said.

MR. POOLE: Do others have questions?

MR. HINRICHS: Yes. I'd just like to get some comments on the notion between one large farm and many smaller ones that are all proximate, and how some of the dynamics of that work. Patricia, this might be something that relates to the experiences Tehachapi, but it's open to anyone. MS. ARONS: I'm not sure I completely understand your question. Are you thinking that there's something particular about how we plan the transmission system?

MR. HINRICHS: Yes, and also some of the operational challenges and design challenges that might come up when one looks at either many small farms that are proximate, or one large one, and the notion that I'm thinking about is how it relates to how we look at large farms and small farms.

MR. DENNIS: Proximate but separate?

MR. HINRICHS: Yes.

MR. DENNIS: But separately interconnected?

MR. HINRICHS: Yes.

MR. DENNIS: Okay.

MR. HINRICHS: Close in location and close within the topology of the grid, but not the same.

MS. ARONS: I guess that the one comment I would make is, when you're dealing with multiple wind parks and the same wind machine and connected electrically very close to each other, as is the case for us in Tehachapi, it is really hard to find the bad actor when you have a problem.

And it is really hard to find what the nature of the problem is that you're having. We have gone through, over the years, experiences with under-voltage conditions where customers get tripped, wind parks get tripped, and diagnosing and finding the deficiencies, whether it's a VAR deficiency or someone has gone in and done a re-power and improved the performance, but created a more heavily loaded condition, those things are very hard to find.

So, I think that having clear standards and consistent standards that don't change according to the next study that you do, because we are continually processing generation interconnections, and to have a whole set of requirements that are then imposed on the next interconnection that may not have gotten imposed on the prior connection or re-power or whatever configuration change you're dealing with, and Tehachapi becomes a real moving target in managing a continually reliable, solidly performing system.

And if you have a single large wind park, it's a lot easier to go in and diagnose what's happening there. But we have so many wind park interconnections in Tehachapi that we don't know exactly what a particular line is loading at, or what a low-voltage condition may have been or where it occurred, and we operate blind and we rely very heavily on our studies.

And we have programs where we go in, and we verify that there are sufficient VARs installed. There was a period of time where we saw that capacitors weren't being maintained and were allowed to degrade, and so there were problems that cropped up.

And so it is like -- it's just a continual, ongoing moving target, and the more participants you have in the problem, the more difficult it is to manage and maintain problems when they do come up. That would be the comment I would have in that respect.

MR. JACOBS: If I could add, I'm only somewhat familiar with the Tehachapi region, and part of the problem, I think, stems from our continuing issue about generator models. I know there's a range of generator technology in the Tehachapi area, and this contributes to this particular issue.

It's just an example of how we have another variable, and our proposal here today is aiming to try to straighten that one out, too.

MS. McKINLEY: I have a question, and that has to do with this concept of relative size of large and small. Ed Torrero gave an example this morning of a small coop being asked to interconnect a fairly large wind project, and that being overwhelming for that entity.

And on the other hand, we have SoCal Edison, which has some distribution lines that are actually pretty huge compared to other distribution systems. So, FERC is in the position, I think, of having to make some decisions about what is relatively large and small.

Do we have -- are there any recommendations for you, from the panelists, on how FERC should relegate that size differential, or are there any guidelines on what is relatively large and small in terms of entities interconnecting?

MR. WHITEHEAD: Well, in our tariff, we differentiate based on what was in Order 2003-A, where essentially small is less than 20 and large is bigger than 20. The size on the distribution system, for the most part, tends to take care of itself in the study process, because if the project is too big for the size of the distribution, then it just doesn't fit, you know, the number of upgrades that are required may be outrageous or it just may not be possible to make the interconnection, so it tends to take care of itself in the interconnection study in terms of the actual size.

But we used the size more for really the processing of it, more than the differentiating between a large project and a small project in terms of, you know, the interconnection, the physical interconnection. We used the size more to differentiate in the process, because 20 megawatts and less tends to have less of an impact.

MR. LAVERTY: We've run into a -- we also use the 20-megawatt cutoff. We have since we were approved as an RTO.

And what we get sometimes is someone will come in with, say, a 10- or 15-megawatt request, and say, hey, look, can you expedite me? Your tariff says you're going to expedite me.

I say, well, it says we'll try to expedite you, but I've got three other 100-megawatt requests at roughly the same point of interconnection, as you describe here, that I have got to process first, because they were here first.

