UNITED STATES DEPARTMENT OF ENERGY

ELECTRICITY ADVISORY COMMITTEE MEETING

Arlington, Virginia

Monday, June 29, 2015

PARTICIPANTS:

STEPHANIE AYERS
IMCOR

VENKAT BANUNARAYANAN
National Rural Electric Cooperative Association

DENIS BERGERON
Maine Public Utilities Commission

ANJAN BOSE
Washington State University

TRICIA BREEGER
Mitsubishi Electric Power Products

MERWIN BROWN
California Institute for Energy & Environment

MARILYN BROWN
Georgia Institute of Technology

DARRON BYRNE
IMCORP

CAITLIN CALLAGHAN
Department of Energy

PAUL CENTOLELLA
Paul Centolella & Associates LLC

CARLOS COE
Millennium Energy

LELAND COPLIANI
Lewis-Burke

RICHARD COWART
Regulatory Assistance Project

ROBERT CURRY
CurryEnergy

KEN DONOHOO
Oncor Electric Delivery Company

CLARK GELLINGS
Electric Power Research Institute (EPRI)

DEBBIE HAUGHT
Department of Energy

PARTICIPANTS (CONT'D):

HONORABLE PATRICIA HOFFMAN
Department of Energy

JULIET HOMER
Pacific Northwest National Laboratory

PATRICK HUGHES
National Electrical Manufacturers Association

AKHLESH KAUSHIVA
Department of Energy

MARK LAUBY
North American Electric Reliability Corporation

KEVIN LYNN
Department of Energy

MAUREEN MALLOY
ICF International

LARRY MANSUETI
Department of Energy

DAVID MEYER
Department of Energy

GRANGER MORGAN
Carnegie Mellon, Engineering & Public Policy

TIMOTHY MOUNT
Cornell University

JOSEPH PALADINO
Department of Energy

WILLIAM PARKS
Department of Energy

RAE F. PAYNE
Illinois Farm Bureau

SONNY POPOWSKY
EAC Vice Chair

WANDA REDER
S&C Electric Company; IEEE

PAUL ROBERTI
Rhode Island Public Utilities Commission

PARTICIPANTS (CONT'D):

MATT ROSENBAUM
Department of Energy

HEATHER SANDERS
California Independent System Operator

PAM SILBERSTEIN
National Rural Electric Cooperative Association

RAMTEEN SIOSHANSI
Ohio State University

TOM SLOAN
Kansas House of Representatives

MATTHEW SPALDING
IMCORP

SAMIR SUCCAR
ICF International

ROY THILLY
Independent

DAVID TILL
Tennessee Valley Authority

DAVID TREICHLER
Oncor Electric Delivery LLC

GORDON VAN WELIE
Independent System Operator of New England

CHARLIE VARTANIAN
Mitsubishi Electric Power Products

ANDREA WAGNER
ICF International

REBECCA WAGNER
Nevada Public Utilities Commission

JIN WU
Medill News Service

CARL ZICHELLA
Natural Resources Defense Council

* * * * *

P R O C E E D I N G S

(8:01 a.m.)

CHAIRMAN COWART: This is an official meeting of the Electricity Advisory Committee, and as usual, at the beginning of these meetings, I remind people that a transcript is being taken of everything that's said here. And that requires that we take certain actions to make life easier for those who are making the transcript. And so if you would speak when your mike is lit, and turn your mike off when you're not speaking, that helps everybody. If you would like to be called on to make a comment, please put your tent card on end, and I'll try to call on you in order.

For members of the public who are present, there is an opportunity at the end of these meetings, to make a public statement, to address the committee. And you must sign up for that. There is a sign-up sheet available for you to do so. We'll reserve time at the end of the meeting tomorrow for any who do wish to address the committee.

CHAIRMAN COWART: And for all of us. All right, a quick rundown of some activities since our last meeting. When Rob Curry rejoins us, we have an announcement about him. But the department and the process that seems to take forever in terms of appointments to this committee, has successfully concluded with a new round of appointments. And the department has decided, and I think this was discussed last time, that everybody's terms will begin and end on July 1. So for new members, the first meeting will be September. And for members who are concluding their terms, this meeting, the June meeting, is the last meeting.

I'm happy to report that we have a terrific list of new committee members, who will be joining us in September. And we can circulate those names in a few minutes. We'll have six new members in September.

For those of you working on projects in the subcommittees, you'll be thrilled with the fact that there's some new folks coming on. And we're going to try and recruit them immediately for work on the subcommittees' work products, and not wait until after September.

A second item, and I think I'll defer to Pat on this, is that we've received comments from the department on the work products that we delivered recently. I appreciate that.

This is an unusual committee meeting actually, because we're not voting on any new work products at this meeting. So it's an opportunity to reflect on the fact that we have done a lot. We've delivered a lot. And at this particular meeting, are not adding anything. But we're going to make up for that in the next couple of meetings coming up.

One topic that did get addressed in between the last two meetings, is the potential of a cybersecurity paper. And there was an ad hoc cybersecurity work group that concluded that we should not advance that paper from the full committee -- a decision that I agreed with. So we didn't take action on it. But I would like to ask Roy and maybe Mark, to comment on that just to let people know what happened, and why you formed that conclusion.

MR. THILLY: Well very briefly, there was a concern that this committee was probably not the best place in terms of expertise to address that issue. And in fact, there's a CEO group, the Energy Sector Coordinating Council, working closely with DOE, specifically on strengthening cyber and cyber protection. There's a review of the ISAC operated by NERC that will involve a number of enhancements. And the thought was that this paper, which I think originated outside of the committee, wasn't really bought on to by the group that had been formed, in terms of taking it further. Instead, we recommended it be given to the ESCC for their consideration.

MR. LAUBY:: Yeah, that's exactly my view as well. And I think actually, if you were to look at some of the recommendations coming out of ESCC, they dovetail very nicely with the results of that paper too, which is working more on content and that kind of thing. So I think that it makes more sense to advise DOE through the ESCC.

CHAIRMAN COWART: All right, thanks very much. I'd like to thank Granger, Mark, David Till, and Roy for the work that they put in to review that question and to make that recommendation. I appreciate it. Thanks. I think our next topic is to hear from Pat Hoffman.

MS. HOFFMAN: So I would like to also express my thanks for everybody being here today and tomorrow. I will be here the whole time. I realize how important your time is, and how valuable your time is, that you spend it with the Department of Energy. And I appreciate the time that you spend here. I look forward to the discussion, but I'd also like to thank the host, NRECA, for allowing us to have our meeting at this location. It is a wonderful location to have a meeting, so I do appreciate that. And thank you for allowing us to do that.

I guess where I'd like to start is, now that Rich said that there were no documents being reviewed by the committee, it's my opportunity to maybe put a whole bunch of wish lists on the table

for more work for you all to do.

But besides that, I think I'll just give you some thoughts and directions on where the department is heading. What are some of our priorities? What's happening? And so you guys can think about that as you move forward.

I will tell you the importance of modernization of grid security. Both of those topics are extremely important in the Department of Energy. We did the grid modernization strategy, multi-year, program plan. We have, as was mentioned, the Electricity Subsector Coordinating Council, which is raising awareness on the grid security issues. We have the Quadrennial Energy Review, that raised the importance of both of those topics, as part of the Quadrennial Energy Review. So the topics are very ripe for what the electricity committee has been talking about. And the importance of your feedback to the department is even more valuable in the coming months and the coming years, as we continue to fine tune our prioritization, and the

activities and the messages that the department is going to push with respect to grid modernization and securing the electric grid.

I value your input as we move forward. I think it's exciting, but yet it can be challenging. There's a lot of interest out there. There's a lot of diversion of opinions on different topics and where we should go in the future. I feel this committee is a great forum for us to talk about the challenges and the issues, but also bring some of those debates out, as well as potential solutions. So I hope we can continue to do that.

If anything, I'm looking forward to continuing to get appreciation of your priorities, the sense of urgency that you see, on some of the different topics that are facing the department. And what is the role the department can provide in helping the industry move forward, as we try to keep the industry moving forward.

The challenge that we get constantly is, what is the role of the federal government? What

is the value that the federal government brings? And what are some of the opportunities in which we can add the most value, given the limited resources that we have.

I've already mentioned the QER. We'll get an update, hopefully, a little bit later on the QER. That was a major policy document that came out of the department, in looking at some of the needs from the grid space. It was transmission, distribution and storage. The Grid Modernization Lab Consortium is another major document, which talks about some of the R&D efforts moving forward on grid modernization. Just to give you a sense of how serious we are taking these documents, with the Grid Modernization Lab Consortium, we're looking at our partnership with the laboratory, and refreshing about one-third of our budget to the topics that were identified in the Grid Modernization Lab Consortium. So that is significant for our program to take about a third of its budget, and look at opportunities and re-emphasizing some of

the directions, provided by the multi-year program plan.

For the grid security side of things, we do have the ESCC group, but what we are doing is focusing a comprehensive effort around grid security, looking at, what are the needs from a physical security point of view, a cybersecurity point of view, interdependency point of view, and weather risks. And so those are the primary risks that we're looking at, across the department for impact to the electric sector. I think those are some of the most challenging things that the industry has to look at. We do have another area within the department that we're looking at for geomagnetic disturbances, and look at things along the research along those lines. But we're trying to move forward with efforts to help the industry in understanding where, I think, some of the value that the NERC report came out on GMD and how -- what is the value that the department can add along those lines?

From that perspective, I guess the only

last thing that I would say is, moving forward in some of the topics for the committee, as we move forward, is the things that would be more helpful in the near term, is probably continuing to reflect on the multi-year program plan from the grid modernization side, and provide feedback on some of the objectives and measures that we're moving forward to number one.

Number two, it is documenting the value and contribution that has already been ongoing and in place from the Recovery Act, and the work that's been done from the Recovery Act Program of what we've accomplished with a 4 1/2 billion dollar investment in infrastructure.

And then number three, pretty much goes on to where I think some of the framework has already developed. And that is your sense of priorities, and what do you feel the urgency is, in moving things forward in the grid space, whether it's on the security side of things or the grid modernization side of things. And I know I use those two -- but they're not totally

exclusive. I mean, there is the interdependency between the two. So don't take that as two exclusive topics, because we do have a complete network.

So some of the things we're looking at is, what are the major game changers moving forward? And once again, what is the role of the department and some of those major game changers. I think there's a lot of pressure, and a lot of advancements on the distribution system, that we have to pay attention to. I think with respect to the transmission system, it's how to best value the transmission system, but also best utilize the transmission system and the changing dynamics. And then ultimately, it goes back to the distribution system, but the role of the customer, and sometimes how the customer can provide -- just the role of the customer for the evolution of the future grid.

So with that, I will stop there. And I guess I will ask my colleagues here sitting to my right, if you have anything else you would like to

add to my comments.

MR. MEYER: I would add briefly that we need to be constantly mindful of the fact that this is one interactive system that we're dealing with. These parts have to work, and work well. We're transforming this very complicated network of components, and there are a lot of uncertainties, which make it all the more difficult to think holistically about what we're trying to do. But in the end, this system has to work, and it has to work well. If it just works in a clunky, rudimentary way, it doesn't deliver what we need it to deliver. And to accomplish that considerable list of key characteristics, reliability, affordability, resilience, you know, you've all heard that litany. But to do that, all the time, the only way you can do it is if this system is very well integrated. And that's the challenge to us. Yes, we have to work on the components, but those components have to fit and support each other.

MS. HOFFMAN: Oh, Larry is doing it.

CHAIRMAN COWART: Larry is doing it. All right. Larry Mansueti, I believe you're next.

MR. MANSUETI: Good afternoon. I'm a last minute substitute for Karen Wayland, who about 11 o'clock called me and said, guess what? I have to be at the secretary's office at 2 o'clock, where we're going to discuss the next QER, so please can I talk. So that's what I'm going to be doing here. And hopefully, I'll do at least a halfway decent job, compared to what she would do. She did ask one thing. Actually not for this QER that I'm going to talk about, but for the next QER. Once the White House decides what the next QER will be, and there's a decent chance it might be on some part of the electric system, such an end- use and/or generation of electricity. Or it might just be end-use of all forms of energy. Anyway, whatever it is, she asked that the committee send in a letter now, soon, saying these are the kinds of questions this particular -- this next QER should address. So that's one request she has of all of you, early input on the

next QER. Questions they should look at, and try to answer.

What I'm going to do is -- I'm not going to go through the entire PowerPoint on QER. You've already been talked to by Karen, and I think myself on QER. What I'm going to leave with the staff, for your looking at later on, is the full PowerPoint deck on the QER results, that you can have. Also, I've gone through a couple of -- I've taken out all of the electricity-related slides -- all the stuff in PowerPoint, and put them in here as a package at the front end. And actually, many of them I'll skip, because you've already heard from Karen what the findings are of the electricity-related parts. And I'll try to go just to the recommendations.

One thing in how the QER is organized. It's based on analysis -- either quantitative analysis or qualitative analysis. That's how each chapter is written. And the chapters are not by energy source. They're not by electricity or oil or gas. They're by themes, that all the various

types of energy have. Except for electricity, which is modernizing electric grids is the theme there. But sheer transport, for example, environmental aspects of the infrastructure and so forth. And so that's what you'll see, both when you look at the QER, as well as this talk.

I'm going to repeat a few things. This is just telling us that the situation with MG is very different than it was a decade ago, even five years ago. Who would have known that we would have energy abundance in this country, with the oil and gas production that we have in this country. It's just astonishing to think that we have that situation now. And there's security in terms of -- foreign dependence on energy is in much better shape. We also have lots of new technologies coming on the electric grid. I'm not going to bore you with them. You deal with them all the time with your talk.

And let's see, what else? And there's always an evolving policy mix that we have. Next slide. A review of the stakeholder meetings --

why don't we go to the next slide. We had 14 meetings. Many of them covered electricity or related topics to electricity. Some of you actually were there, according to Bob Marley. And Carl, I think you were there, or your principals were there.

And why don't we go to the next slide. And Karen went and tried to put all the various testimony and statements and so forth, at the QER hearings into buckets. She put them into these three buckets. How to operate the system fairly, safely, efficiently. Who should be responsible for that, and particularly, reliability and security and safety? And who pays -- how to allocate the cost of resilience measures. That's in all corners of energy.

The next slide -- and by the way, these slides, all these graphics are really the chapters of the QER. This one right here is the chapter under resiliency and reliability and safety.

And why don't we go to the next slide. This really is not related to electricity, but the

reason I wanted to show you this slide is, the secretary, and Melanie Kenderline, who runs our policy office, are very enamored of having graphics. Pictures tell stories. We've heard that phrase before. And here -- well, the QER is peppered with those kind of graphics or pictures. Here is a picture that we made, up in the upper left-hand corner, of all the types of weather events, severe weather events that affect energy restructure. In the bottom-right corner, the purple lines are obviously hurricane tracks. And then we have tornados in the middle part of the country. And then out west, I think it's red or orange and green, earthquakes and wildfires. The outages that one has in the electricity system are going to be very different, depending on where you are in the country. The bottom right is storm surges in the Gulf Coast. Substations -- how many of them are vulnerable?

So why don't we go to the next slide. This is on the resiliency chapter. The only one that's -- well there's two or three that are

related to electricity recommendations. One or two of them relate to giving money to states. There's money from Congress. The 2 1/2 to 3 1/2 billion competitive grants -- that would be really over ten years. So it's not 2 1/2 billion dollars in one year. It's more manageable in terms of getting money from Congress, perhaps. So there's a couple different grant programs that help states sort out energy insurance plans and so forth and prove resiliency. The fourth one down is on transformers, really large transformers. We all know about how they're very custom. What if there's an outage of them, due to terrorist or physical or something. And still the recommendation there is for the administration department to finish its study -- Pat's very involved with that -- finish the study of large transformers, with an eye toward perhaps some kind of a national stockpile of some kind. I note that eight utilities a few weeks ago, announced a consortium called Grid Assurance, to have a company that you could sort of buy insurance --

and they would stock various critical transformers.

I want to go to the next slide. And this is modernizing the electric grid chapter. And the next slide. I think Karen would have talked about this slide before. The main takeaway is that things are different in the electrical system. We have growth or lack of growth, compared to historical means, and it seems to be flattened out. And it looks like it may stay that way for a while, in addition to not just energy efficiency, but changes in the U.S. economy, and how we consume electricity different, for many different reasons, not just one or two. And also we have perhaps self-generation as a coming trend too.

The last point -- lack of adequate information and tools, that they came across in a bunch of areas of the QER findings. Lack of adequate data sometimes prevents us from making decisions.

The next slide -- this is actually from

Edison Electric Institute using FERC form one data, as well as EIA data. It's looking at where is transition being built for what reason. These reasons will change over time. Right now long distance renewables went in solar, some geothermal, 26 percent. That would have changed -- 20 or 30 years ago it would have been nuclear long distance (inaudible), so that changed with time. But this is an example of the quantitative analysis. There's a lot of data out there, and that's one of the ways we did the report.

The next slide -- I'm not going to go through all of these findings. Some of these were already gone through before. The second one is the one that I want to go into, because it can be misinterpreted. You might think with saying, well, we don't have to build any more transmission. No, quite the contrary -- what it's saying is that modeling that was done for the QER, as well as looking at the existing modeling that's been done -- for example, in the connection-wide planning processes. If you look at it in

historical context, that's the upper left-hand graphic there. That goes back to 1960 or so. When you look at the build-outs of transmission, particularly for the generation mix that was being added in the sixties and seventies, there was a large build-out of transmissions in this country, and the conclusion was, we can do it, if we need to. Now, it might be a little bit harder than it was in the sixties and seventies, because siding is perhaps more tougher. So I won't bore you with the stories about transmission siding and so forth.

The other two things on here is -- oh, I did not mention the findings here, that we pick up as recommendations on the next slide. Because those recommendations have their own supporting related findings. So it's not on here. One thing -- down at the bottom, one size does not fit all. I think we know that. The U.S. is very diverse, not just in population and culture, geography, electricity resources, values in terms of what one state's population wants for its generation

sources, if they've done any legislation on that. And we have to respect that, and we think we did in the QER. And the one above it, relating to that is -- part of that diversity is the state's are the test beds for all of the things that are occurring out there on the grid in many cases.

Let's go to the next one and drill down -- let's go back one more. Yeah, right there -- recommendations -- these are the recommendations. These will be new from our last meeting, because Karen only talked about the findings for electricity -- the grid modernization. The first one is, let's spend some money on grid modernization. I won't go into that. Kevin Lynn and Bill Parks from DOE are here, and they'll talk about that in the next few talks on QER and grid modernization or grid consortium, and so forth.

Also, a recommendation is a review of national transmission plans and bearings to the implementation. Before, I should say -- if you're going to ask me, exactly how are you going to implement this particular recommendation? How is

this department going to implement recommendation number six on there? We're working on it. I don't think there's any QER work recommendation. Perhaps in the transformer one, that has a study -- the spare transformer that has the study underway. But many of them are in the formulation phase. You know, we're talking inside/outside the building and so forth. So the national transition plans -- the available ad that we thought of would be -- we want to take all the transition plans that have been filed under FERC's order 1,000, look at them, put them together in a national mosaic, and see if there's any patterns there. Actually see if others may want to (inaudible) from there. We talked about FERC, and all they're doing is approving or disapproving -- you did not meet our process on the order 1,000 filings. So they said this would be valuable, and that's what is going to be done. It will be part of an annual transition data review that they will monitor on, and we'll be involved with. Along with that would be any accessing of barriers to the various

transmission plants.

Let's see. We're going to look at storage, and try to come up with a flexibility in storage, framework, and strategy. That one we just really haven't yet thought of how to do. Another one is to give grants to states OE's FY '16 budget request has $27 million in grants to states on reliability, electricity planning and so forth. So far the House and Senate have said zero. We'll see. And we'll see for FY '17. Coordinating goals across jurisdictions -- that's something that I'll be involved in implementing. We have a constitutional form of government, the 10th amendment leaves everything to the states, except -- it's by a constitutional order -- I forgot how that goes. So obviously transmission siding is one area that there's been historical conflict between states and the federal government. There are other areas that you're familiar with. The main response, FERC, there's a Supreme Court case on that. Our thinking is, instead of opening up things like that, maybe do

something that's different. Well, for one, I found out we couldn't really get engaged on the main response FERC states' issue, because it's a party to a Supreme Court case. So we couldn't talk about that. Power plant -- you could say, well, there's some commissioners that say there's a conflict between states and federal government. Well, the administration has proposed (inaudible). We can't work on that either. So the thought is, why not look at evolving -- well, the whole plethora of new modern technologies for the grid. Grid large -- not any specific one -- their nature may be causing conflicts between state governments and federal governments on jurisdiction. Is there something we can do there? Get some people thinking, and maybe we could do -- we could arm both the federal government and our states with some kind of thinking that could perhaps resolve those potential conflicts before they happen. That's our thinking so far.

I'll skip to the bottom one. That's improving grid communication through standards and

operability. The reason for doing that, I think, is -- we all know -- we use it in the QER. The analogy of the USB standard for all the gizmos that we have -- smart phones and all that kind of stuff. Well, it's a fact that there's a USB standard, allowed a lot more of these devices to be invented and used -- much more plug-and-play. Well, there are versions kind of like that in the electric space. IEEE 1547 for DG interconnection -- that's already out there, but it needs to be upgraded. What the DOE can do is -- it's already been spending money, actually since the 1990s to accelerate its adoption -- IEEE is a voluntary organization. Maybe we could accelerate it even further. And the same thing with grid out and smart grid in operability standards. Those are two areas we want to work on there. Following new grid services and technologies -- that's been of a lot of interest, and the secretary has spoken about it before Congress. And it's not just about net metering, it's a little bit larger, and the secretary has said that he hopes to have a broader

approach to valuation, that will also include how to bundle and value all the different services provided by both conventional jurisdiction, as well as ER on improving baseload, and the services that the grid itself provides. It may be difficult. We may not try to come up with consensus, but can we better inform the various methods that can be used by those who do have to do the valuation.

I'm going to go to the next slide. Shared transport -- that was a new theme that we put on there -- gas and electric interdependencies. This one shows -- the upper-left graphic shows how many coal units in this country are -- coal regeneration are dependent on Powder River coal. Well, there's been a lot of interplay between our competition for rail transport, between all the oil from the Balkan, grain, coal. We had some problems with the reliability of coal.

Yeah, let's go to the next one there -- recommendations. One of the recommendations is to

get better data on that. There was a lot of recommendations in other areas. There was a graphic that is in the appendix to this PowerPoint that showed a ship channel down in New Orleans that's dredged -- at least it's designed for two tankers, and the graphic is two tankers. They're supposed to be able to go side-by-side, and the reality is the image on the right, which is just one tanker that's doing, basically self-dredging of the channel, because it hasn't been dredged in a long time by the Corps.

I'm going to go to the next slide. North American energy markets -- next slide -- this again, is one of those graphics that tells a large story. It's not location specific. You'll see all the different kinds of energy that flows across the two borders. When I saw the first graph, I said, where's the Northwest Hydro? It's in there. The electricity is on the right, but that's not really location specific. It's the whole border. But do you see -- most of the energy that goes across the Canadian border is

actually crude oil.

So why don't we go to the next slide, which is a potpourri of various recommendations that came out of bilateral discussions, both with the Mexicans, as well as the Canadians. One story about this graphic is -- improving data can be kind of boring. But I hear it's pretty important, because we tried to -- you could say regional variation of electricity prices. How come we don't have any prices from Canada and Mexico? Well, we asked our staff to pull together Canadian prices for example. And it turns out we couldn't get it very quickly or easily. And so that's one of the areas we want to work on. Particularly when our secretary went up to Ottawa to meet with his counterpart in Canada. One of the things that was mentioned -- you saw this graphic is -- geez, the most expensive parts of the U.S. with electricity is New England. That happens to be where we have our cheapest electricity, right across the border. So, I'll leave it at that.

Next slide -- siding and permitting -- I

think this is my last slide. Why don't we go to the next one? And some findings there is, for electricity we do have a rapid-response team for transmission to better coordinate the federal permitting. Because we all recognize that as a problem. Particularly where there's federal lands in the west. Well, one of the recommendations is, let's enact that authority, that executive branch action into law. There are some other things that are in play on the Hill too. Department of Transportation will do the same thing too. A bunch of signals recommendation is the second one. Some of these agencies that are in charge of permitting -- Rural Land Management or Forest Service, permitting is not their main mission. So we often don't have the staff or the money to devote to it. So it's calling on Congress to make sure -- and the administration itself -- ask and provide enough money for the staff to do the permitting.

Again, it's a boring buttons and signals issue, but down at the field level it's important.

And similar would be -- some agencies cannot recover costs -- a lot of cost recovery, as FERC can do. And apparently RUS cannot do cost recovery, when it's doing permitting. I think I want to go to the next slide which says, I'm done. So let's leave it open for questions and answers.

CHAIRMAN COWART: Questions for Larry?

MR. GELLINGS: 1547 has been revised. It's been balloted and published. The issue which I nudged (inaudible) about, and I'm going to do it right now, is that the states each individually have to adopt the revised -- what is now called 1547A. It's desperately needed, in order for us to get the integration, particularly of distributable resources correct. And so I don't know what to do. It was in our recommendations to Pat, to suggest that you have some role to play. I don't know what word to use best here, but influencing -- you can't force, I understand that. I travelled 34 weeks last year, and many of them were to address commissions to try to highlight some of the issues around integrating distributed

energy resources. And one of the points I made in each case was, that they need to, you know, adopt 1547A, in place of what now is 1547. And they don't know what to do with it. They don't understand it. There are several options for implementing it. This is not a high budget item, but it really could use DOE help in making 1547A the standard for the nation.

MR. MANSUETI: Perhaps we should talk to (inaudible). If that's a scenario he wants to help his members in, the department maybe can help with some funding.

MR. MORGAN: I've looked through the set of recommendations in the Quadrennial Energy Review. But what I don't understand is the mechanism by which this enormous amount of effort and time, will actually be used to shape DOE activities going forward. So will you talk a little bit about the mechanisms by which, having produced this big and lovely report, something will change within the agency.

MR. MANSUETI: Well, there are 63

recommendations in the QER, if you go through every chapter. What you're saying is we need to -- well for one, we know it's 63, and the secretary did have an internal meeting a few weeks ago. We rank ordered them and assigned people. You're in charge of this recommendation, and you are in charge of that recommendation. The proof is in the pudding. We have to implement these recommendations. There's only a handful that require Congress to make a change.

MR. MORGAN: Well, there are some out of your control. It's up to our congressional budget.

MR. MANSUETI: Yeah, yeah.

MR. MORGAN: There are many that don't.

MR. MANSUETI: You're right. You're right. And it's on us in the administration to make sure we actually implement them. That they don't end up on a bookshelf. I've heard the secretary himself say, this is not going to be a report that ends up on the bookshelf. But the onus is on us. You're right.

MS. HOFFMAN: So that I would like to respond to, because that's probably what my comments were going to be. So I apologize if I'm going to jump in from here. Some of the questions that OE and other offices within the department are trying to address -- one of them goes down to -- what is the metrics around resiliency? And how does one define or advance the resiliency conversation? You know, there is a national academy study, I believe that they did on risk or resilience. There's a couple different reports out there. But what does it really mean to the electric sector, when they say resilience? And so that's one thing that I know there will probably (inaudible), or some sort of thought process around resilience. Transformers -- we are probably going to do an RFI around transformers, but we do and have talked about a transformer strategy that's more comprehensive. It's mitigating the criticality of substations, looking for long lead time components to accelerate manufacturing, to look at the next generation

transformers. In addition to, you know, what potentially could be a transformer reserve. But we recognize that on the transformer side, there's a comprehensive approach. And it's more than just, you know, a reserve, and looking at the transformers.

The third aspect of the QER that we're trying to pull out -- it comes to the whole valuation discussion. Whether it's value of distributed generation; value of the distribution system; value of the transmission system; value of the network, using David Meyer's point. And that's something that we're trying to really get our arms around that side of the conversation. So those are three things that I just wanted to pull out, that personally I'm aware of. That within OE, we're trying to implement those recommendations. On the state side, looking at technical assistance to the states and so on, that's kind of budget related.

CHAIRMAN COWART: Thank you, that helps. Merwin.

MR. BROWN: Merwin Brown with the University of California. Pat, you answered my question, I think, to some degree. And that is, how do your prioritize what needs to be focused on in this report? It sounds like you need a lot of metrics first. So that sounds like that's your first big goal, is to get as many metrics as possible in place, and then you can begin to prioritize. I guess the other question I ask, and maybe it was done and I missed it. Did anything really big pop out? Did any really big urgent thing, whether or not we can tackle it or not, that the nation needs to be aware of, that kind of thing? You mentioned one surprise, for example, was the sudden abundance of oil in this country, which raises another question. How did that happen? How did we not know that this was all going on? It didn't happen overnight. Why did it catch almost every policymaker and planner by surprise? That's a rhetorical question, by the way. But did anything crop up in that sense, that really stands out as something to watch out for?

MR. MANSUETI: I'm deferring to my boss here, my other boss.

MS. HOFFMAN: I'll go first, and then I'll leave it open to some of the other federal employees for their thoughts. Some of the things that came out to me, that we knew, but we actually hadn't done enough detailed analysis, is the shared infrastructure and interdependencies. And we spent some time talking about gas and electric. And I remember, you know, I forget how many EAC meetings a long time ago, where the committee was turning around to the department, and saying, this is going to be a big issue. You look at the energy water issues. You look at the rail issues. What you're seeing is a tightly interconnected network, instead of networks. And I don't think we can look at whether we're talking economic evaluation or a reliability evaluation of just singular stovepipes anymore. And so that was probably one of the big lessons learned, from my perspective. The other is, that it's just a dynamic environment, which goes back to my earlier

set of comments. There's a lot of things coming at, or pulling at the electric industry at large, from the EPA regulations to distributed generation, to modernization, and the use of information technology, to cybersecurity, that -- we've got to take all of this into account, as we move forward. It's exciting, but it's also a massive amount of work that's out there. And there's a lot of risk involved.

MR. MANSUETI: All right, one more thing. And that is, it's outside the electricity area, but it's one of the main significant findings, or recommendations, actually -- the strategic petroleum reserve. We came up with that in this country in the 1970s, when we thought we'd have a shortage, oil embargo, what have you, so that physically we'd be short of oil.

Now it turns out, we have lots of oil in this country, and the SPR was designed just for enabling laws to pull oil out of the ground, during a shortage. While enabling laws really -- the critical thing now is energy. Oil is an

international commodity, so it's market price, world market price. So we do not have the legal ability to try to mitigate price spikes for oil. That is probably the oil strategic thing we have to be careful of, and (inaudible) in Congress, to take a look at the authorizing laws, update them from the 1970s.

MS. SANDERS: One thing that I thought was really interesting in the recommendations was this need to align jurisdictional goals. And I want to comment on this right now, because one of the critical areas that needs to be figured out is this jurisdiction on interconnection. In California right now, we have a lot of distributed energy resources being added to the grid. These distributed energy resources want to participate in the wholesale market to access that revenue stream. Many of them are not net exporting from behind that meter. How do they interconnect? Is it a wholesale distribution access tariff, or is it a local distribution, state-regulated tariff? In California, it's called Rule 21. This has got

to be figured out. And what's happening right now, is we're mostly at a stalemate. Because these resources want to interconnect under Rule 21. It's cheaper. It's faster. But then they want to come into the wholesale market, and then there's this question about metering, visibility, jurisdiction. The state doesn't know. The utilities aren't motivated to go to FERC and figure that out. So this one is pretty critical in making the most out of these distributed resources that are now coming onto the system, so that they can participate in many services, both distribution and transmission.

MR. MANSUETI: Point taken, and hopefully I will cover that in the implementation of that recommendation. Thank you.

CHAIRMAN COWART: I was taken, in addition to the other comments already made, by the recommendation of 300 to 350 million to states, in assistance for -- I was unclear. Policies toward grid modernization or pilot projects, what is behind that bullet?

MR. MANSUETI: There's a couple different pots of state money. One would be just for energy assurance planning. A second pot would be for resiliency efforts. And the third one would be for electricity and reliability, which could include state or particularly region, getting together and planning for 111(b), for example, or other attributes. We haven't yet -- it's pretty broad right now, the recommendation and the RFP, or what's called a bureaucratize fallout. We haven't written that yet, so we haven't yet figured out exactly how to do that.

CHAIRMAN COWART: Thanks very much, Larry. Anjan.

MR. BOSE: I was just wondering -- I mean, DOE put together a very large effort to put out the QER, and there was a lot of people who put it together. And I was wondering if that will continue in some form, as a follow up? This is kind of Granger's question. The reason I ask is because I was somewhat involved with IEEE. I was one of the people that were asked to come in.

Just like many other outside entities were asked by DOE to get involved. And since then, IEEE has been asked to continue some sort of liaison with DOE. And I was wondering if there is going to be continuing activity, or this thing will just disband until the next QER will come in five years from now or something.

MR. MANSUETI: A two-part answer -- that's (inaudible). Thank you, Anjan. The secretary has made it important that he's setting up an infrastructure to implement these 63 recommendations, and they've been rank ordered. Which are the most important ones to do, and so forth, both by the secretary in combination with the White House staff. I'm looking over shoulders. So we've got to keep going with the QER, and not let it fall in space, and start working on the next QER. As I said at the beginning, the next QER, we don't know what the topic is going to be. We thought we'd have it by now, but the secretary was busy with Iran and other kind of things. And the White House staff

were focusing on other things. Hopefully, maybe this week -- maybe today at 5 o'clock -- there's a meeting at the White House at 5 o'clock. That's why Karen is not here right now to discuss the next QER.

What the secretary has said to Congress is a two- part -- the next QER will have two phases. One, something that will have results of something in six months. So things that are easy for us to analyze and make recommendations on, in six months.

And then stuff that takes a little bit longer, because we really were stretched for 12 months, many nights and weekends. There was a bit of exhaustion going on with the staff. And also, we didn't like giving people a week's notice, before we had a venue set up for one of the field hearings, and asking people to come with a week's notice. We didn't feel good about that. So we'll try to come up with a second part of the QER in 18 months. So it will give us more time to get -- and more time for folks to weigh in, as well as

more time to do the analysis. I'll leave it to you, whether that means also, anything that will be controversial, will be done as the administration is leading. But I won't speculate on that.

CHAIRMAN COWART: Merwin.

MR. BROWN: Merwin Brown, University of California. Another follow up on the metrics thing -- I agree with you. There's a lot not known about the electric delivery system. And it's going to take a lot of measurements to find out what isn't known, and particularly, if you're going to go smart grid, it's all about knowledge. It's all about knowing something. We, meaning CIEE, the organization I work for -- we've been involved in quite a bit of research recently, following that path. Trying to learn more about the electric grid by measurement technique. And one of the things we're finding out is that it's actually very difficult to get data. And I think it's become a big issue for us to go forward with any of these plans, as a large group, like the

Department of Energy or any organized approach, because of the security problems, the market competitiveness issues, legal liability issues. It just seems to be getting tougher and tougher. So I guess, you're nodding your head. I'm not telling you anything you don't already know, but I see it as a big challenge that needs some attention somehow.

MR. MANSUETI: Yeah, there are many areas in the QER, where we had to pull back from making a recommendation. If someone proposed a recommendation, someone else would say internally, well, actually, the data doesn't exist to make that recommendation. So, we're agreeing. We found that out in many different areas.

CHAIRMAN COWART: Anything further? Larry, thank you very much.

MS. HOFFMAN: So next up is going to be AK from our office. And he has been taking the major lead on working with the S4, which is the under secretary for science and energy, on doing an update to the quadrennial technology review.

Some of you may be familiar with the department's earlier release of the first Quadrennial Technology Review. We're in the process of updating that, and so AK is going to provide us an update on that.

MR. KAUSHIVA: Good afternoon. My name is Akhlesh Kaushiva. You may call me AK for short. I am here to share with you, our experience on the QTR, the Quadrennial Technology Review. This is the outline of all the different chapters. The first thing I would like to do is go over the process that the department used. The initiative was started last year. And there were quite a few people within the department that worked on it. Right from the onset, we wanted to make sure that we engaged the industry. There was a big outreach effort to the industry, to academia, and some of the folks that are here, I know have participated in the process. Our challenge was to limit ourselves to the four technology issues. So this is a snapshot of where we are in 2015, in terms of the energy related

technology status.

So if you look at the middle section, there are seven chapters there for assessments. You'll see that the electric power system was the first one. Then we talked about the clean power technology, the efficiency of the (inaudible) and what have you. The clean energy technologies for manufacturing, and then we had the fuel part, transportation, and science and energy in terms of the enabling capabilities. All that was captured, as part of this QTR review process. And in addition to this, when you had, on a separate basis, six technology assessments -- that's where we took a very deep dive on those six topics, which kind of fed into this process here, for the report.

Now you may be wondering, where are we, and when is this going to come out and be released? Right now the chapters have been written. They've been reviewed at various levels, and the current target is to have it released in July for the general public.

This slide here, I just have for the landscape. I think I'm preaching to the choir here, in terms of what we have, in terms of the number of operators across the countries. The different flavors of it in utilities, the co-ops and municipalities, and what have you -- the number of substations in the transmission's line. So we had a daunting challenge, when we tried to modernize the grid, when the delivery system is so deep-rooted and widespread across the county. The distribution system usually was kind of a neglected one, because most of the effort and concentration went into the generation and the transmission side. And there was not much happening on the distribution system. The current technology and the smart grid is changing all that.