And, you know, we get that issue. If they are, indeed, isolated, you still go through a lot of the same steps. You might cut out some stability, you might -- you're going to narrow the scope of what you look at, because the scope of what this particular generator affects is narrowed, and that's where you see the big difference.

In the small-gen NOPR, what I noticed was that you tried -- I thought, anyway, you tried to take that into account, that, look, if it's very small, try to speed it through. And then you had another level.

If you can't really speed it through, try to speed it through with a little slower method, and if that still doesn't work, kick it over to the large generator procedures, and our experience has been that that's appropriate.

MR. CALDWELL: Jim Caldwell, PPM. There's a couple of sort of historical accidents that I think sort of help us here, and one is that a lot of the rural distribution networks that exist in this country, were designed by the same person at the same time.

You know, the Rural Electrification Administration back in the '30s and '40s, had sort of a standard design for this sort of thing, and they went through the same sort of process here, and rather than do everything sort of trying to precise-up everything, they designed them all pretty much about the same.

And if you look around, I mean, 20 megawatts doesn't turn out to be a bad number, just because of that historical accident, and I agree with Pat, you know, in the sense that what we don't want to do is set up something where you're incentivized to go to somewhere else, simply because of that cost.

However, I think every standard or everything is -- I mean, they used to say the QFIQ test was, why would you ever want to build anything over 49.9 megawatts, you know, because there was a 50-megawatt cutoff for some of these things. So, we're always going to run into that, but I don't think that in this case, for this instance, that as long as we stick with this 20-megawatt cutoff, that we're going to get into huge trouble everywhere.

Sure, it's going to be an issue in some cases at the margin, but it's not going to be a big deal, and that's a strike accident of the REA in many cases.

MR. POOLE: Okay, it's -- oh, we've got one more question out here.

MR. QUIST: I was talking with our contracts guys, and if they had druthers, they'd like to lower that down to ten, just because there are enough requests that if the number was moved down to ten, it would make it so that from ten on, it would be a fairly smooth transition, but below ten, actually you start hitting the point where those would actually be distribution.

So, I just want to make that point, that there are some who would like to see it dropped a little bit.

MR. POOLE: Okay, I'm just going to open it up to other people in the audience, other than just the speakers.

MR. MORRISON: Thank you very much. I'm Jay Morrison, NRECA. A couple of things: One, I thought Jim's comment was interesting, since there are hundreds of cooperatives out there built, according to the REA standards, that are under 20 megawatts total peak capacity, so 20 megawatts is awfully big for a huge percentage of the cooperatives.

Not all of those are jurisdictional to the Commission, but some of them are. So, what's big and small, is really going to be comparative to the system. So, a 20-megawatt wind farm near a substation on a large transmission system, is not a big deal, but it's going to be enormous for an already-stability-limited, long, radial facility.

So for the Commission -- the Commission needs to be careful when it says small doesn't need to do X, just because it's small, because small, somewhere in the country, is actually going to be huge.

The other thing is, I agree with Jim that there are funny incentives. One of the other standards in PURPA is 80 megawatts. And there's an awful lot of 79.95 megawatt QFs out there.

We want to be careful that we don't wind up with somebody putting in 12, 19.95 megawatt wind farms in the same area, instead of one good-sized one. It's not efficient, but it might wind up being cheaper, if the Commission comes up with at standard that if you're under X-size, you just don't have to do these things.

But when you've got 12 of them, you really do need to have those standards to protect the system. So, we're uncomfortable with hard-and-fast size cutoffs on anything.

On small-gen NOPR, we've expressed a great deal of concern with the two and the 20. We're not sure that those are necessarily always system related. In this same context, we need to be careful with specific cutoffs as to what is a large or a small system, just so we don't wind up getting all sort of unintended consequences.

MR. POOLE: Yeah?

MR. WHITEHEAD: I'd just like to quickly respond to that. At least the way we apply the process, the 20 megawatts is really more of a process related cutoff. The requirements are what they are, whether they're 20 megawatts or 50. It's more a case of the processing of it in terms of whether the processing gets expedited or not.

So I think that your concern about, you know, what the requirements are, I think, is based -- you know, the requirements are based on what they are, and I think it gets back to the earlier question of whether we had, you know, ten 19.9 megawatt projects or one 200 megawatt project, the difference would be really in the way it gets analyzed, because if there are ten projects, there are going to be ten queue positions, and you'll analyze the projects and if you can accommodate all 200 megawatts, you can do it whether it's a single farm or ten separate ones.