We had a driver, in terms of obligation to serve. And now we are trying to make sure that we are adapting to the changes in the system, and the drivers in the industry to react to and deliver the power in the most reliable fashion,

including the changes that are coming in from the customer's side.

This slide here -- if you look at it, you have about 38 quads going through the energy into about 40 percent of the 97 quads of energy that goes through the system for the country. Electricity plays a very important critical role, as you can see there.

So in terms of the different components, we have the generation side. We had the load side. Then we had the delivery in the middle. And then we had the expectations of the customers. It's often said that Graham Bell would not recognize the telephone system, and I think Edison was feeling left out, so now we are about to change all that. And if it were to be reviewed, you'd probably not recognize the soon to be changes in the infrastructure.

So in terms of the mix and the generation, as you know, we are moving away from the measure -- big plants next to the water sources, and what have you, and going into the

smaller, more adaptable distributed energy resources. We have the market side, the customer engagement is increasing at a very rapid pace. This market technology is changing the middle section in terms of how the distribution systems are reacting and adapting to these changing environments. And then the customer expectations keep going up. So we have the entire chain of different segments that we have in our industry, changing at a very rapid pace.

You may have seen this chart here. We are kind of here. The transition has already started on the smart grid and adaptation here. This volume is going to continue to increase. The saturation is going to continue to increase. And you can look at it from the communication side, the smart grid devices side, the customer engagement side. They are all going to go up in saturation, and that's what is kind of the upcoming challenge in terms of how do we manage this and make sure that the grid is going to be reliable -- as reliable as in the past, if not

more, as we react to these changes.

So the problem was a difficult one. The concept is rather very simple. You have all the drivers of change, you put them in a bucket, and you kind of analyze it, to see how you want to go about doing it, and what are the prioritizations -- not prioritizations, but the R&D elements that you need to do. One thing I like to emphasize is that as we started this initiative, we wanted to stay away from prioritization. We wanted to stay away from the budget issues and what have you. This is strictly a technology review, so we wanted to make sure that we were doing (inaudible) job, in terms of capturing, what are the technology issues? What are the challenges? And what are the things that we need to do, in order to react to each of those challenges. How do we solve that problem? And that's the main concept that is the driver for this initiative.

So now I'm going to quickly go through some of the different components of the QTR. For the T&D -- as you know, we had the PMU saturation,

and if you look at the map here for 2007, you'd be amazed how few dots we had. And as part of the ARRA grants, and the other initiatives from the industry, we have lots of PMUs there. They are producing a good amount of data, and if you were looking at the state items, they are very short-term, four second or so duration, a snapshot. Now what we are trying to do is look ahead. And we are concentrating in terms of the dynamic models that are needed. And we have to have simulation tools and stuff, to look at it, to see how the system will behave, and whether we will reach the stability and the steady state on it or not.

This one here is controllability, and the problem was not hard enough. Instead of a few controllable points, the magnitude of those nodes is considerably increasing. So from (inaudible), if you have less than 20 or so nodes, now you are talking about going to the building. Now we're going to go through all the details in the middle. I think it's very intuitive. You folks are very

well aware of those things. You have up to 150 million points conceivably. You have the customer relationship changing, with the distribution operation, and this is the timeline here. And the other (inaudible) part coming in. And we are starting to see the tip of the iceberg on that front pretty quickly. So that's the challenge that we looked at on the T&D side.

The next component that we looked at was the T&D components. In this dynamic environment, the analog devices and the systems that we have, can't really function because they are not really designed to be so reactive in terms of changing the (inaudible) the states. So you have the solid- state transformers, in terms of the technology. We've got flow controllers, because now you're talking about a two-way flow. The customer is generating the power also. The protective devices have a new challenge. Previously they were designed and rated for one-way flow. Now we have to make sure that we are protecting the expensive equipment for the

contingencies and the back flow also.

And then we have the cables and the conductors for the distribution system. Traditionally, you had the higher rated cable up front, and as the feeder went out, the (inaudible) kept on going down, because there was not that much power going in here. All of that is designed for (inaudible) now, because you're talking about supplying power from the other substation and reverse current coming in. So we've got to make sure that we have good control on the cables and conductors.

DER, a game changer -- as you can see, we are getting into the micro-grid area. There are lots of projects going in across the country. We are experimenting and trying to learn how we simulate the concept of the micro-grid, and the DER into the grid on a larger scale. And that's the challenge that we have here.

I'm going to go through some of these slides rather quickly, because these concepts are very well known. And here for energy storage --

if you look at the size, which is the main problem, to bring it to the level where it is up to the distribution level in terms of megawatts that we need to transmit, or store rather. And with the PD and other resources available, there are challenges in terms of the technology available. We had the (inaudible) is much more adaptable. There is no memory loss. Where it usually works great for a shaver or a small appliance, not for a megawatt level. And those are the challenges we are running here for the storage part.

Each one of these categories warrants a lot of discussion, and with the deep drive that we had for the six technical assessments, we went into that much level of detail. Now with all the data coming in, both in real time, as well as for planning needs, we need lots and lots of planning tools, which can react to the changing environment, allow the distribution planners, as well as the control room operators, to be able to do their job. And this is where we'll need

computing skills. The industry is changing. It used to be that you could have a distribution operator or a transmission system operator kind of grow within the organization, but you now pretty much need an electrical engineer to play that role, because of the complexity that we are going to be having soon in the control rooms.

With all of that coming at us, based on the technology changes and the infusion of the electronic equipment that we are putting in there, cybersecurity is becoming an issue also. And the effort that we have to really emphasize at this point, is that the cybersecurity has to be at the ground level, not an afterthought being put in, once the devices have been put in and so forth. And with cybersecurity, we also have the interoperability issues for the digital devices. And so we have a lot of challenges in terms of some of the factors that we just mentioned, in terms of the drivers for the vendors. There are proprietary issues. There are legal issues, and what have you. And it is incumbent upon us to

make sure that we are looking at all of these different challenges, coming to a solution in an amicable fashion, so that no one sector is penalized by getting negatively impacted. That includes most of all, the customer also. Because once they have the PD and what have you, the other devices, they want to make sure that they are playing a role in the market and not getting sidetracked and getting the benefit of that.

So, on this one here, we have to close the loop of all these monumental changes. We have to improve the grid. It's not an option. Failure is not an option. We have to change. We have to make sure that the new generational components are put in place, starting from the generation side, all the way up to the delivery point. The distribution system seems to be getting the bulk of the impact at this time -- the customer engagement on all that. And as you know, you can deal with the hardware and stuff, but dealing with the customer reaction and behavior, and how they will adapt to a given piece of technology, and as

part of the smart grid programs, we saw that there were a lot of utilities, that the consumer behavioral study, in terms of getting the display and the reaction is different in terms of how engaged the customers were on that front, in order to be able to change their behavior, once they see your message and so forth. And then the other planners and decision- makers for the new generation of tools that support the change. And that is a major training issue for workforce. And the electric utility industry, as you know, has been kind of a very conservative industry. It hasn't had much of a change. And now, with the aging workforce, we are having all these kind of changes come in. So we have to make sure that the institutional knowledge is transferred to the new workforce, to make sure that we have a very trained, efficient workforce in place, to react to these tools. And then we have the cybersecurity becoming more and more critical.

On these three last slides, I have a very high level. The different categories that we

did and R&D opportunities. And this is kind of the end result in the chapter. The chapter we started at about 55 pages at one point. We are down to about 30, in order to make sure that all 11 chapters are within limits, that people will read them. And will be able to appreciate the entire wide spectrum, the coverage that we have. So we have the control system for T&D. In the next one, we have the components, the resources, the DER and the storage. And the last one was the tools in the cybersecurity. And I think these slides will be available, so you'll have the details in terms of that. And I have about two minutes left.

CHAIRMAN COWART: Are there questions or comments? All right, Paul, Merwin, and Wanda, in that order.

MR. CENTOLELLA: So thank you for the presentation. I'm wondering as you are going through the QTR, to what extent are you attempting to do a gap analysis between where the technologies are evolving today, and where you

think they will need to be, you know, 20, 30, 40 years from now. And if so, how are you defining the standard against which you are assessing that gap?

MR. KAUSHIVA: That's a very good question, but very heavily loaded also. So I'm going to try to answer to the best of my ability. In terms of the long term, it's a very difficult projection to make. I've seen one slide, and I think Craig from (inaudible) has it, in terms of how many computers were expected to be in use. And look at what we have today. So I think it is prudent to look for another 10, 15 years, and kind of end it. Not 20, 30, 40 years, and for that one, when we did the review here for the R&D initiatives that we are outlining in this QTR, our vision is for the 10, 15 years, is that you will see improvements in material, science, computations, where the computer will come in. A super computer might be even needed if it was a challenge. So it's a mixture of trying to look at which components we are trying to address, and how

far we can see in a realistic fashion, in terms of the R&D that can be conducted in the next four or five years.

MR. CENTOLELLA: What I would urge you to think about, is to think broadly about what the power system may need to become. You know, as we're potentially moving to a very low or zero carbon environment for example.

MR. KAUSHIVA: Right.

MR. CENTOLELLA: Or as we're moving to a much more secure environment. Because there may be things that we need, that aren't on the research agenda for the next four or five years, but ought to be. And unless you draw a clear picture of what the future need is, you may not identify them.

MR. KAUSHIVA: Thank you. Good point.

CHAIRMAN COWART: Merwin.

MR. BROWN: Merwin Brown, University of California. Actually, I'm piggybacking on your comments. And that is, the presentation gave me a tone of -- we have a legacy grid, and we're trying

to do obscene things to it, with these new things coming. And we've got to develop new technologies to handle them. It's a logical approach, I think. But maybe you did this as a group, but step back and think about some fundamental sea changes that are taking place. Like one, I notice on protection systems, it was talked about worrying about reverse power flow and things like that. When in reality, if you sum it all up, actually we're getting into a place where the protection system is creating an autoimmune disease, in which the very system it is protecting, is causing worse illness in cascading outages. The fact is that the grid is getting less and less inertia in it, as it goes along. That creates problems. It also creates opportunities --

MR. KAUSHIVA: Mm-hmm.

MR. BROWN: -- for a new kind of activity. The ability to use more realistic approaches to operating the grid, and if we can get the data, using lots of data to do that. Again, it opens up opportunities to look at a

whole new way of doing contingency analysis and running the grid and planning the grid. Then minus one criteria might not mean all that much, going into the future. I give you those reasons to think in terms of -- I think what you did is right, and it's in the right direction. Could it go a step further and think in terms of, what else could happen, if we were to take these new technologies coming along, and using them in new ways to change the legacy system even more.

MR. KAUSHIVA: Thank you. Again, a good question. Most of the stuff that you mentioned, was discussed as part of the QTR, in terms of the modeling and all the other things you mentioned. And I think this is a good point, where we should recognize all the help that we got from the industry and the academia. And the processes were pretty open and stuff. And these are the type of things that were raised, and are duly incorporated in the process.

MS. REDER: Just a few comments. I really like what you had to say. I think that the

rate of change we are going through as an industry, is far faster than anything that we have gone through for a hundred-plus years. So the concept of change management, and how do we really embrace the rate, is something that I think is well worth pondering. And you mentioned in some of your comments, the need for the competency building. We know we're going through some significant attrition, but the skills coming in are much different than the skills that we've had in the past. I heard the words. I don't necessarily see it in the bullets up there. And I do think it's a really big deal, in order to fulfill this vision.

MR. KAUSHIVA: Yes.

MS. REDER: A couple of other areas is, no matter what we do, we end up kind of bucketizing things. It's just a method to the madness, I guess, in terms of organization. But in doing so, we also kind of create these silos. And it kind of gets back to David's comment earlier. I think we have silos of excellence in

the organization methodology, no matter how we slice it. And in the end, we have to think about how we get the whole thing to work together. I don't expect an answer, but I think how we organize, we really have to think about the cross-functional aspect to make sure the inputs and outputs are connecting in an architectural design.

And the last comment that I have is lots of commentary here on modeling, simulation, using the real time information, on it goes. I think we could use some help on, you know, how much is distributed in nature versus central. You know, how much of it can intelligence actually take action on its own, versus we're extrapolating the information, using the intelligence to make better decisions. Where is the break-even point? On it goes. That type of added oversight, I guess, on how we use the analytics to better further the agenda would be useful.

MR. KAUSHIVA: Thank you. All the points were very valid, and I appreciate you

making them.

CHAIRMAN COWART: We have time for two more questions. Heather and --

MR. PARKS: Rich, can I just --

CHAIRMAN COWART: Yeah, sure, Bill.

MR. PARKS: I'm going to touch on a couple of those points that both Merwin and Wanda brought up in the next presentation.

CHAIRMAN COWART: Okay.

MR. PARKS: So we'll just continue into this.

CHAIRMAN COWART: Are you okay to stay a little bit later, because we need to take a break --

MR. PARKS: Sure.

CHAIRMAN COWART: -- and we're running a little behind.

MR. PARKS: Absolutely.

CHAIRMAN COWART: Thank you. Heather and then Marilyn -- and then I think we'll cut it off.

MS. SANDERS: Heather Sanders,

California ISO. I really appreciate the way this is laid out. And it strikes me that there's a lot of focus on coordination, control systems, prioritization, the control of real-time measurement and visibility. But the non-sexy topic of after-the-fact measurement, didn't seem to be covered. And what we need to do from a technology perspective, is think about how we move beyond, you know, the smart meter concept, into more of these onboard sub-metering capabilities. As we think about it, especially in an energy storage area, where you have several different opportunities for energy storage to contribute to grid management, not all occurring at the same time, how do you measure that? Because people want to get paid for these things. And I think this, while very un- sexy -- who wants to talk about metering -- is really challenging, because when you have this physical device that has to be certified and sealed, and that's what you pay on, you can only achieve so much on baseline technology. So what I'd like to see, is an

advancement in how do we use these onboard measurement devices that can be as accurate. How do we secure them? How do we make that work? Yeah, it's super non-sexy, but it's really important, because it's about money. So I'd like to see some of that enter our technology conversation.

MR. KAUSHIVA: Okay. Good point again. As you know, the smart meter implementation that we went through the ARRA grants, there was a lot of work done by the utilities, that we know from first-hand information, because we went for site visits for those grants. That they went through sort of a vocational program for the meter. And a lot of the utilities had the analog meter and the smart meter on a parallel basis recording. And, you know, the analog meter, just over time, slows down. It seems that there were a lot of other issues that were identified, but the utilities have, I think, in my personal judgment, have done a good job of trying to be sensitive to the accuracy part. And you have a very valid point in

terms of when we get into the DER and stuff, we have to make sure that our after-the-fact measurements, and the reimbursement, is a process that the customers can have confidence in. Because if you don't do that, then we'll lose the confidence, and it's very hard to earn it back.

CHAIRMAN COWART: Thank you very much. I can't help myself from commenting on something Heather just said. She said it was really not sexy, but it's all about money. And that's a pretty unusual combination of statements.

MS. SANDERS: It's not an autoimmune disease at least. (Laughter) I've got to at least go there. But good visual, Merwin. You got to like that.

CHAIRMAN COWART: All right, thank you very much. We're running about 15 or 20 minutes behind. Bill Parks has agreed to work with us on that. But it's time for a break. I sadly announce that the café that's in this building is still closed. And so those of you, who were looking for a place to find coffee, I actually

don't know where it is.

MR. ZICHELLA: There is a Starbucks right around the corner.

CHAIRMAN COWART: Oh, that's right. It is right -- last time the Starbucks was also closed. This time it's right around the corner at the Westin. There's a Starbucks. But we're going to start right again at 3 o'clock.

(Recess)

CHAIRMAN COWART: Folks, please take your seats.

We've discovered that congestion paragraphs arise in many different ways (Laughter).

MR. PARKS: Including Starbucks?

CHAIRMAN COWART: (Laughter) Including the line at Starbucks. Bill Parks, we're happy to hear from you on the grid modernization update.

MR. PARKS: So, thank you very much for the chance to be here. And I'm going to continue on a little bit from what you heard from Larry and A.K. on how some of this starts to come together

and will implemented. And I want to acknowledge Kevin Lynn, sitting in the back room. We're going to work on all of this together, and he'll be helping on the Q&A part. I'm just going to walk through this pretty quickly, so you'll have the slides, and then try to bring up a few points, and we can have discussion about it, if I can figure out which of these buttons is actually going to do this. And here we go.

So, we talked before about a vision, and this really fits into again, those other documents that you've seen. And the five bulleted things, the ILITIES in the QER reliable -- some of the ILITIES -- reliable, affordable, secure, resilient and clean, we're going to concentrate on in this talk a little bit, because exactly to Merwin's point earlier, is we have to understand, first of all, what it is we're after, and secondly, how do we measure it and how are we going to go.

And we think that we're going to have to, you know, start from where we are and what we can baseline; take advantage of things like the

spark grid investments, but we're going to have to establish as we go along, what are the right kind of metrics for the world that we're moving to. And that is a non trivial issue from how we see it. So, we couldn't agree more with Merwin, and you know, buckets of security liability, economic growth, innovation, environmental sustainability, those drivers that we've all been looking at and many people here are very familiar with.

What we're trying to do is talk about the grid modernization, in addition to how do we actually start implementing this. And we're concentrating in the short- term on getting the national labs organized and directed, and as we talked about last time, we've been working on the multi year program plan that really targets, you know, the five year period.

But we're really trying to think about how do we accelerate the modernization through 2025, and the things we're going to do, and the kind of activities. And again, it gets to some of the dialogue earlier, and I'll touch on it in a

little bit, of what are we going to do within those, to use Wanda's words, stovepipes of activities, and how are we going to integrate those to make sure they really come together?

And here, all of the things that really make up part of that is, we kind of see as working on these technology activities and demonstrating them periodically as we go through to make sure that they come together, and that we can talk about an integrated system, and how do we work in partnerships to do that, because of the complexity of all of this, it's going to take a lot of the -- not just the federal and state entities, but the different parts of the prime sector really make this come forward.

We talked about this before, as well. Our six areas that we put in -- institutional support, tying into the technology areas, designing planning tools, you heard. And these mirror very closely what A.K. was talking about, and as you look at the MYPP and also, as QTR comes out, you'll see that mirroring.

System operations and power flowing control issues -- how do you get to new architecture; what are the controls as you think about distributed controls and how that works. Sensing and measurement -- what sensors do we need in the distribution side? How do you move that down? How do we take advantage of you know, the PMUs, and how do we get access to that data? Or who gets access to that data? All of those kind of things are critical things. And then, what do you do with it once you have it? Who gets to use it?

And pieces of that are being talked about throughout the industry, in terms of who has access to data. But that needs to also accelerate, if we're really going to move this space. Devices, integrated testing -- how do they all come together, especially at the distribution scale? How do you put all of these different things in? Are they interoperable? What kind of market structures do they play in? What signals do they send out to the utilities or the market

space, and at what level? How does aggregation occur? All of those are really, really important questions.