If you can't, then, you know, if you can accommodate five of them, the other five will get, you know, higher interconnection requirements, so I think it's -- again, I think the queuing process and the way it's set up, takes care of the concerns about how they are analyzed.

MR. POOLE: Yes?

MR. MAZOR: My name is Ron Mazor, and I'm from Manitoba Hydro, maybe one of the few Canadian utilities here today. I'm not sure.

(Microphone fails.)

MR. MAZOR: It's just that cold weather from up north, that froze it up.

(Laughter.)

MR. MAZOR: By the way, wind turbines stop at minus-30.

(Laughter.)

MR. MAZOR: As I said, I'm not going to -- I'll probably provide some written comments, but I'd like to talk about a couple of things that maybe were just very briefly mentioned and emphasized.

Manitoba Hydro has about 5600 megawatts of connected generation, 99 percent of which is water, hydraulic powered. I have an IOA signed for a 100-megawatt wind farm that we've spent about the last year and a half doing iterative studies with the developer on, and I guess that's one of my comments.

There's been a lot of talk about feasibility studies and the need to have perfect data when the request comes in. I guess the question to some of the people that have connected hundreds of megawatts is, is that really a need? I see kind of an iterative need in the feasibility study.

We like to look at high level. Is this thing going to work? Is it the right spot?

I don't think I need models that tell my damping needs fixing or anything like that. And, you know, maybe instead of changing the process, fix the requirements in terms of the different levels of study.

Secondly, we do have a transmission system interconnection requirement posted. It's on MISO's web page under MHEB. It does address to some extent, some wind issues.

Maybe I'm going to change it after what I heard today, but -- I guess I'd like to talk a little bit about power system stabilizers. Obviously you can't put one on something that doesn't have an excitation system.

But I guess I would say that if the situation is such that a damping problem is enhanced or degraded, and we do have damping problems -- I know Wayne mentioned earlier in his discussion -- there are ways to fix it, and it probably needs to be the responsibility of the generators causing it.

And you can fix it by supplemental damping signals on FACTS devices. There's more than one solution, and I don't know if anyone has experience in going in that direction.

We fixed a partial damping problem of putting some signal onto an SVC at one of the major stations on our 500 KV line. So, I think that has to be a point.

Enough is said about low-voltage ride-through, but it was briefly mentioned, maybe voltage ride-through or over-voltage. Wayne, I think, mentioned DC converter blocks, and when our 2,000 megawatt one blocks, I can tell you we'll have 1.3 per unit over-voltage for a couple hundred milliseconds before the controls are designed to pull it down.

We do not like to see, you know, 100 or 200 or 500 megawatts of wind farm drop out, you know, after we already lost 2,000 megawatts. It's an essential requirement, if you're going to connect to hydro, and we have about 1200 megawatts request in a connection queue, just like everybody else.

I don't know how many will come to fruition, but there's a lot out there. One other thing that I think needs to be considered -- and maybe it was mentioned briefly, is you need to look at over- and under-frequency as well, because you will get under-frequency situations about generation loss, and you want to be able to have any generator, not only wind generators, withstand that sort of requirement, so don't forget frequency.

Finally, maybe a last point, and the rest of them, I'll relegate to written comments, is that we talked about SCADA. One of the things that it's nice to have maximum plant output. I guess our operators will dispatch these things, so we need to have wind forecast information, and we agree with some of those proposals.

We also probably would like to say that we need some voltage set point or power factor set point adjustments, and that's something not mentioned, so I guess I'll stop there, and be interested any comments, particularly on the need for detail at the initial feasibility stage. Thank you.

MR. LAVERTY: Could I comment here briefly on the need for the data on the feasibility? Ron makes a good point. In a feasibility study, it's almost a fatal flaw analysis. Is this a really good idea or not?

But one of the lessons we learned in the late 1990s with the rush of gas generation, was, you need a drop-dead date for your best design at the moment.

As stated earlier, it is subject to change. You take a look at it and see if the changes are material or not. But what we saw was, while waiting for this data which in some cases never came, you ended up with a clogged queue backlog that snowballed, and that doesn't benefit anybody. So, you know, if not at sort of the feasibility study, then definitely by the start of the system impact study you do need to know which manufacturer to be tested, and as I stated that drives what is needed for that model, which is at least a pretty good preliminary design.