And lastly, can you do this? How do you do this in a way that is both secure and resilient as we move forward? And we're seeing, in just our discussions of things -- it's kind of really interesting, that connections, even with our own programs, have strengthened just through the dialogue of all of the QER, QTR, MYPP discussions of things like okay, we've always talked about if we're going to do a solar call.

How is that connection to cyber security, as an example, as they're working on inverters -- how do we strengthen that? And we've got actual calls out working those programs that are targeting that space between programs; some of those gaps that have been there, and people have been kind of aware of, but we've not worked as hard as we plan to in the future.

So, I'm going to cover those three very quickly, again. High level outcomes, what are we

looking to do? But a lot of these topics have come up in the discussion. What is the value of DER? How do we get at that? And as many of you know, we had an evaluation workshop last year moving into the next phase of that and how we're going to work on that.

How do you do distribution planning to the point in California? And you know, the work in our FY '16 budget request and others on -- to accelerate, as Larry talked about, working with the states, working on their planning activities and their coordination of all of those things are all embedded in that.

Design and planning tools. How do we get to new tools? How do we, you know, think about (Inaudible) and different ways to even approach this fundamentally? And as many of you know, in the grid modeling work and working with the Office of Science has gone back into, what are the basic computations and modeling even capabilities? Can we just challenge our assumptions in some of that space, and move to

more parallel processing or different ways to come at getting information in the actual operations and the feedback loops with those controllers; as A.K. talked about, trying to get into a more predictive world as we go forward.

So, let's talk about how we really do that, and what are the steps we need to make those things happen, and how do we get to contingency analysis tools? You know? And we have some targets that were thrown out here into the size of some of this, as you see on this. And these we'll continue to refine, and all of the numbers in here, we'll continue to refine as we go out, as we talk about the outreach that we're going to do toward the end, and get a feel for what are the best targets, and continue to try to sharpen that.

From the operations power flow idea, the grid architecture work is really important. What does this overall blueprint, this integrated system look like, and what are the tradeoffs that you make as you show interest in something and work out of our own activities, and New York Rev

and other things going on, to try to really get at what is this thing that we want to go forward and make rules about, and then plan to go forward?

And how does it really work? You know? What do you need that we don't have today to really have an operable control system? And how can we take advantage of some of the breakthroughs in RPE and in the outside world on power electronics and some of the devices that are coming in terms of their capabilities that go beyond where we are today.

Analytics computation model, wide area control -- how do we get to that? Now that we've had some wide area visibility, how do we move that to control on the PMU situation, for example? And then sensing measurements, reduction cost of these across the sector -- how can we make them cheap enough to put into a lot of different places?

How do we really connect to the buildings? We're all working a lot with the buildings program and the grid space, to think about how does load play differently? What are

the different aspects of it going to be? How can you do things like have HVAC systems working with the PV system to levelize the output from a building, as an example? And then, real time data management -- and again, how do you get at those low cost sensors?

Devices integrated systems. How do we look at energy storage? How do we look at the micro-grids? What do we do about getting the cost of not only the devices down, but the interconnection of those things? How do we start to look and think about our world, where there's more transactive opportunities going on, and what structures really are looking for that kind of thing as we move forward?

Security and resiliency. Pat talked about hardening the transformers. How do you get resilient architectures, as you think about, you know, inter-nested micro-grids or interconnectivity in different ways; networking among the system more than it is today? How do you make that safe, at the same time?

So, we were kind of thinking this is, over the next 10 years, a concentration on the kind of R&D needed, as you can see in the first left hand side of the slide. And then, how do we think about regional demonstrations and how they go out. And can we work with partners at the states and industry level to demonstrate the right kind of things needed for that region and activity, and yet, continue the core R&D?

Some of this can be done in the three to five year period. Some if it's going to take longer. So, kind of different -- you know, how fast can you go in the control space? And at what point do you spin off and say, I need to test this out, really get some feedback on it, simulate, model it differently and feed into the R&D that's continuing to go on?

So, it's that iterative loop that needs to happen as you go forward. And I think a little bit in the discussion with A.K., I think Merwin, you had -- how far in our -- Paul's point of how far does this -- do you hit this? And I think

it's a set of iterations as you go forward, and feedbacks to really make it happen.

We talked about the five ILITIES very briefly. These are the ones that were concentrating on a grid space -- reliability, affordability, security, clean and resilient. And it's a balance of those in an integrated system that's what we're trying to get at. So, that's the hard part.

You know, we know how to go after parts of these. We have parts of these already embedded in the system, but as we move forward to this future vision of whatever this set of things are in the future, how do we make sure that all of these are in play, and we're thinking of them?

I talked about demos being very important. I'm going to talk about three kinds that we're hoping to move forward with early in the FY '17 - '18 kind of timeframe in our multi year plan with demonstrations charting in the '20 timeframe -- FY '20 timeframe. But the ideas that we're trying to talk about in this place, and we

talked a little bit about these before, if you recall -- so I didn't go into great detail about it, it's how can we think about lean bulk power (sic) systems? How can we start to think about fewer reserves?

And what are the things that make up and give you the confidence that you can operate with fewer reserves? How much can you pull from the load side? What is the quicker balancing of the system, and to make it work? And then, what are the kind of measurements and metrics that you want to do that hit at those ‘ilities’ that you're talking about and start to get at those?

And we're going through and talking about you know, what our are baselines, what do we need, what do we need to really even understand that we don't understand in order to get at the baselines for these demonstrations. So, if the demonstrations are a couple of years out, we're working now try to get at how do we baseline those demonstrations, so that when we actually get the results of those demonstrations five years from

now, we've got a delta that we understand, and we did not, you know, totally miss the boat?

Similarly we want to do clean distribution systems; do a series of these around the nation, kind of look at the coordinated micro-grids with you know, fewer outages, shorter recovery times. How do you get to affordable, secure and clean in those environments, thinking about higher concentrations of DDR in some cases; thinking about again, what from a regional standpoint, do you need to really make those go?

And lastly, the linking grid, planning and analysis and working with the states on what tools -- how can we really speed up the planning tools and make them accurate at the same time, and have them represent what's really going on there? I think this is another critical piece, and again, but embedded within trying to move in space on all of the ‘ilities’ at the same time.

So, that's really what we're trying to do and lead toward that integration occurring by kind of forcing ourselves into that demonstration

space and linking all of those together, and then learning from that to move downstream.

In terms of the MYPP, we finished the technical sections. We're pretty close. We're continuing to work on the QTR and the QER -- the draft of the QTR and the QER that's out there, an alignment to that, and both an alignment of the '16 request that's already on the Hill, and the '17 request that's being done. So, we're pretty close to those things.

In terms of a lab call, we're doing a lab call first for planning for FY '16. We're hoping to send that out this week. Kevin and I, we're walking around this week with crossed fingers that this will actually launch this week, and really answer some of the questions, I think a little bit too, about what are the things we're concentrating on here as we go back to MYPP.

And this is looking at coordination across OEE, EPSA and a little bit at fossil on how are we going to tackle the grid space. What are the things we're going to ask for the next three

years of the natural labs to concentrate on? So, there will be some definite requests. It's an integrated lab call that not only touches the integration space of all of the activities, but also, what are the program priorities in the grid space?

So, it's not only contributions by, for example, on the (Inaudible) side building with solar -- what do solar buildings want to do in this space that coordinates back? So, this is really the first time Dewey's pulled together and integrated approach to getting all of that out there at the same time, and having people in the labs respond and their partners respond to how this will go forward.

And then, as we go forward -- the plan is kind of as we move into FY '16 proper, we'll do that with the industry, with the university work and that kind of thing, and think about how do we coordinate those calls across programs and across offices in a way that we've not, and be more effective at getting this connected, integrated

approach to things.

So, that's what we're trying to do in the kind of first phase, hopefully after this week on our lab related activities. And I really -- a suggestion back to you, Rich, is, you know, does it make sense for a subgroup of us to meet with us once that issue -- and say, hey, this is what we're doing; feedback back to you? And you know, what is the way that EAC can contribute here in terms of what we're doing?

We're actually hoping to make awards on those three lab calls in the fall; in the early fall, so it's a pretty fast schedule. And we hope to move forward this week.

Outreach activities -- we're also meeting next week with the labs to talk about how are we doing in coordinated outreach. As you saw Larry talk about earlier, the QER has done some. The QER will do more. Some that are specific are being planned from the list of things that QER talked about. Some are being coordinated with us.

We're also working with people like

Gridwise Alliance on the lining things and the interest areas about -- again, everybody is trying to get toward the same direction of what are the things we need to do, what do we need to understand from the localities and the regions about their interest in the things, and how does that dovetail and working well at all.

So, you'll see activities going forward in some of this space here. And lastly, what we plan to do is, now that we've got connection and know the things that we're asking for, how do we do a better job with these regional dialogues? How do we take it down to the next level?

We have some resources you know, in part -- using the labs to do that. And how do we really get that dialogue to be a more robust dialogue, and again, try to accelerate some things that are going on. That's really what I had to say today.

CHAIRMAN COWART: All right, Bill, thanks very much. I think you left us with those last two slides -- two or three slides with an

open question.

MR. PARKS: Yes.

CHAIRMAN COWART: Could we collect a subcommittee or a working group of the EAC to take a look at the lab call -- I assume that's what you meant.

MR. PARKS: Yes.

CHAIRMAN COWART: And to then, give some feedback on what we think is most important. Is that --

MR. PARKS: That's correct. And you know, what kinds of things would you like -- would it make sense to have come out of that. Is this robust enough? You know, as we think about the responses from the labs, which are going to give very specific value milestones and deliverables, that kind of thing -- are these the kinds of things that we should look for? And that kind of thing would be helpful input.

CHAIRMAN COWART: Any comments or questions from the committee? We do need to move on to the panel. Paul?

MR. CENTOLELLA: So Bill, thanks for the presentation. I am interested you know, in this topic, you know, and seeing more about what you're doing with the lab calls. I would like if you could talk briefly to -- you know, it seems like you sort of went from, this is what the labs are doing to demonstrations.

And it strikes me that the innovation process -- there's a lot that generally comes in between things that the labs may be good at and getting to demonstrations, and particularly, involving folks from the private sector, as well.

MR. PARKS: Right.

MR. CENTOLELLA: And you know, seeing some of those entrepreneurs participate in a way, and supporting that activity, whether it's through test beds or simulation facilities or other things. And I'm wondering if you can -- I think of demonstrations as being kind of towards the back end of the innovation process.

And at least parts of what the labs do is more on the front end. And it's the middle

pieces that oftentimes get neglected. I'm wondering how you're thinking about the process.

MR. PARKS: So, without trying to talk about something that's getting ready to come out and things, I agree. I agree with you. And so, even the lab call itself is not just about the labs. It's about how they partner and the ties to that regional outreach and the partnerships that happen.

And so, what we want to do is make those demonstrations and their research leading into that as robust as possible. And that doesn't all reside at any one place, whether it's the national lab at universities or the private sector. So, how do we take advantage of all of that? And it will take a while to get this -- we're not going to get everything in one single call, obviously. Right?

And as I said, we're going to try to coordinate also, the university and the private sector work that we're doing in these program areas, as well. So, all of that together leads

towards the demonstrations. The demonstrations are not just a result of the lab work itself.

CHAIRMAN COWART: All right. I think we need to cut this conversation off here. Bill, I have a request for you. If you could create a question in the form of a couple of paragraphs or a one page statement of a question or challenge to the committee, we will circulate it, and we will collect a willing group of committee members who would give you feedback in response to that question.

MR. PARKS: Very good. Will do. Thank you very much.

CHAIRMAN COWART: David? So, we're now going to discuss the ever present, wonderful, challenging, theoretical, practical (Laughter), important question of what is the value of a VAr.

MR. TILL: Let me start by saying we have nothing for you today (Laughter). I couldn't resist with that introduction, Rich. If the panelists would come to the table. Let me say that in the ever present, and I don't remember all

the rest, discussion about the value of the VAr, one of the things that's come up is directly aimed at me and my speech patterns, and what you can infer from them.

And that is that I'm implying when I speak to you, that I don't think we have enough dynamic VArs on the system. And so, I want to provide a little clarification there. That's not exactly true. These people will help us figure that out. I don't know what I think. And that bothers me.

We never want to be in an untested state, and we never want to be without the knowledge that we need, and I worry that as we're making decisions that are sound decisions about where we need to go in a larger context than just the power grid, but the power grid being a huge context, that we might be eroding our margin of dynamic VArs. And with our planning process that's setting up an operational disaster in the future without knowing it.

And I exaggerate that greatly when I say

it, but my point is that we might not, and we want to make sure that we do have enough VArs, enough voltage support. And so, that's where I'm aiming with this. We have four very distinguished gentleman here, and I got very excited during the telecon where we discussed this panel with each other.

We have Ken Donohoo, who is the director of system planning and distribution and transmission at Oncor. We have Dennis Bergeron, the director of the energy programs division with the Maine PUC. We have Tom Sloan, representative -- Kansas House of Representatives. We have Charlie Vartanian, Northwest territory manager, Mitsubishi Electric Power Products.

Now, let me ignore what they turned in as bios and tell you what I think is important about them. Ken has been around the planning world forever in leadership roles. Ken has headed up the NERC transmission issues subcommittee and many other various venues, and he's just intimately familiar with the planning world for

the grid.

Dennis is doing a lot of work -- has done a lot of work in wholesale electric markets, something that I know nothing about, and I'm looking forward to a perspective from, and in transmission planning with Maine and with the surrounding area. Really, that's regional transmission planning, so not just Maine. And you find too many PSE PUC people stepping up to speak to this topic, so obviously, he's a courageous man.

Then, we have Tom Sloan, who concentrates on renewable energy and transmission reform from his position as a representative in the Kansas House of Representatives. Most of us in the room, if not all, know him from the Electricity Advisory Committee, and appreciate his leadership.

And then, there's Charlie Vartanian. Charlie is a salesman, but he's not a salesman. Charlie looks to match up solutions, technological solutions with needs, but he's really representing

on this panel -- we have Ken from the planning community, Dennis from the regulatory community, Tom from the policy making community, and Charlie was nominated to represent environmental stakeholders. And that says a lot about him.

I think a great deal of Carl Zichella, and he trusts Charlie to make sure that every possible solution is considered, and that the right ones are picked in a process that Charlie is in. So, I appreciate you all. You know the order of your presentations, and I'm going to get out of the way.

MR. DONOHOO: Just so I know how to drive it -- David? Okay. Ken Donohoo from Oncor out of Texas. We're based out of Dallas, kind of gives you an idea. I want to make clear, we're not an energy company. We don't buy or sell energy. We're just wires.

Remember the old TXU Holding Company? Essentially, Dallas Power and Light, Texas Power and Light and Tesco Companies, and essentially the red kind of shows you. Our biggest light center

is Dallas-Fort Worth, but we go all the way to East Texas, almost all the way to Austin. We go out to Midland, Odessa, north to Wichita Falls. It kind of gives you the area that we're dealing with. We're number six as a wires company in the United States. We're the largest in Texas. So, that kind of gives you a idea.

I want to hit a couple of planning concepts real quickly with you. Now, you talked about the customer earlier. That is becoming more and more an issue; knowing your customer, talking to your customer. The expectations, the interest, the communications is increasing, not decreasing.

Recently, I was on a trip. What was everybody doing at the airport? Looking for a place to plug in. What do you every night before you go to bed, guys? You plug in. So, think about that. They want to know what's going on. They want to hear what happened. They want to know what you're doing about it. It's not just the same old environment anymore, and it's got to be quicker, faster, better, and they want to know

the right answer, not just a pat answer, and particularly for their situation.

Compliance and oversight increasing -- normal. I think that's fine. It's really good. One of the biggest things is full employment for planners. I'll tell you. The problem is finding them, developing them. That's the bigger issue. I hope to retire someday, but right now, over half my staff are new engineers. They don't have the experience and don't know sometimes what they're working with.

But they do know computers. They know software. They know how to automate those things. They just aren't sure about what they're getting out of it. Generations are locating away from load centers. That's been going on for a while. Think about that. That's a big factor.

VArs are a local issue. About 10 to 20 miles is about as far as you're going to -- they do not wheel across the system. It's local. So, you're talking about Dallas-Fort Worth, 10 to 20 miles across -- you aren't bringing in VArs

outside of Dallas-Fort Worth. Big issue.

Increasing renewable distributed generation demand response in our world. I think we've been hearing this for a while. It's going to continue. That is the way that our industry is heading, period. It's there. There are people saying no, no, no. We're heading there right now.

Another one -- big concern -- NERC's talked about this. Low system inertia. Where are your big units? Where is your frequency control? How do you control frequency? Renewables do not lead frequency at this point. In the future, they may. But right now, you've got to have big units that lead frequency on the system. And when you get down to certain levels, you're going to have a problem maintaining frequency.

System strength is weaker. What do I mean there? Fault duty. Low short circuit ratios. If you get generation as your primary source of your fault duties locating farther away from loads, you've got some issues. Out in West Texas, our fault duties are as high as our low

current. System protection guys, do you see a problem? We do.

Dynamic and transient stability is limiting transfer capability more than static limits. The old static limits, your steady state voltage, your thermal aren't your limiting factors anymore. That's what we're finding out.

Oscillation and the control interactions are an increasing concern. Big time. How are these things going to interact? What are they going to do to each other? How do they work together? Here's one I got for you: Load and peak demand projection, highly variable based upon many factors.

How are we going to project peak load with DER? Think about that? What does a planner plan for? Do we plan to have DER in place, or do we ignore and plan ahead and have an extra margin? That's being debated right now all over the place.

System operational center and coordination is very complex and is getting worse. Think about the operator sitting there. Most of

the time, something happens -- well, what just happened? Usually, too late, the timeframe that we're talking about.

System security, flexibility needed for events under changing conditions. That's a big factor in what we do. The HILF events, High Impact, Low Frequency events, the CIP, the physical security concerns. We are now factoring those in to our planning efforts. Why don't we plan in those in our planning, instead of just trying to work around them?

By the way, if you put up a big wall around a station, what is it? Maybe that's one I should attack. Makes you wonder. So, we've learned a lot through. And by the way, we have done a lot of analysis around those scenarios that we don't make public. So, outages and clearances. That's our biggest issue.

Right now, most planning is done on a base case that has no outages or clearances in it. Every day, there is something out or being maintained for clearances. Every single day. But

our planning doesn't account for that. So, maybe we should be forcing N minus one minus one analysis more and looking at that.

Change load types. We've gone -- just an example. Lighting -- we've gone from incandescent to CFL to LEDs. I love the LEDs. I've got about half my house in them right now. You know why? They don't burn out. They're very efficient, but they're also in places that I don't really like changing light bulbs. Big guy on top of a ladder -- not good (Laughter).

Here's my big one. I used to have a different term for this. Models to support good decisions. Bad models make bad decisions. And what I mean by models, I mean, like load models, motor models, dynamic models. Something we talked about over here -- what are the right models? Right now, that is a big issue, getting proper models from proper places.

And I'll tell you, Charlie, I'm going to pick on you a little bit. Some of the manufacturers, you get a model from them. It's a

black box. You get a model from somebody else. They don't play well together sometimes in our simulations.

Here's another one I see. You're probably going to see this in the next 10 years. Power electronics enabling transmission control and re- dispatch. That's coming. Heard of the voltage source converter? We think that device may be one of our controlling aspects in the near future, being able to change the flow on an AC line.

Right now, our problem is, is the physics -- the voltage, the impedance. That's what drives what we do. Can we affect the physics by using these voltage source converters in unique ways to control the flow, and actually work around a transmission problem. What's the issue there? Communications and control.

It's got to be fast enough, and we've got to be able to have control of our wired area in a very short period of time. We're in a unique industry. We have to immediately respond to load

requests.

Going to that part, the power system is dynamic. It's constantly changing. It's actually essential to understand the power system reliability and stability. The system is never truly in a state of steady state, ever. Frankly, I think years ago, we used to just do power flow analysis using stead state cases. That's where we started.

Frankly, our guys are starting from dynamics cases now and then going over to steady state. Radical approach? All my planners on transmission all know how to run dynamics. My assistant protection group knows how to run dynamics. You aren't really -- what makes a power system planner? Right now, it's static analysis, system protection and dynamics -- all of those together. So, that's kind of where we're heading.

Right now, we have a number of small disturbances all the time, changes in load, change in a generation, ambient temperature. Solar. Clouds come over. Big change in the system. And

we have to immediately respond to those adjustments very, very quickly.

Frankly, a strong or robust system can usually absorb these changes easily. Right now, and under those things, a steady state is a pretty good approximation. But really, who has a robust system these days? So, kind of interesting.

Here's your stability problem. It's just not one piece, but what I'm going to primarily talk about is voltage stability. There's many different pieces to this analysis, both short and long-term. The voltage stability problem is mainly the ability of the source to maintain stable bus voltages following a disturbance or a deviation from an initial operating condition.

And you know the things that happen when we have voltage stability. You've experienced them yourself. One fairly recent one. So, ultimately, we don't want a voltage collapse. That's where we really get in bad shape; and then trying to rebuild the system. I'll tell you what

probably the biggest thing is, the load is typically the driving factor.

Dallas-Forth Worth -- we are susceptible to a voltage collapse or a delayed cleared fault. It's due to the air conditioners. We get a drop in voltage. We use mega VArs. Capacitors are dependent upon the system voltage. So, if your voltage goes down, you lose capability.

By the way, Dallas-Forth Worth is a very fast collapse. An under voltage load shed scheme for load does not work. It will happen before the system even realizes what happens. We have a delayed cleared fault. Our air conditioners seize, and then we have a voltage collapse.

It used to be the units used to take up the difference. Your permanent solutions normally for voltage -- increase the reactive power support in areas of depressed voltage, of course, improve load power factor. Another thing is, you need to know what your load is.

Distribution feeder capacitors -- they can be automated to be controlled. Substation

capacitors -- we've done that. By the way, in our analysis, we found out that we have the most highly corrected system in the world. We went to consult and we went all the around the world. We have so many transmission capacitors and distribution capacity, he said he'd never seen this many.

But our problem is, they're dependent upon voltage. You can also add generation in an area with dynamic reactive capability. What's our problem in Dallas-Fort Worth? Not a (Inaudible) area. That is actually one of the quickest fixes. That same consultant (Inaudible) said, well, can you get generation here? No. Okay, move on. That variable is gone.

We're now looking at -- honestly, you heard about synchronous condensers? We're back looking at them in (Inaudible). Not rebuilding old units, putting in new ones. That actually helps the low system strength problem. Right now, our fix that we put in that we're using, dynamic reactive device. SVCs. I think we're going to

STATCOMs. STATCOMs are our D.C. based capacitor. It is not dependent upon system voltage. I think if we ever put in another one, we'll be looking at STATCOMs rather than SVC. That's our next step. Essentially, a fax device.

Also, you can decrease the reactive power losses in the network -- serious capacitors to lines. In other words, shortening the lines electrically. Static synchronous serious compensators, fax devices, those in there.

I've heard of this. I haven't seen one in place yet. Super conducting magnetic energy storage. Maybe. I probably will not buy version 1. I'd like version 10, maybe (Laughter). You know, I really don't like being the tester. So, those sometimes are not pretty.

By the way, this is the side of our list, SVC. This is down in Brown, near Brownwood. This part of the CREZ Initiative, the Renewable Initiative. This is a Mitsubishi static VAr compensator. There are two of them here, each one rated at plus 300 mega VArs, minus 265 mega VArs.

The response time, 20 milliseconds. That's a blink of your eye.

That is a huge 345 KV station down in Brown County that wasn't there five years ago, in service and operating right now. I've thought of Dallas, back when we had the last shutdown of plants in Dallas due to environmental reasons. We had to very quickly go out and put in SVCs. June of 2008, we started construction, August. See downtown in the background? That's downtown Dallas, September, October, December, February of 2009, in service. One year. We had to do it very, very quickly.

Again, same size, plus 300, minus 265. Two of them at this site. We put in two more at Rinner on the north side of Dallas. There is also another one at Parker. We have seven of these devices in the Dallas- Fort Worth metroplex. I sleep a lot better at night, I will tell you, because of these. And they work, and we've confirmed they're still continuing to work.

We re-analyze them every single year.

That's who we are. So, are we holding the questions, still, till the end of the panel? Okay. David? Hey, Dennis. Charlie? Charlie's next?

MR. VARTANIAN: Good afternoon. Charlie Vartanian from Mitsubishi Power Products, U.S. And thank you, to the Committee and the Power Delivery Sub-Chair for this chance to speak today, and exchange some ideas.

Real quickly, for background, Mitsubishi Electric Power, U.S., was a joint venture between Westinghouse and Mitsubishi Electric about 30 years ago. Mitsubishi now is the sole owner, and our tradition has been larger-scale FACTS devices, circuit breakers, power transformers. But I think it's very telling that we have started an energy -- an electric distribution division, and I'll be touching on some of that technology, and how it actually supports the bulk system.

I'm an Internal Subject Matter Expert, I work with customers to make sure that we understand their issue, and dynamic VARs is about

as complex as you can get, and understanding and then making sure the delivered solution works. But for those interested in touching on some of the business drivers of why would this company with a very established business on the transmission side dove into the realm of electric distribution which is a new area.

Tricia Breeger, the General Manger of the new Electric Distribution Division is here, and I'll pre- point any of those questions to her. But before, I'm going to actually throw out some numbers what is the value of a VAR? But first we need to understand, and this builds on Ken's comments, you need to ask me for the right VAR. If you just need a static capacitor, buy a static capacitor. But as Ken pointed out, one of the real limitations when you are challenged with a situation, a grid event, a grid condition that requires support through deep voltage deviations -- yes, your VARS go away as the voltage comes down with the capacitor, and you'll notice SVC isn't noted there, because there are many ways and

SVC is just a power electronic switch to a capacitor that could be brought on very quickly.

But once it's on, if you've got a very deep voltage excursion, though the VAR, the VAR, the Q, coming out of your SVC declines as voltage drops. So that's why there is an interest in devices that hold their VAR support output through events that include deep voltage deviation. So, there you give into the dynamic VAR 2 Quadrant, stat column and synchronous condensers are two units that provide that capability.

And I'll take a quick aside. I just came back from a factory visit, where was an integrated circuit switch with IGBT transformers on them, going into an inverter. And I asked our factory person, literally, (inaudible) to get in, is that the same IGBT switch that goes into our STATCOM? The simple answer was, yes.

This was part of the revolution, the good news is to do a STATCOM even five years ago, you are building from very expensive discrete components, now we literally have integrated

circuit chips, it looks like a blown-up version of what you'd put on a PC board in your computer, that not only has the power capability, it had onboard monitoring, and onboard control.

So when I looked inside the inverter, there was one there, with the number of control panels, because the switch was also integrated, but it was amazing. But here is the issue, I need to research. I bet it's the same integrated circuit power switch that's also in Mitsubishi train drive product. It may also be the same integrated circuit power switch in the Mitsubishi electric car.

So there is this convergence and crossing over of industries, and I know we have one competitor that purposely pursued and electric car switch to build a distribution, a transformerless smart converter, and that actually grew out of Georgia Tech, the same man whose last product was a very appealing PMU sensor that was a plug-in outlet level.

But that being said, the point is,

Mitsubishi is leveraging just the availability in advancements and technologies to deliver STATCOMS with these devices that once they are mass-produced will drive down the cost. It doesn't necessarily increase the capabilities, I mean that could have given Ken amazing capabilities; he could have bought a SMS 10 years ago. The issue was really cast in my mind.

Now, you go to 4 Quadrant, I was part of a team at -- in investigating and utility, and most of my career was transmission planning that eliminated the need for annual contracts for 1,000 megawatts of generation that were on contract annually for nothing but local voltage support. We would place 1,000 megawatts of generation with about 1,200 megavar of switch caps.

So, here is my first point, well what's the value of VAR? If you look at that annual contract value and put it -- a carrying charge rate for utility, those VARs cost about 1,200 per kilowatt in generating capacity contracts. How did this get through so easily? It was a slam

dunk, those costs of those VARs was about $20 per megavar. It was avoiding -- You know that, essentially a capacity purchase. So I'll throw that as one point.

Now the issue is; do you want to run generation for support of VARs? Well that was a case in point if you need static VARs; by no means do you want generation to put out the capacitor. Where it gets more complex is when you truly need the dynamic VAR.

Synchronous condensers, STATCOM are here today, they are technically viable, I think that STATCOM has more room for some dynamic cost reduction; just because the synchronous condensers are more based on establish generating technology where I don't think anyone is anticipating technology breakthroughs that will drive down cost from where it's at.

The other issue, what's the value of VAR, what you are getting out of it? And I think a lot of the value is based on how you apply it. Again, if you need steady state, voltage boost,

use a cap, but in California, example, where solar noon, and a massive amount of PV is coming on to the distribution circuit, you get spot cases where you've got high penetration, circuit by circuit, where they are having high voltage problems, and if you've traditionally only put out caps that boost voltage, you literally don't have a tool to drop voltage.

So, again the capacitor of a single quadrant, an example of an in-hand problem, where now there's a need to regulate even in steady state to reduce voltage during certain times a day. That's really a new requirement driven by high PV penetration in certain areas. You have the 2 Quadrant in the dynamic aspect, and you do get the dynamic V-boost and V-buck, and these are solving what I call the NERC liability type challenges.

The one in 10 year worst-fault system level, heat bust voltage, these solutions exist, SVCs get put out, synchronous condenser. Once again, with the STATCOM you've got the ability to

stick in there, and one comparison is the SVC is in the capacitors or cats, STATCOMs and synchronous condensers are dogs, they kind of stick through it a bit better.

Again, and highlighting, that ability to follow system voltages, one term is fault-induced voltage, delayed voltage recovery, and NERC has done a lot of work, and that's an example of phenomenon that's increasingly present where you do need these solutions, that really stick with the system, don't fall off or diminish their output through the whole event. They can go 10, 30 seconds, out to a minute, which in terms of volt system dynamic issues and responses, it's fairly long term.

Now I'm going to touch quickly on 4 Quadrant; 4 Quadrant, the other two are just real power, and here is the ability to absorb and inject power, energy storage is a much more increasing, a much more prevalent aspect on our grids. I think it really behooves both the solution providers and those people meeting

reliability, obligations to look at this option, not just for, you know, a lot of people look at it as a market resource but black start support, providing synthetic inertia.

So as the last of, you know, energy from traditional assets go away, I've got a couple links to some papers and actual examples of experience, where synthetic inertia can be provided to the right inverter and energy storage. As a solution provider it all comes down to, I need the solution needer, just to characterize that need, so we can match that solution. Again, if it's not asked for, we really won't provide the right solution.

The value of a VAR; Oak Ridge National -- ORNL, Oak Ridge National Labs has done great work. They have distributed energy resources lab that work a lot on dynamic VARs as input to the creation of a capacity market for dynamic VARs mid 2000s in the East Coast. And these numbers are still representative of what I see in the market. You know, if you need a shunt cap, you are going

to do that for $20 per megavar.

If you need the full dynamic VARs, you are going to be going from $80 to 100 per mega VAR. And, again, if you were going to put out a generator or user generator, for provision of nothing but dynamic voltage, it's a factor of 10 more expensive.

And in fact, if you are going to burn fuel, if you look at the NPC of the OpEx, you'll find that it actually does make more economic sense today to put out a power electronics-based dynamic VAR solution, versus either burning the gas or the coal, in a sun-cast it with no CapEx, or investing the CapEx for the most efficient or investing the CapEX for the most efficient gas-burning, you know, CT or combined solar (inaudible) you can get.

Now, if you need that sustained energy output, you know, this is apples to apples, I'm talking just VARs. Now if you are putting in a generator because you need a generator, that's a different issue. You know, I kind of previewed, I

hope, some of this message. These are Mitsubishi products that run the spectrum from hundreds of MVA synchronous condensers, hundreds of MVA, SVC to STATCOM, and to the upper right is where we are headed. The VARs don't travel.

If you look at the impedance of a transmission line or a circuit, you are going to get 4 to 10 times the reactive impedance versus the resistance impedance. So, it's what's -- you know, the good news it's nothing more than basics physics, there is more impedance to reactor flow, so you do want to place those resources to where the need is, and the reactive needs are usually load- driven.

So that upper right is 100 kilowatts at a time of dynamic VAR. Now, at some point we will likely have an offering where you add energy storage to that reactive device, and you have the distributive full 4 Quadrant system that I'd love to see at price points, the value related to price well under that cost of putting out generation, and hopefully not too far north, of putting out

the shunt cap.

Thank you, again. And I do have some references if someone wants to go deeper into a few of these ideas.

MR. BERGERON: Okay. Great. Thank you. Denis Bergeron, I've been with the Maine Public Utilities Commission for close to 30 years now, and sitting here today listening to the perspectives from the DOE folks about how things are changing. I look back and I think, through my career, I've actually never been bored at work, I've never had a dull day at work, and I'm thinking to myself, boy, are things going to be fun now.

So, I was asked to come up and give a presentation on the value of a VAR to a regulator, and Ken and Charlie are the implementers and the solutions providers. Tom does the policy stuff, and we are the guys who have to find out how to pay for all this stuff. So, that's kind of the perspective I'm bringing to this -- and how -- Here we go.

Okay. So, they send you to regulator school and, you know, you learn this maxim, safe and reliable service at just and reasonable rates. And it's good that safety and reliability are job one, and then, you know, the economics what is just and reasonable follows. It's clear from the order of the objectives, that the first one is reliability.

And as I thought through it, I realize that value is really a matter of perception. It matters whether you are a Federal regulator, you know, if your perception is different. If you are a Federal regulator, or if you are a State regulator, your perception is different, if you are a transmission provider of reactive power it's different, if you are a generator who provides reactive power it's different, and vertical integration, it's different under unbundled regulation.

It was actually the -- it was the development of large Federally-funded hydro power that started lots of increasing wholesale

transactions across the system, a lot of it, actually by public power, wanting to get across systems of integrated utilities in wheeling power, where people would recognize that reactive power needed to be furnished to the system to be able to wheel that power. And it was in 1990 where FERC actually recognized that it could be a separate charge for reactive power.

And in those days when everybody was pretty much vertically bundled you thought of it as an incremental -- just an incremental service. Everybody was under cost of service regulation, and turn on equity for their rate base, and when they started looking at how much the increment of providing reactive power was it seemed vanishingly small --

Okay. All right, so under Order 888, reactive power now is, FERC decides after the unbundling that reactive power is an ancillary service. Still, you know, it was said to be quite different, quite low, and there were, you know, when generators were coming, wholesale generators

were coming to interconnect to the system, people were actually thinking about it, as well, you know, it's such a low incremental cost that you really ought to be connecting to the system, and providing a service as your contribution to connecting, and that really didn't work very well.

We found out that when generators are not working on return on equity, but when they are actually requiring to earn a return the competitive power industry, that they value the generation as an opportunity cost and it has to be -- and you have to pay them for their opportunity cost -- I'm really have a hard time with this device here.

So, it's a matter of perception, and one of the things is if you try to introduce reactive power in a market and have the market self-select reactive power, it doesn't work very well. The liability is a public good, and you need reactive power to maintain reliability, need VARS, therefore reactive power is akin to the public and the studies show that when society tries to value

public good, they always undervalue it. It's like clean air. It's like police protection.

So, you need to have a central administrator wherever you are -- whenever you are producing this reactive power, and that central administrator needs to be the one that sets the rules and buys the correct amount for the system. You know, as the regulator you quickly realize that you get what you pay for. If the reactive power is being furnished through a transmission device, Charlie just said how inexpensive it can be -- how inexpensive it can be through -- Thank you.

So, if it's coming from the transmission device, transmission owners still are under cost of service regulation, and it's still a return on equity, it's still a balance sheet, it's still low incremental cost, and there isn't -- You know, from the transmission provider perspective, it's great to be able to provide reactive power services on their system. Again, if it's generation-based in an unbundled region it really

needs -- you really need to provide their energy market opportunity cost.

And now that we are starting to talk about stuff on the distribution system, there's been a lot of talk about that here today as well. So, our perceptions again are changing, you know, that's what keeps our jobs interesting. We are seeing the opportunity cost piece, but we are also seeing technological advances and dynamic volt/VAR optimization going on. That's become quite a topic these days.

That is an opportunity to provide some voltage support on your systems, but it's much akin to demand response and energy efficiency where you are reducing the energy consumption, and so there's lost revenues there. And we are talking decoupling. You know, we are -- people need to be compensated or else they will not want to do it.

And then, again, if you are looking to people with distributed generation to be providing dynamic reactive power onto the system, they are

going to view it much like generators do, and it is an opportunity cost of not producing energy and not getting the sale. So, they have to be compensated, and we have to figure out a mechanism to be able to compensate them if we want to realize this advancing source. Look at this!

Okay. So, getting down to the question of value, if you look at most of the recent power failures we've had on the system, the widespread outages, if you read the reports about the blackouts that have rolled through the country, you'll find that every one of them, there's a mention of a lack of adequate reactive power. It's some kind of vegetation problem, and there's a lack of reactive power to restore the system.

And when you look at the first energy outages, it was 70,000 megawatts, 55 million people, four hours, if you look at value of loss load calculations you'd come up with an estimate. I came up with over a billion bucks in cost. You know, when value is -- really, it's the measure of utility of a device or service, compared to its

cost, so when you think about the value of a VAR there, they really are quite valuable and it's just a matter of trying to figure out how t pay for them, and which devices provide them to the system most effectively.