MR. MILLER: Nick Miller, GE. Great straight man over here. I want to answer a couple of his points real quickly.

Power system stabilizers is something we've worried about, and I kept making references that there's some aspects of wind generation that's superior to conventional generation? That's one of them. At least the technology that GE builds do not like to oscillate with system. We have a paper at the next IEEE meeting showing some of that. Power system stabilizers? Don't need 'em. Performance is substantially better, more stable, and especially in these long skinny nasty systems like we're going to get in Montana and Dakota.

High voltage? Absolutely. The manufacturers, including us, have these high voltage trip points in our specs. The good news is that sucking VARs down is pretty much duck soup for everybody. So pulling the voltage down to keep the machines from tripping is really quite easy, but nevertheless ought to be standardized.

And the final point, absolutely, on the frequency. But since I saw everybody's eyeballs roll back when I talked about the box with the corners cut off, there's another degree of freedom which is frequency. So it's really a cube with corners lopped off. We don't like high frequency; we don't like low frequency and high voltage, but I'll leave that for another day.

MR. POOLE: Do we have other commenters?

MR. WHITEHEAD: Just one quick comment on the feasibility studies. I agree with Eric. I think the point of a feasibility study is more or less a go/no go. And one of the things that you get out of the feasibility study is whether you are being influenced by other projects in the queue or whether you are influencing other projects in the queue.

You know, that's one of the most important pieces that you get out of the feasibility study. So I think it is important to keep in mind that, you know, we don't require all of the detailed information at the feasibility study, and I don't think--well I know MISO doesn't, as well.

It's more or less, you know, the high level study. The detailed stuff really comes at the system impact study stage, and at that point I think, as Eric said, you have to have a pretty good indication of what the project is in order to keep the queue process moving forward.

MR. ROMANOWITZ: I'm from a warm climate, not the cold ones. I am Hal Romanowitz. I am president of Oak Creek Energy and president of the Kern Wind Energy Association. Kern Wind Energy Association is home of Tehachapi, and so we've had lots of experience with the issues and so on.

We very highly support what's being done here and feel it is urgently needed. The transparency issue is extremely important, and I think that our recommendation would be to go quite a step farther; that the results of the studies should also be widely available so that the entire community that is connected to the grid can benefit from the work that is done incrementally, and that studies need to be released and need to be widely available in order to have a good transparent system.

In Tehachapi, we have gained significantly over time by working heavily with Southern California Edison where the transfer capacity out of Tehachapi has been about doubled over a period of less than ten years by the industry and the utility working together and enhancing and retrofitting to increase transfer.

Secondly, these rules are necessary so as to not benefit large generators in California as a result of the energy crisis. All of the contracts that were let went to large, in many cases inefficient fossil generators. Wind energy was largely excluded to a large extent because of perceived unreliability, and these rules are necessary in order to keep the market going and to give wind generators a fair shot long-term.

The other thing is that reactive energy and reactive control, as Nick Miller has pointed out, can be as good or better than an SVC or in that same order of magnitude. And while wind turbines may not today be fully capable of doing all of those same things, the inherent capability is there and it is important to set the standards and the specifications now so that as you go forward that capability is there and it is far more efficient to not duplicate equipment to more effectively utilize the equipment that is already in place and have a single capital investment rather than multiple investments.

And you will have a better result and a long-term grid. So the importance of including dynamic performance specifications in the standard I think is really important.

Thank you.

MR. POOLE: Do we have other questions or comments?

MR. HAIDLE: Just one. I assume the wind farms cannot generate VARs unless they're turning.

MR. JACOBS: I don't believe that's true. They can. It depends on technology. If you would like us to brief you on that, both directly and in this docket, that's something we'd definitely like to communicate.

MR. HAIDLE: Okay.

MR. POOLE: Patricia?

MS. ARONS: During the energy crisis in the year 2000, toward the end of the year, we were in the process of studying tens of thousands of megawatts of generation that wanted to connect up to the grid and solve the capacity crisis that existed in California.

That crisis, in retrospect, was probably a price crisis not a real capacity shortage, but there are capacity needs in California in the future that will provide an incentive for new generation connections. And to the extent that we can get a very clear study process and get the data from wind generators as early in the process as we possibly can, that will improve our ability to provide other generators that might be behind them in queue with better information about what their requirements are.