And Charlie, I'm going to give this to you. Thank you.

MR. SLOAN: I appreciate the opportunity to be here today with you. I have missed attending your meetings because I've learned so much in the time I've spent with you.

CHAIRMAN COWART: We missed you, too, Tom, so we are going to keep inviting you back.

MR. SLOAN: All right. I'm going to take the liberty of an elected official and go beyond VAR as an issue, because there are things that the EAC has worked on in previous years that I think tie into this, in terms of previous recommendations. And we also need to understand that -- I don't know how many of you know State legislators, as a group we are not very bright. We are certainly not very knowledgeable in any

specific area, I'll give you an example, in the Kansas House of Representative, the Utility Committee has 23 members, the closest to a person with utility experience, is a geologist.

So they have no idea how anything works, and we are not abnormal in the respect. For the policymakers and the regulators, ignorance is the greatest threat to the Department's ability to guide grid modernization while maintaining reliability and resiliency, if we don't understand utilities will be less inclined to act due to concerns about cost recovery and earnings.

And a lot of this I think is coming down to just the ability of customers to monetize their self- generation capability going forward. That's going to create problems that panelists have talked about, and you all know far better than me, but allowing customers greater control over their own electric consumption and generation is directly contributing to instability, and when problems occur, customers call the utilities, they all regulators, and they call me, and I don't want

those calls.

All right. This one we can kind of skip over in a hurry, voltage regulation is important to engineers and technical nerds but, you know, not to the customer. And now I'm having problems here too. Here we go.

You already know adding intermittent generation affects this and these are the things we can skip over. Now, what is it that the DOE can do to help us? And some of these as I've said, tie into previous recommendations from the EAC and some other subjects, particularly where we recommended model-building assistance in terms of how system operates going forward.

But provide webinars for policymakers and regulators, and why voltage regulation or anything else is important. Be innovative and put descriptive interactive videos on YouTube and have Netflix-like downloadable videos. Develop game-like simulations, similar to the partnership you have with NARUC on some of the energy assurance issues. Provide non-technical

conferences in conjunction with legislative and regulatory groups.

And you want to be reaching out to where we are. My folks, my colleagues are not going to go into DOE websites, and so it has to be, you know, in areas that we understand and we frequent.

Develop and make available electricity operations and reliability factors, explanations for dummies, meaning you've got, you know, all kinds of books in the bookstore shelves about, you know, programming for dummies, or, you know, word processing for dummies. You need to bring it down onto our knowledge level.

Now, when I was in college, and there were cliff notes to help you understand some books. There also were comic books on the classic English novels. One of them being The Hunchback of Notre Dame, or Hunchback of North Dakota, I don't care, but the idea is, you look for ways to make things, technical terms, that these guys have been talking about, understandable to the non-technician.

You've got your, you know, national labs and such. And why is it important? Because if I can't explain it to my constituents when they call about why rates need to go up, or why investments in smart grid need to made, they are going to make rates go up, then all of us have problems.

Again, the technical assistants help us by providing alternative models for use by decision-makers in defining, assessing, measuring, mitigating risks to electricity, including the risk of not doing anything, or associated with not doing anything. Provide us the tools. Again, I can't emphasize enough, in simple terms. And help us to anticipate, I mean, it's been mentioned by a couple of the people in terms of asking questions and making comments on the DOE presentations before this Panel.

It's not enough just to tell us what's going on today, what should we be thinking about? What are you thinking about? What keeps you up at night, you know, so to speak, that I need to be concerned about, because if I'm not setting the

rules for the regulators in this room, then they are not going to have the tools they need to meet the forthcoming term.

You know, a glossary of terms is always important, and you've got all kinds of resources, we talked about some of that. You know, again, as we are looking at the -- in this case, the volt/VAR optimization, what can the utilities do? They know what that is; how they can recover their cost becomes important. If they can't justify an investment it's not going to occur. They have to justify it to the regulatory community, but in a larger sense they have to justify to me, and to my colleagues, because the constituents are aware that electric costs are rising, and they understand why.

They don't understand the impact on rates of the power plan from EPA, or MATS, or anything else. They don't understand that the investment in smart grid results in improved efficiencies and performance. All they see is their electric going up compared to what it was a

year ago or a month ago.

You already support pilot demonstration projects and I know from previous EAC Reports we've sometimes said that those reports on the demonstration or pilot projects are not necessarily well receive across the country, because the regulator in Kansas will say, well whatever you did in Kentucky has no relevance to us. And so we have to address that as an ongoing.

The labs can also help, validate claims whether it's - you know, we have the good housekeeping seal of approval on a lot of appliances, you know, for the home. How do we understand where AEP's bold technology, really might be applicable, and where it isn't? How do we understand what integrated controls will do as compared to a power plant, as was mentioned by Charlie? How do we make those determinations?

And please don't promote best practices, because best practice is dependent upon being applicable, affordable, feasible, and if I don't adopt your best practice, then I'm a bad

policymaker, utility executive or regulator. Instead promote options to consider, alternative technologies and processes to ensure grid reliability, and electricity affordability. And, you know, that modeling assistance that I've harped on a couple of times.

And above all else, be visible, informative, be an asset to the smallest and largest, but most, at least well informed public official, and a consumer looking for information.

And so, in summary, I'm not asking you or encouraging you to duplicate what FERC, NERC, RTOs and others are doing, but I am asking that the Department, in conjunction with the EAC Members, really provide us the necessary tools to operationalize how we adjust to the changing electric industry. And with that, thank you.

MR. TILL: Thank you. Before I open it up to the floor for questions, I want to ask Denis -- I'm saying two speakers, Denis and Tom, how much of what Ken and Charlie said that you all understand? Use the mic, if you would?

MR. SLOAN: All right, Tom Sloan. I understood more of what Ken was talking about than what Charlie was saying.

MR. TILL: Okay.

MR. SLOAN: I think, close to my point.

MR. TILL: What about you, Denis?

MR. BERGERON: I've got a fair -- I've got a fair understanding of it, you know, we mind our Ps and Qs when we do our transmission planning at home.

MR. TILL: You also have a mechanical engineering background, right?

MR. BERGERON: I do.

MR. TILL: So, although not electrical. Now, what was it, Tom, that kept you from understanding everything about what they had to say?

MR. SLOAN: My degrees are in political science, that's about as far from electrical engineering as you can get. And in my role as a legislator, in the course of a normal day I can be looking at banking issues, farming issues,

environmental, water protection, maybe something related to oil and natural gas, et cetera. So, I and my colleagues are not going to be subject matter experts on technological changes and cost factors or comparisons.

MR. TILL: Okay. I am an Electrical Engineer, I've headed a planning department, a pretty stinking good one, but I didn't follow everything, because I'm a slow- talking, slow-thinking individual, and the acronyms came so quickly that I couldn't follow along. So, I'm not saying this to our Panel, because they've done anything wrong, I'm saying this because we all, together, are trying to reach a point where we can communicate.

And in earlier discussion with the Panel we talked about the fact that initially some SVCs and STATCOMs, which are just two different technologies that can either raise or lower voltage fairly instantaneously, but STATCOM is doing it much instantaneously, really couldn't be applied in a situation where they were applied in

some cases to prevent voltage collapse, because they didn't a right-through capability for the event.

They would often be the first thing to go off the system, and the issue was not whether the STATCOMs or SVCs were being constructed properly, it wasn't a planning issue, it was primarily a communications issue between the planners and the designers. And as I listened I found that I've got a long way to go to understand anybody. And so, with just saying that, let me throw it open to the floor for questions.

MR. BROWN: Merwin Brown, the University of California. Lots of good stuff here, but Tom, I think, was the only one who actually brought up, in a very definite way, the use of load for VAR control. And yet load is the cause of most of the VAR problems. And so I was wondering why --

MR. TILL: And the customers.

MR. BROWN: That's right. Can you get rid of the customer? From a serious note, should that be looked at too. For example, a lot of the

delay voltage recovery problems are due to air conditioners nowadays because they use a temperature cutoff, and they have lower loss or internal impedance completed to the old-fashioned ones.

So if they had voltage cutoffs it wouldn't necessarily be creating the same problem they are today. So, just raise that question, is what about demand response or -- I don't mean it in the limited sense, but in the very broadest sense of regulations, codes standards changes of customers' products. And now as we bring in distributor generation that essentially are owned and managed by customers they also become a Volt/VAR source as well. Both the source of problem, and potential source of solution, I think.

MR. BERGERON: One of the things that I mentioned is how do you compensate people for providing that kind of service, and Heather actually mentioned something about it in California, because of the magnitude of the PV

impacts that they are having on your systems there right now, and it's very difficult because people -- small customers that want to transact business in the wholesale energy markets have a host of issues that are -- you know, that are -- the transactional management that go on to be able to do that are very, very difficult.

And our office as a public advocate has actually come up with an idea that -- is to have somebody -- have an entity that's like an central procurement office that bundles all of the resources together, and then manages that transaction, manages those transactions for the smaller customers, so that they can interface with the wholesale markets and maybe bring the value to the customers, but that's as far as I've gone down that road.

MR. DONOHOO: I think it's always an idea that load can respond, the question is, example of Dallas/Fort Worth our issue is the air conditions that are already out there, thousands of them, will they respond appropriately? Can we

retrofit enough to get a response? How can we verify the responses adequate enough? All of those different things, it's not just, yeah, it's a good idea, there's an implementation problem, especially when you have thousands of them already in place.

So, again, you've got to get back to know your customer, know what load you are trying to serve, that's been the big impact, and that's always an option, but most of the time, the load is not very open to that a lot of times. It's got to be a fairly big impact to them before they are going to consider it, and there is always going to be a segment of customers that no, I'll pay that difference, handle it.

MR. VARTANIAN: I think load is an active participant, could be a challenge, but I point to the fact that steady state VARs are managed by the load usually being required to maintain a power factor or you know -- and this usually applies to commercial and industrial more than residential. But that's an example where an

existing tool, while it meets that steady state where we'll be -- the requirement will not support the dynamic VArs.

I want to make a comment on the supply side for DER, the IEEE 1547 even with the amendment, and everything before the amendment, cannot provide voltage support at the point of common coupling, if you are meeting the baseline requirement, and there are real-life scenarios where some (inaudible) PV that supplies real power and they will trigger power factor penalties. Because that inverter, because it's meeting the base most -- lowest level of 1547 compliance is not providing any VARs at that location.

I am on the IEEE 1547 Forward Vision Working Group that has just opened activity, and a couple more people in this room, and I'd like to just say it. In fact, Henrique sponsored one of her meetings recently, so really this area where the crossover, it's a great form for the grain between what's T what D? What's the impact of autonomous fleet action? And more importantly and

for this group, what's the fleet impact of controlled or intentional DER action? And I think that's where the DOE can really help us, especially that intentional fleet action.

MR. SLOAN: Since Charlie brought back up the 1547-A issue, I would point the Council State Government has a suggested State legislation list that's approved every year, that states look at, so to model legislation. So, IEEE and DOE and such are looking for ways to get into the legislators' hands, what might be the appropriate legislation, that's one way. NCSL has, you know, a different process but it's the same thing. So, I guess I'd go back to where -- through ignorance, we can cause you more problems than you can solve.

MR. BROWN: I'd like to follow up, with somewhat of a loaded question, but the reason I asked it, is that the topic was the value of the VAR, and also related to what's the cost to fix the VAR problem goes into part of that value, and I don't think we know what the different cost would be, whether we fix it at the grid level,

with an active mechanism, or whether we fix it at the customer level through various codes and standard that go into the various appliances.

And I have a feeling I just stirred Clarke here. And so that would be a question I would like to see answered, and it's, what is the variable cost? I was involved in this -- we did a project for the State of California on the delayed voltage recovery problem with air conditioners, and developed a new load model process for that at our institution.

And I was thinking, how inexpensive it would be to put voltage -- low -- voltage cutoffs on the air conditioners that were the major cause of this problem, when we ran right into the problems you were talking about. Huge institutional problems, and there was no real argument, from a value point of view, which was the better way to go. We just gave up and said, okay, we'll just make the grid solve the problem. So anyway, sorry or that speech.

MR. TILL: Before we go to next

question, let me point out that when you put those cutoffs on air conditioners you are going to still lose the air conditioning load. It's just another -- a different mechanism by which you lose it, you lose it by the cutoffs as opposed to the uncontrolled, which one decides it's reached the summer limit first.

And so having heard the cutoffs proposed for years now, I'm sensitive to the fact that some people out there still that's the total solution, I don't think you do, but I think it's a simple solution and it's just the air conditioning industry, and that's just not the case. I would point out, if you've got the time, you've got to decide if you are going to leave or not, so.

CHAIRMAN COWART: I have Mark and then Tom.

MR. LAUBY:: Thank you. You know, NERC is very interested in this area, certainly we've done some work handling what we call now, the Essential Reliability Services, we used to call Ancillary Servicers. We identify two areas, one

is voltage support and other is frequency response, and as a result of that we actually developed a tutorial to describe this -- you know, nothing more the flummox of (inaudible) is asking him to describe reactive power to a lay person, it's just -- well, squared to the minus 1, and then they go off, yeah, they go off in the never-never land.

But most engineers kind of understand it from a mathematical perspective, but the point is, we did actually try to put together tutorials available on NERC's website to try to describe this to policymakers. And why do we think it was important was because policymakers were coming up with things like, 30 percent shall be renewable resources. But within that needs to be this construct that meeting certain types of essential reliability services to support the actual integration of those megawatts, and all that kind of resource.

And it can be done, but needs to be understood, and I think that's what's key here.

And when I start thinking about some of the, you know, the VARs and how to actually do the engineering, you first have to understand that there's a local phenomenon, and I think that that's what Ken was talking about, and the fact that load drives voltage collapse and voltage stability, and the fact that we need good models for load, not only today, but also then forecast in the future.

And when I talk about models, I talk about the nitty-gritty engineering stuff, and the dynamics of load, and how that's changing so dramatically, and how do we make sure that we model it correctly, we have to understand what VARs we have today, and what VARs we need now and in the future as a result of understanding that concept NERC has gone out now and started actually measuring that, and asking through pilots with certain industry, organizations to tell us, well, you know, on an ongoing basis how many VARs do you have.

And of course, the first thing we ran

into is, well, it's a big balancing area, so now you've got this kind of cloudy to really actually and you need to understand the zones within, the reactive zones within a balancing area. So now you've got this kind of cloudy, you know, do we really actually need to understand the zones within, the reactive zones within a balancing area. So that gets into a lot of - kind of an engineering messiness.

I guess in the end what we are looking for is to understand how much reactive power we need now and in the future as we go through this transition of generation, and actually, you know, the transformation of load, and the different types of load et cetera, and ensure that we have the interconnection correct -- interconnection agreements correct so that. For example, if wind turbine or wind generator can provide those kind of VARs that you need, and frequency response that you need, as long as you, of course, make sure that it's in the interconnection agreement and that they can get a rate of return on that.

And that just comes down, just kind of getting it right to begin with so, you know, I think that it -- I really love what the Panel has done here, because it kind of laid out what the issues are, and from both a technical perspective, a policy perspective, the potential solutions that are out there, we need to be able to tie all that together, and to make sure that we are ready today, but also in the future. Thank you.

MR. TILL: Thank you, Mark. Let me say real quickly, Charlie had a 4:30 hard stop, so if he decides to leave with hard stop, excuse him.

CHAIRMAN COWART: And before anybody makes a move then, let me ask the Committee to give the Panelists a round of applause. (Applause)

SPEAKER: (off mic).

MR. VARTANIAN: I'm sorry for that. I will withhold the after-duty beer mug, phone VAR description.

MR. ZICHELLA: This is Carl Zichella. I want to just start out by thanking Charlie, who I asked to do the impossible task of representing an

environmental perspective when he represents Mitsubishi, but I wanted to thank you for being here, Charlie, and we communicated on email and such. We haven't actually met, so I'm really glad you could make it, and thank you for your presentation.

I thought the overall Panel was terrific. I think Mark just some of what I wanted to say, so I'll try not to repeat it. I think the key takeaways for me, were how localized things are, that there is a broad array of ways of meeting these needs, and that they can be tailored in specific locations based upon what's available, and it could be used to take into account some of the environmental considerations that are driving some of these things.

Like, reducing the amount of generation that's needed to provide this, if you have these other tools available to provide VAR in certain locations, recognizing not every location is going to have every tool in the basket. So, figuring that out is going to be, I think, really one of

the bigger challenges for us, but I do think the key aspect to his is, inventory as Mark said, how much you need, but also how you can get it; looking at the menu of options available to you, and considering that the options that perhaps help, or don't contradict the environmental goals.

So, greenhouse gas reductions, or ambient air pollution problems as we saw from Ken's presentation in Dallas. Of course, we have a few of the same in California. So, your choices may be different in your location, based on a whole variety of factors, but you need to take stock of what you do have, that you could use to meet the need.

No one disputes the need is there and it's really critical and impossible to run a system if you are not certain that you have it, so that quantification part of this is, I think, something that is really important. How much do you need and how much can you get from what you've got?

MR. TILL: Okay.

CHAIRMAN COWART: I tried to write everybody's name down. I have Paul, Wanda, Gordon, Tim --

MR. CENTOLELLA: All right. Well, I have to say I approach this as an economist rather than an engineer, so this may be a challenge for you guys. But I keep -- every time I encounter this topic I keep getting this feeling, this nagging feeling that I'm left with a set of administrative rules rather than something that actually puts everything in a common framework and gives me a common sense of value. And lets me know, should I be, you know, for example, installing these fancy power electronics at secondary distribution levels that can equalize voltage across those distribution levels and giving, you know, 5 to 7 percent reduction in generation requirements.

Should I be using smart inverters, but I don't know how they coordinate with anything else. Should I be relying on more conventional technology, and is there a way that I could -- our

should I be including load in here and charging load that puts, you know, reactive power burdens on the system in some way?

And is there a way that I can create some sort of economic or market, or some other framework that allows these things; number one, to be valued; and number two to be integrated on a common framework; and number three, to be coordinated in real time so that I'm actually able to use those things that make the most sense. Engineers, tell me how I can do that?

MS. REDER: You are asking them to tell you?

(Inaudible/no mic)

MR. CENTOLELLA: If I can -- if I was going to make you tell me I can. I can't. I don't know.

MR. DONOHOO: Okay. Let's go from an economist to an engineer. As a planner when we come up with, we identify a problem, and we come up with a list of solutions, and there's ones that are viable, and ones that aren't viable. But we

consider all those solutions, then we analyze each one of those, can we do it? Does it fix the problem? So, all those things have to go in.

The problem is, you get so many different variables now working, are they necessarily together or not, the only group that can really put all those pieces together is to analyze it, but we've got another problem too, how long is that analysis going to take?

We've got a term we use, sometimes we get stuck in analysis paralysis, sometimes we have to see, what are the variables, what's the most sensitive elements, we do a real quick sensitivity study and try to focus on what can give us the most bang for the buck, and that's where we tend to go a lot of times.

So, we continue studying for years on end, but that still doesn't solve the problem to the customer. So, I guess I would still, one step further, if we are going to have all these distributive resources out there, you know, somebody is going to have to be solving some

version that in near real time to know which one should be operating.

That is the real key to what's going on right now. I'll let you know, on the Alpha Grid, we have over 4,600 DG sites right now. And we are actually trying to figure out, number one, what is the penetration level on particular feeders, on particular subs? Is there a unique character to where these things are locating? And what is the impact?

And that's actually what we are watching right now like crazy. It's on our radar screen, we haven't gotten up to a level of concern yet, but we are tracking it like crazy. By the way, on our system, I know the rules in Texas, every single side has to sign an interconnection agreement, and every single has to have a meter. So, luckily we've got the data and that was set up right up front.

I think other areas have different issues, but we are right in on it now, and we are trying to decide all these factors. And how do we

factor those in the plan, should we count them, or not? That's actually one of the debates going on right now.

CHAIRMAN COWART: Clark, I had a sense you wanted to respond to Paul, so maybe -- Paul's question.

MR. GELLINGS: It really started with him. So, this has actually been said, it's just that I haven't said it. It kind of reminds me of FERC Order 888m where, you know, in testifying I would be asked this question, like, how can I increase the power flow on this corridor? And my answer was, it depends.

That frustrated the hell out of everyone in the room except for the engineers, because it does depend. It's already been said that you've got a whole array of technology options, you've got a whole variety of systems, and Ken, I think you just made the point.

I mean, distributed energy resources, like it or not is going to be a feeder-by-feeder analysis. Every feeder is going to be different

and there is no -- you know, this question about, what's a VAR worth? And I know that was, David, big tongue in cheek, when you asked that, because there is no one answer, it is absolutely all local, and it's all very dependent on the configuration of the power systems, and the technologies involved, and so on and so forth.

So, Paul, no, I'm not going to answer your question, it's a silly question, (laughter) but I am pleased that you asked it, so that you were elicit this response from me. Thank you.

MR. CENTOLELLA: Can I follow up, just briefly? So, if you can't answer my question, can you at least tell me, is it possible to structure a market that would answer that question in real time?

SPEAKER: No.

MR. GELLINGS: That's going to be a very difficult problem -- I'd say not.

CHAIRMAN COWART: Let me just suggest this -- I'm going to jump in on part of this dialogue. Sometimes because the value of

something is very distributed and very variable we don't -- we decide not to make a market for it, we decide to provide socially, and just collect the money and distribute it across all users. And we do that for, you know, stream crossings and highways or, you know, you can think up a thousand examples, but I'm just tossing this out as a question.

We do that for things that are widely distributed, widely variable, and in individual instances, don't cost that much, so my question for the Panel would be, does that describe this situation, or are there situations where the individual cost causers are causing really big things to -- big expenses where we ought to be able to answer one of Paul's question is, how are we going to allocate the cost?

MR. MOUNT: Do you want an answer?

CHAIRMAN COWART: Yes.

MR. MOUNT: So, a few years ago -- This is Tim Mount -- A few years ago, FERC was very excited about the prospect of a VAR market, and at

the time we were testing different market structures at Cornell, and basically we concluded that those markets would not work, they could not possibly be competitive, because VARs are worth nothing most of the time if they are provided by generators, they are extremely valuable at other times.

And so it's a situation that's much more akin to wanting to ensure against those bad situations. So you pay your supplier a fee to be there when needed.

MR. van WELIE: So, may I ask Tim a question, because it sorts of goes to my question as well. You've got a rolling debate going here, Rich. But it's pertinent to what he just said. I think what you just said is absolutely true with today's grid, where you are getting the VAR support free, inherent of the capacity that you are buying.

But in a world 20 or 30 years from now when, what you are trying to do is run the power system, the solar panel and wind turbans, it's not

going to be inherently free in part of the capacity, and so does your answer to the question change?

MR. MOUNT: Yes, it does. We were looking at VARs provided by generators, and we were looking at that curve which I called the line SAC curve turn 90-degrees but I don't remember what the real name is. What are those things called? Reactive power, real power --

SPEAKER: The bullnose, the bullnose curve?

MR. MOUNT: Yeah. That curve, right.

MR. TILL: That is the D-curve, right?

MR. MOUNT: That was the technology we would --

SPEAKER: The D, it's the D-curve, yeah.

MR. van WELIE: Rich, I had a follow on question for the Panel, which was, it seems to me -- I listened to the Panel and say, this is locally corresponding by the load, can only be supplied locally, and so if you set aside the free-rider problem that Tim describes in today's

marketplace, it seems that you should be able to create a market for something like this, if you can measure the supply and demand in balance. And so my question to the Panel was is there a practical way of doing that on a large scale?

MR. BERGERON: I will never run a stability model. But it seems to me that the disparity of the situation down at the distribution system makes it very difficult unless -- I just don't know the communications exist to do that right now.

MR. DONOHOO: Okay there's today, there's the future. Twenty, thirty years from now I think we're going to have the computing and the communications out there. I don't think we're going to -- we're going to have to. Today -- a couple facts about DG and DER. We reconfigure our feeders all the time, the feeders move around, the DG moves around, I got another one for you in the market. If we move the DG and just change his market is he going to come after us? Kind of interesting. I think one of the problems you're

going to have on creating this type of market is how do you police it? Right now I don't think you are going to get there?

MR. VAN WELIE: It seems to me that Tim's point that until one can actually measure this thing that you are wanting to buy through the market you are stuck with having to socialize -- estimate how much you need in advance and then socialize the cost of it.

MR. DONOHOO: It's not just what you have in the market but what's available in the market also. How can you verify those limits?

MR. TILL: Could I ask a question of my own? And then I'll start it with a statement. When -- there is a very tight core group -- not too many in our nation really when you think about it, of people that study stability and that work on it daily. You don't have to get far out of that community. You don't have to leave the departments that they work in to find people that don't fully understand what they are doing. And one of the things that drove my interest in this

is that as I go into planning departments and I ask do you have an intuitive feel or do you have a methodology -- for determining as we are making policy decisions. And understand I'm not against shutting down coal, but the grid has to be protected along the way and that's my interest in asking this question. Whenever we look at shutting down a coal unit or a plant we do a very detailed study as Ken has mentioned of generally that area and then try to project outside that area, but the VArs are limited in how far they'll go. We do this real detailed study and we put back into the system an amount not equal to what we're taking out by retiring the units. We'll put back in what we'll need for the next year planning one. And so we're giving up potentially -- not always -- please understand that. If we put a gas plan in this would be an entirely different situation, but depending on what we do we could be giving up head room and insuring that we're going to have to spend money in the future, not in every site but in the -- particularly in the urban

sites. We are going to have to put back in VArs later to go beyond the 10 years. And so I'm interested in being able to show the executives a conscious decision here. This is what it's going to cost immediately to retire that versus all the other cost and benefit, but there is also this issue of -- in the 11th year we might be running into more and when I ask people how are you keeping up with that? Almost always their answer comes back to the D curve. But the D curve is a curve that tells along it, places that you can be stably and places that you can be firmly without messing up the generator. If you are on x megawatts you can put out y megaVArs and that changes as you go around the curb. All of that is based on steady state, not on the most feared situations where we need a quick dynamic rush of voltage support in the system and so any time I hear a D curve I think well you are talking about a market and that's a different thing. But that market is not protecting against this sudden voltage collapse. Let me shut up and let the

experts talk but I just wanted to point that out that I'm seeing people that are very knowledgeable confuse these studies and I'm no more knowledgeable -- somebody's just taught me along the way and explained it.

MR. SLOAN: This series of questions have been kind of interesting because what we are really talking about is how do you monetize grid protection? And whether as been said it's the cost causer or the socialization of the cost, but we're fundamentally saying what is the regulatory model going to be going forward? How does the PUC oversee that self-generator and how do they hold those people accountable either for performance or for not screwing up the system. And that comes back then to the role of the policy maker, does the commissioner have the tools he or she needs in order to regulate the non-traditional utility and the non- traditional grid?

CHAIRMAN COWART: All right, we're having a lovely time. We're cutting into your subcommittee time and as you are aware but --

MR. TILL: I'll give up all my subcommittee time.

CHAIRMAN COWART: Okay, Tim I assume your card needs to go down? Is that right?

MR. MOUNT: I would like to challenge the implication that sort of cost to know the need about VArs. I mean I've worked with system engineers for 20 years and I don't want to know anything about VArs. Basically I want to offer two issues that I'd like your reactions to dealing with voltage problems on distribution systems. The first one is hierarchical control. And that is having distribution system operators, aggregators, I don't care what you call them but they run the distribution systems and they provide a well behaved load to the grid. And this is essentially what the wholesale customers like Cornell do now. We have a range of power factor and we get our hands slapped and our pocket book raided if we violate it. That is in a way to pay for bar control because Cornell has a lot of stuff on campus. Only four people know what it is but

it sort of works. The second thing is the problems -- a lot of people are pointing at air conditioners which is absolutely correct. We are completely subjected to these wretched things in determining the systematic (inaudible) requirement so what about thermal storage? Why isn't that more of an issue so that you basically shift your air conditioning load, you can have variable speed chillers and do a heck of a lot better than we're doing at the moment.

MR. DONOHOO: Kind of interesting about air conditioners. I want to let you know I don't have a back up generator at my house, I told my wife I said if I get one you better be worried. But guess what I do have? I do have a back up window unit air conditioner for my house. Texas we know how to chill. It's kind of interesting but yeah I think there needs to be some things done. I got another one I'm going to add to you. Just ground return air conditioners. I've looked at those. What it really comes down to is money. I've looked at it myself in my own house. Just so

much cheaper and so much more effective to put in one. Next time I will do it I will zone it, but that this point my unit's running. I'm not going to modify it. My electricity costs are fairly low. I'm more worried about water then electricity at this point. Kind of interesting but it's a good question. I think there is a thing we could do in those areas.

MR. MOUNT: Can I make a response to this? I think one of the problems why thermal storage does not have a good business plan if you like is because you don't get sufficient credit for not having demand on the peak and until regulators can figure that out we're never going to move forward.

MR. DONOHOO: I will let you know we have a number of schools that are doing thermal storage. I think it's another area that could be expanded and increased. It would help quite a bit along with just some basic changes.

MR. TILL: It's certainly Tim an idea that needs serious consideration. We looked at

replacing air conditioning and we looked at it too early and we didn't fully understand what you are talking about because we weren't looking at it in relation to the FIDVR exposure that we had at our cities particularly two of them but particularly V1 that's our largest that we've had FIDVR in. And so we looked at it like it was a pump storage hydro- plan. Really as your implying we should be looking at it to get out of our summer situation. And it's insurance and it seems like it would be good insurance, certainly useful to get air conditioners -- large commercial air conditioners grouped in a resort type setting all on this and to get some load off the system that way at the very time that we are vulnerable to our worst fear. So this is a case of what goes around, goes around and around and around and we just need to come back to that I think.

CHAIRMAN COWART: Anjan's been patient and we're back to Merlin and maybe that's it for this panel.

MR. BOSE: Actually Clark defended the

engineer very well, but usually what happens with these kind of discussions about VArs is I find that everybody is left with the feeling that this question is very fuzzy. But actually the engineering part of the question is not fuzzy. It's very clear. We have to balance the VArs in the system just like we balance the real power and as Ken pointed out there is many ways to solve that problem, there is many solutions, they cost a different amount and so on, but we know exactly how to do it. Where things do get fuzzy is when we ask the question who's supposed to do it? That's when things go haywire. And that's -- some policy maker will have to decide that. We used to do it when we had the vertically integrated power systems. We knew exactly how to do that. We would say the power factor at this point and at that point that work will always have to be won. And you just design the (inaudible) whether it came from the distribution side, whether you did it from the grid side it didn't matter. We knew how to do that and we still do so the engineer

already know how to do that. The other question that always messes this up is if you are going to put a dollar value on it and this is the economics question that Paul adds because how many times they'll try to look at this problem and as Tim pointed out the big issue always is that the answer is very volatile. The dollar figure comes out very volatile so it's really hard to put a market together and so it tends not to be a market and I don't see even with all the communications and everything just because the VAr requirements and the sources have to be localized. They have to be close to each other which makes the market -- which even in the longer run it's going to be a hard market to design. Once some of these policy question are decided if it says that it's the transmission system -- the grid operator whose going to make sure that VArs are going to be balanced on the grid? Okay, so you put in a whole bunch of VSCs or whatever and you get it done. If you want the distribution people to do it, the distribution operator will have to then figure out

how to handle it and then with the DMSs going in today you can do it in real time. The answers are all there, the policies are not there.

MR. TILL: Can I respond? I agree with you that the policies are a huge piece of this but when you say that we know exactly how to do it technically I'm touched by your faith. I appreciate it. When I was running the department I needed people to think that. But the situation -- and this is a variation of it. I don't agree -- I don't disagree with much of what you said but a little piece I think is important and it goes back to what Kim said that we really don't what the loads are. We have made a lot of improvement with DOEs assistance and NERCS and others in getting aggregate residential models better so that we've got the models out there, but there is a key piece of information that we are missing and that's the load research that back when we used to have just a heck of a lot of time to go do things that we wanted to do most utilities that I know of have given up their load research departments

years ago. We don't have that key piece of how much of this is inductive and how much of this is resistive and how much is -- thank you for your faith.

MR. BOSE: I think Ken kind of suggested the answer to -- load modeling has always been difficult and it will continue to be difficult and we'll probably never get it right but you can always put sensors and measure it and that's I think what Ken was saying.

DR. DONOHOO: I think that's one of the things that we're seeing on the syncophasers is giving us the level -- in the past we didn't have the technology to give us that level of detail. The syncophasers are now giving us that level for both the gen. and the load and we're starting to model it. Be careful David the engineers -- actually I wish we knew exactly what the load was. I tell you how we do it now. We do a range at different levels and see where we are at and then we go out and test and see if we go anything so now we're out there doing it but we wish we knew

more, where it was heading, where it was going, but right now we just actually plan and arrange and see if we get into the situation and like in Dallas it was inert category C at the time we did the saves and the plant -- the standards have changed but we went to our management when we found it and we found that over a certain motor penetration level we got into this situation. Our management made the decision we needed to go forward now to get this problem resolved. It was a bad enough situation that we responded. Some of the gaps I wanted to point out, we were talking about storage. I want to plant the seed especially for David's presentation tomorrow. Does battery storage have a place in fixing this problem not just thermal storage?

CHAIRMAN COWART: Merwin?

MR. BROWN: Merwin Brown, University of California, two comments on these exact points, one of them is and I'm probably going to have trouble managing expectation here, we are in the middle of a research project at CIEE developing

micro-synco phaser. We've got some installed. We're now shipping them out to utilities to be put in place for application development. We think that we can use macrosyncophaser to tell you what each customer -- what each distributed generation is doing on the system by using the angle measurement type thing. It may not be that far off before we can do that if you can figure out how to handle all the data and get policy in place and regulations and markets in place to do something with it. The other comment I was just thinking, a lot of the VAr control and VAr support systems are actually energy storage systems. They don't have much ride through, they are very short term. It would lead me to think that energy storage with greater capacity could play a big role in VAr support. Yes, I think the answer to the question is that it really could. Again if you could find a value for it, so someone would put it in for that reason.

CHAIRMAN COWART: I'm seeing the other Ken so I think we're back to you just for

concluding remarks and what you'd like to say about the paper.

MR. TILL: Ken mentioned they got there just in time and the point of discussion and the point of the paper is to push this forward into the planning world so that we're not so rushed for time and don't have the risk associated with needing to put something together in a year as the project that you talked about where normally we wouldn't stretch the organization that way. I felt a lot better about our panel discussion the first time that the EAC and the panel laughed. I cannot overemphasize how important it is for us to be in conversations like this. That drive understanding forward and give us a better idea of what type of understanding we need to create outside this room and that's where the paper is going and I appreciate the fact that it can be informed by excellent panelist and I appreciate the fact that it can be informed by excellent discussion on the part of the EAC. Thank you.

(Applause)

MS. REDER: Okay, the next session is on the smart good subcommittee. There are a few slides. We're going to start with Carlos Coe. He's been working with Merwin on a distributed energy storage paper, so he's going to give us an update and then I will give you some added insight on some other work deliverables and Joe Palladino will follow me quickly on some of the ARA efforts.

MR. COE: Good afternoon, it's always great to be brought after a panel like that. That was excellent. As you know we've been looking at the DES space and one of the things that's great about this space is when you talked about earlier is how quick this market is changing. But first I would go back and tell you kind of what we set out to do, how this has kind of changed a little bit as we've gone through it. The first part was to describe what we meant by DES and we're focused on distributed energy storage that's located at the station or all the way down behind the meter. We also agreed to look at other categories that Tim mentioned earlier that's related to thermal energy

storage and how DES actually plays in what we are going to call the DER space, but also as you look at this DES is actually a very important piece or element in microgrids and so there is going to be a microgrid slant to this discussion and we're covering the broadest possible way to look at it from market to regulatory and interconnect to I'll call it status or technology issues to benefits, codes and safety and again I was describing an appendix that we're writing or including which is going to address DER which will include also thermal energy storage. And the goal of this was to first of all identify gaps and I think gaps her refer to gaps of the broadest possible perspective and last -- by some recommendations and suggestions to DOE. I showed this map the last time. This is going to be updated and I will tell you that from the time that we talked the last time to now we've probably doubled the number of locations. We talk about an area that's changing rapidly that's the part that we mean, this is a market that's changing and it's changing as we're

talking about discussing it. Where this market will change the most -- in places like California which has incentives for these kind of programs but even in Texas this will change it. If you see something cropping up in Texas then you know there's something going on to this. I know if it's in Texas, I'm from Texas so I can just tell you that it's an interesting place to be in the power industry. And that goes back to the recent DS news which our encore folks are still here. But I think as you may or may not know encore made roughly a five billion dollar proposal to the PUC that is focused mainly in distributive energy storage. And that's the idea to put a significant DES resources into a largescale grid system and use that system for not just balancing the bulk system but we talked about VAr support. Another key issue I think that came out of the panel that Charlie mentioned was what happens when we take all of these large scale resources off the grid and we lose inertia. How do we replace inertia? And that's an area that I think storage is

uniquely suited for, to provide what I call synthetic inertia or any other term you would like to use. We also had the announcement from Tesla and Tesla is providing a DS product offering in large scale and that product offering is going to span all the way from residential application to small commercial to large scale commercial. And they've established a pricepoint for that product offering that they believe will generate a major penetration of storage into the DES world. When you look at what TESLA is offering you also understand that's a key contribution also and to Solar City World where there goal is to take a lot of these distributed generation resources, now distributed energy resources, storage resources and package those together to be a major impact on -- in a particular grid or application. And they're -- internally they are looking at the majority of that Giga battery factory capacity to go to the energy storage space versus the vehicle space. In looking at putting this white paper together we decided not just to depend on the

experience set of our panelists. We have great people on our panels, but when you actually went out and did expert interviews those expert interviews covered all the folks that you see on this list. And we got a wide range of interesting items and we basically allowed the interviewers to cover the topics that they thought were important to this particular market. We got a wide range of interesting ideas and perceptions. When we first did this we didn't cover electric vehicles and thermal storage in the interview process. Since then I have covered the EBs with three OEMs. I would call and say I did that informally for a couple of reasons. One we were talking about the idea of using the batteries and EVs as a DES resource. I think what we got from the OEMs said that this is not a technical issue to them, this is a liability issue for them. So they are trying to figure out how to address the liability of using that battery set in the vehicle for reverse flow as they call it. Reverse flow. A lot of them are also looking at the approach that TESLA

is taking, remember going back to the previous stage where TESLA is coming out with a product offering specifically using the same batteries that are in those vehicles in a stationary application. The other battery -- the other vehicle OEMs are considering the same process.