One of the things that we saw going through the process, we were having to do re-studies again and again for generators as changes to other units that were earlier in the queue changed conditions, that subsequent projects faced, and I believe that the wind community should really take the lead in making sure that the models are good; that the utilities are provided with the best data available, and that the burden doesn't reside with us to go out and chase down these models.

Make sure that you're giving us the best data that you've got. I have to believe that it's out there. It's just we're dealing with people that don't want to step up to the plate and do the work necessary to support the interconnection process.

So I really do encourage the wind community to do the best job that they can in giving us a clean application right at the outset, even as we're doing feasibility studies because it affects others that are connecting in queue behind you.

MR. PORTER: I am Kevin Porter with Exeter Associates. We are a consulting company in Columbia, Maryland. Just two things:

First, a commercial. Mention was made of the Utility Wind Interest Group. They meet twice a year. They are meeting October 27th and 28th in Albany, New York. I know Ken will be there.

The second thing is, in listening to a discussion of the AWEA proposal, and I heard concerns about comparability of other generators versus the AWEA proposal, I am wondering particularly with the--and I'm not technically proficient so the leading and lagging indicator really doesn't mean anything to me--but I'm wondering in particular on that and voltage, whether the AWEA proposal should be treated as a rebuttable presumption?

So in other words, rather than the burden being put on say the transmission provider to show that anything less than that, or more than that--pardon me, more than that, is required, that maybe it is treated as a rebuttable presumption, and then the interconnection agreement comes to FERC, or they work it out and it comes to FERC and you bless or not bless as the case may be.

It's just a thought from hearing some very good comments today.

MR. KELLY: Kevin, there was a question I was going to ask the panel earlier and then I dropped it, but you've kind of put half of it on the table, which is that AWEA has in some sense put this out as a 'don't require low voltage ride-through unless it's shown to be needed.'

And in the comments of Pacific Corp, they had kind of the opposite theme going of don't be hard and fast and require everything, but presume that a large wind farm should behave the same as any other unit unless a case-by-case study shows that it's not needed.

You might argue those two positions aren't that far apart because neither one is dogmatic; each allows case-by-case studies. But I kind of wanted to, in a sense, expand your questions say between those two views, which is a preferred view, if you were going to ask any of the panelists to comment on it.

(No response.)

MR. KELLY: And if not...

(Laughter.)

MR. POOLE: Any comments?

MR. LAVERTY: Well, it seems the low voltage ride-through is one--this has been said several times--is one tool among many to solve criteria violations on the transmission network. So the question is: Do you require the capability up front and then see if you need it? Or do you not require it and then require the transmission provider to go to the developer and say: Do you have this? Can you get it? Can you meet this? It's a question of what's more efficient, I think. That's my opinion based on having done a few of these.

You know, you get some time delay and you go back and, you know, can I meet this profile, can i not? If not, then we're looking at FACTS devices, or maybe a third line brought into an area.

MR. JACOBS: Well I think Eric actually sort of hit upon it in a way. The interconnection study process identifies what upgrades are needed to keep the system from degrading. That's what I think we mean to say.

If you need something to keep the system from degrading, that's part of the outcome of these studies. We don't reconduct every line because a generator is added to it. It's an outcome of the study.

MR. WHITEHEAD: I think I would just agree with that and just expand a little bit, because as you do the study, you know, as Mike pointed out, you're incrementally adding generation or transmission or whatever, you're incrementally adding to the transmission system. And at some point your reliability criteria area violated. At that point, you have to decide what is the solution. And the more solutions you have in the tool box the better off you are as far as being able to solve it in the most efficient way.

So I don't think you want to preclude any solutions in it, but I don't think you necessarily want to force any solutions, either. So I think it is the idea that you go through and determine what the needs are, and then make them happen.

MR. POOLE: Well if there are no other questions or comments, I would like to thank everybody, and particularly the people who were on the panel and came in for this.

I have a couple of other items. I just wanted to remind you that we would like to have all the written comments in within 30 days, or about October the 25th, that Monday.

We are also, although we didn't really--today we mainly discussed wind, we are interested in any other alternate technologies that somebody might identify that might need some sort of special presentation in the Interconnection Agreements, and we would like to have any comments on that.

If there are no other things, we are adjourned.

(Whereupon, at 4:25 p.m., Friday, October 24, 2004, the meeting was adjourned.)