If we take our expert interview objects of recommendations again the market is developing and evolving very quickly and when we looked at that map I said that map would look double the number of sites that have been projected. If you add in the encore discussion and the TESLA impact that maps going to become much more involved. When you look at the market models and the market mechanics we have great application. We have a rate base -- a large weight based example going into -- through the process and then we have what we consider an open market condition where the market and this is happening mainly behind the meter side of it. There appears to be quite a bit of traction going on in developing the DES market certainly behind the meter. What's lacking in

this are what I call DES physical models. We saw that in the discussion earlier about where DOE sees opportunities. I would say models on the distribution side. When you look at the bulk models, the bulk models are I'd say pretty well advanced. When you look at the models on the distribution side they are covered with a lot of what ifs. And so the question is how do you develop models that can be used effectively without getting into as Ken said analysis paralysis, but models that can help drive the kind of meaningful dialogue that's needed to talk about leading into the next topic -- controls. What kind of controls are needed for this kind of system? Is it local versus central? That means if you let the distribution system operate on its own, in a sense with a set of rules or is it strictly controlled by the bulk system? And then obviously what's the interface that ties those things together and how does that look and what's the hand shaking and so forth beyond that? And if you talk to people in this space I think that they

-- I meant the providers, the technology providers in this space, you'll get a wide range of answers of what they think this should look like but everyone is debating a question that we don't have necessarily the models to fully understand it.

The next major topic for this is on the codes and standards and the question is what kind of codes and standards are required for the rapid deployment of -- rapid and safe deployment of DES. And when you think about putting energy storage at a substation that's one level of risk, but when you thought about putting energy storage inside a residential or commercial building and things that's a whole other level of risk. And the question is how do we address that? And I think that what most of the response that we got from the interviews were that those standards should be based on risk, but also should allow the codes to basically cover all types of applications. In essence a plug and play kind of approach which leads into what kind of interconnect standards and when you look at these in some ways when you are

behind the meter the codes and standards should include the interconnect and how that should look.

And that interconnect standard should look like what we talked about -- the standards for inverters and bidirectional inverters, but I think you need to go beyond that and look at a standard that's for a device. That's something much more complicated than just an inverter. A device that has an inverter storage and other control systems around it. And the last part is where this fits in the microgrid development and advancement. And as these systems -- as DS is deployed you effectively are creating the capability for microgrids. And the question is is how are those devices going to be controlled or integrated into the bulk system or how will they operate with or independent of the bulk system. I think instead of giving you the actual recommendations to draft our convention why don't you give me the categories that it appears that these are heading into? And we will basically be fully fleshing out these recommendations through

the two subcommittees both the smart grid and the energy storage subcommittee before we release it to the final committee. And this is the schedule that we're on. We basically have completed all the expert interviews. We are still drafting the recommendations so I would say we are not there yet. I put June on here but really I think is going to spill into July and we do have the guts of the white paper together that we expect to release to the two subcommittees by July. I think the target completion date by September still -- I think that's optimistic to give ourselves time to fully vet out these comments. I do want to go back and say I think the work associated with this is in a market that's actually -- this is probably a timely perspective of a marketplace that's evolved.

MS. REDER: Any questions for Carlos?

MR. CENTOLELLA: I just have one comment. I'm sorry I didn't have a chance to be more involved in this particular paper. But there is another category of what I'll call virtual

storage that I think is actually in some ways -- potentially dwarfs the kinds of things that we are talking about in terms of electrical energy storage and that's the ability to take advantage of the thermal inertia buildings and in water heaters, refrigerators and flexible loads of all sorts and this is a capacity that already exists.

It simply requires a connection to control signals of some sort and actually DOE has done some work through LBNL suggesting that this a very large resource and there was a potential study done in California that looked at simply managing a couple of degrees of flexibility in the temperature, thermostat, a little bit more in water heaters and refrigerators. Essentially a level that customers wouldn't even notice and suggested that the power capacity of treating that like storage would be for the residential class in California, 40 gigawatts, the energy capacity -- 11 gigawatt hours and that's a majority of residential demand throughout the year in California. And that's just in the residential

sector and it doesn't take into account the commercial buildings like this one are going to have a lot more thermal inertia than most residences. This is I think a very high priority area for the department and something that really ought to be looked at in terms of how one could best take advantage of that kind of capability since we're really only talking about how to use primarily existing communications and begin to tap into smart controls of these kinds of loads in a way that could dramatically change the power system.

CHAIRMAN COWART: That's fine and while Wanda is coming up I'll just mention this connect. I've an observation that connects our last conversation to this one. It's just a short story from Europe. The European system operators recently put a proposal to the European commission regarding the next round of standards for major appliances including storage water heaters and the air conditioners and what have you and they proposed that there would be -- required to be

installed in each of those appliances a smart chip that from the get go accept that -- their proposal was that the chip would only be addressable to deal with frequency regulation and not also load management of the type that Paul was just talking about. And numerous people woke up and said why would you want to be so smart that you would enable some frequency regulation off of these appliances but that you would not at the same time make them addressable by demand response program or the equivalent of the thermal storage idea that you just talked about.

And so thankfully the commission woke up and said I guess we better not approve that so they ended up with no requirement. I think at the moment they are going to have no requirement but we're hoping that we can get them to go the next step.

MS. REDER: Okay, I guess with that input from a buildings perspective and thermal inertia we will kind of transition into this smart grid subcommittee report. As Carlos mentioned

certainly his piece with distributing the energy storage is one of the work product deliverables that we have in process right now. We suspect that that will be in final form this fall. Three others that I want to talk about that are in various stages is the ARA project status and the next steps. And I'll talk about that and how it's morphed a bit over time. Also I want to introduce a couple of new ideas. One is to bring forward some reflections on the Clean Air Act section 111(d). We know that's in flight but in anticipation of that I have some ideas of how I might get organized. And then the last one is a microvented work product deliverable which would likely be next year. With that the ARA -- American Reinvestment Recovery Act as you well know was 4.5 billion dollars of federal funds that were allocated as shown in a pie chart there about five years ago. Those project are now concluding and there is a requirement for a report to go forward. In 2016 the systems report and Joe will talk about that. But anyway our thought from

smart grid subcommittee is that we would reflect upon the importance of that effort covering all facets. In fact in some respect it was spelled out by Congress in 2009 that we're obligated to weigh in on this. The approach that we are taking to weight in has kind of changed a little bit over time. We definitely want to talk about the importance that the effort has had in technology adoption.

Clearly there is much more will in the marketplace and I think those of us that are kind of ingrained day in and day out see that now there is enthusiasm for technology. Folks that are in utilities are talking about it with each other. The interest to take on technology and imbed it into day to day processes is there and it's there in spades. I think that ARA efforts really made a big difference in making sure that that adoption about technology is moved forward must faster than what it would have otherwise. In fact, it's truly expedited the acceptance rate market from my perspective. So we want to give accolades where

accolades are due and bring that enthusiasm out in the report. We think from the EAC that's the appropriate role for us to take. Now are the markets there? Certainly we've had a lot of discussion on that. There's a lot of opportunity on the market space and on the workforce development and on the list goes. But technology adoption has certainly come along ways in a short amount of time. In addition to that we also want to take and lay out what we think is next. What does it mean for the grid of the future in terms of a vision? What are the implications, so that there is a bit of a stake in the ground on that forward looking aspect.

And also weave in themes around the change in relationship with the consumer that's likely to happen in the foreseeable future. And we believe in coupling these two facts into the report yet if we can get it out in this fall timeframe when we meet again it's there in a timely way for the smart grid systems report to be done in 2016 because they can use it as an input.

We've been busy collecting numbers and trying to sync up with the plans that are underway within DOE to get the smart grid systems report and the respective schedule put together. And I'll let Joe talk about the language to the extent that he wants to here, but essentially the schedule -- as you look at these pieces interwoven through 2015 there is a bit of a briefing that Joe's going to do shortly. We're in the process of finalizing the smart grid systems report outline. You can see that EAC input. It's essentially our fall deliverable from the EAC. To the extent that we can craft out perspective on how the ARA piece went our vision -- it becomes a bit of an anchor for the report going forward. And then of course in 2016 the actual smart grid systems report will be delivered to Congress with obviously input from a lot of different sources. That's the approach. Soon I will be routing a round paper for more participants in this effort. It's definitely an exciting piece of work and I think a very important one. Switching gears many of you have

been in a lot of different ways in this Clean Air Act section 111(d) which is in flight -- the rules are not formalized. We also know that state by state what the solutions are -- going to likely be different. It's going to be local but we thought there is certainly a likelihood of reliability implications. There might be implications in terms of the coordination.

What's the role of DOE in the federal scene versus at the state level? So we're not exactly sure what scope this might take, but we think that there probably is a role for the EAC to weigh in from a very reflective perspective. So the thought is to have actually a panel at the next EAC meeting that's focused on this aspect because then the rules will be finalized. We'll have more certainty on where we are headed here and that panel then could be a springboard for narrowing the scope on what we might take on to the extent that we want to obviously. So this is early stages but I thought well -- it's well worth teeing up. I think that this is something that

would go across all of the EAC -- any folks that are interested in contributing from any committee. They certainly would be welcome to. We'd need to figure out the organization and the leadership but to the extent that you want to put forward a work deliverable along these lines -- it takes a while to get it organized so it's probably worth talking about it now.

And then the last one that I wanted to mention. Tomorrow morning we'll have a panel on micro grid. As Carlos mentioned the storage piece is a facet of it, but certainly not all. The idea is that the piece tomorrow is more focused on the market viability, the financing, not necessarily the technical aspect but actually how to move this forward more in a commercial respect. And this could be a springboard into a work product that would be finalized sometime next year. So those are the pieces that we have underway in the smart grid subcommittee. I am now going to be really bold and run around some sign-up sheet if you are interested in participating in any of these --

111(d) is the first one. Actually these contain all of the committee efforts from all of the subcommittees so feel free to write names down on anything that you might be interested in. And yes we are going to be recruiting from the new members very quickly as well. Implications of high penetration storage is the second, distributed energy storage is the third, ARA project information recommendations fourth, value of the VAr, grid modernization lab consortium and micro-grids so don't be shy. Now what I'm going to do is have Joe come up and you can talk a little bit about the smart grid systems report and then after that we'll take the remaining time for questions and dialogue.

MR. PALADINA: Wanda asked that I give one slide on the status of the recovery act which I'll do now, hopefully. All of the Recovery Act funds are to be costed and the end of costing occurs at the end of -- by September 30th of this year. Project are beginning to close. They will continue to close throughout the end of the year

-- that's 2016. We've expended almost all the funds on the SGIG side. We will probably have expended most of the funds although it's going a little bit slower on the SGDP side. We released about 14 or so reports in 2014. We'll send you the latest listing of all those documents and this listing has all the links to the documents. Some of the documents for instance -- one of the documents focused in on fault location, isolation and system restoration. Specifically focused on some specific utilities that we're applying that technology and talking about the results we got. Another report talks about the cost of synchrophasors. Another report that talks about the application of electric vehicle charging stations and things like that. We have some very detailed focus reports that we issued last year. This year we've issued the interim customer behavior study report. Talks about things like opt in and opt out and how that has affected customer participation. It gets into how much response we're getting with in some of the

variable pricing programs and it also gives us some cost benefit analysis.

We will issue the final consumer behavior study report in June of next year because those studies are continuing again for at least another year. We'll have some interim special topic reports. There is going to be a final report that we're preparing right now on the advancement and applications of synchophasor technology that's expected out in July of this year. There are other reports that will talk about the application and costs and benefits and impacts of distribution automation technology. That's expected to be out July 2015 and a similar report on advance metering infrastructure and customer assistance which is expected out September 2015.

Final SGIG report will probably be out in the last quarter of this year and then on the smart grid demo program side the recipients are still issuing technology performance reports. These will continue to be issued throughout 2016

and some will be even issued later than 2016. In fact I think one is due in 2023. I don't remember what the name of that one is, but it has to do with energy storage. That's where we are with respect to the recovery act project. Let me switch topics here quickly and talk about the smart grid systems report. Here is another report. It's actually mandate by Congress. We've issued three reports already. It was initiated by a paragraph in the Energy Infrastructure Security Act, Title XIII, section 1302 which asks DOE to submit a report to Congress every two years on the status of smart grid diplomas nationwide. And Title XIII came out in 2007 and the world has changed significantly in this space since then. We've gone through a whole recovery act implementation deployment program, we've got field devices out there, now we've got DNR integration, active market, et cetera.

And so we're taking a really hard look at how we want to craft this report. The language -- the paragraph in 1302 asks us to identify

regulatory or government barriers to the deployment and the continued deployment of smart grid technology. It also talked about the current status of prospect of smart grid development including what the penetration of this technology is in the marketplace, what kind of communication network capabilities we need, the cost of the technology and the obstacles that are currently in place with respect to continuing to deploy the technology and it also asks us to include recommendations or challenges with respect to state and federal policies. And we're supposed to consult with you and the smart grid advisory committee, et cetera on this.

Now one of the big questions we've got with respect to this report is at what level do we write it? And I'm particularly sensitive to the comments that Tom Sloan gave today, because we want to be able to provide insight to policy makers. I think the audience are policymakers in Congress because obviously they ask for it, but also policymakers probably at the state level,

legislators, regulators, et cetera, what level do we rate it at? And what kind of insights do we provide in it that can truly inform these policymakers. And so we really need to think about that. And I say jokingly -- I've said this jokingly but I'm actually half serious when I say this, is we should develop and infographic. And there are very intelligent, amazingly informative infographics and it'd be actually kind of fun to do something like that.

But I say that jokingly but if everybody raised their hand here and said let's do an infographic we would seriously probably consider that. In addition, the other questions that are key questions are how do we describe smart grid technology? We have not been very good at describing the IT aspect of it. We can talk about the operational aspects. When it comes to the evolution of the information management system and the evolution of the sensing communications and control systems we have not been very good at that and how do we describe that in a meaningful way

again to regulators? And then also how do we package the technology so we can actually talk about its current and forecasted rate of deployment. That's one area of questioning. Another one is what are the factors that are driving and enabling smart grid deployment?

And we talked about that a lot. We've talked about the availability of digital technologies and how that is being adopted and how utilities are actually deriving more information as a result of that and it's sort of transforming the utility business space. And their ability to operate in a more efficient manner. We talked about state policies and government policies. State policies driving DER integration. Some state policies actually changing markets and markets at the distribution system level. And we've talked about again with respect to those markets how consumers and third parties are actively engaged in the management and generation of electricity. These are all things that we can talk about, but then we have to be able to talk

about how those drivers and how their affecting the system in how they are transforming the system.

All of a sudden we've got a system where -- all of a sudden everybody needs information and data and data has to be readily available. We need to be able to describe this advanced system especially in the IT area and then we want to be able to address what market regulatory and technological issues will affect the ability to realize the potential smart grid technologies and then again what are those challenges and then how should we address them. Those are the key questions. We'd be very happy to work closely with you or working closely with Wanda to really take a hard look at the questions and to be able to hone and determine how we should craft this paper. Which doesn't have to be long, but need to be focused in just the right way.

Currently we are in a planning phase where we're providing you this briefing on where we are I think over the next two months we want to

be able to develop a fairly detailed annotated outline and I think we'll be talking to current stakeholder groups to do that. We'll be talking amongst ourselves and we will share that with you and then finally after enough bantering we will go ahead and begin to write the report. We have groups of subject matter experts that we are actually working with right now to do that and then go into report development and hopefully have a report ready by December 2016. And that's where we're at. Thanks.

MS. REDER: Are there any comments on the approach for the ARA work product support, seems like a reasonable way to go? Just done for the day? Heather.

MS. SANDERS: (off mic)

MS. REDER: Joe, you got a vote there.

MS. SANDERS: But they can be very effective when you walk into that legislators or regulators office. You've got one page with pictures. You can actually get them to look at it. I support that.

MS. REDER: Good. We certainly talked about how important it is to keep it a level can relate to the regulatory arena. There's been so much detail that's been written and it's been well done. The intent is not to read the detail but to somehow convey the drivers, the importance, the next steps and so thank you for that feedback. Anybody else? All right, we'll switch then, 111(d). Good idea? Carl.

MR. ZICHELLA: Potentially, yes. I think we should look more into this and I think we need to assess what others are doing as well and see that what we are doing is adding value there. I think there's a lot of work going on this this space right now. Also, some of our new members have actually been doing some work in this space too, so we have some capacity there if we need it. But, I think tentatively after we take a look around, possibly we could really add some value there. There are aspects of it that may be not as quite fully explored. We'd consider any of those.

MS. REDER: Excellent. I would just

challenge over the outcoming few months that we think about what role we could play that would be valuable and hopefully that will be leading towards a more fruitful discussion when we meet next time.

MR. MORGAN: On 111(d) as I told you I'll get you some names, but there's a group of folks, Paul Fishbeck, ZHi and Jeff Anderson in our shop who have built a decision support model that models the performance of every coal fired boiler in the country and allows one to go in and do analysis that says suppose the following assumptions. Don't hold up and in fact we only get that and looks at the implications. This has only just recently been publicly released. It's available now. I think this is a resource that might be helpful to -- as the committee figures out what it's going to do and as I say I will get you the contact information.

MS. REDER: That will be great, thanks, Marilyn?

MS. BROWN: Yeah, on this one I think

that the timeline that we talked about in the committee was really more expansive than this maybe would convey. The idea is that the next meeting we would have a scope, not an actual product or even an outline. Just the -- because the final rules aren't due out until mid-summer which I think people are saying mid-August and there's some really big decisions that will -- could play out and would impact what approach we might want to take. For instance, whether or not peakers are included in the CO2 budgets for states is really big and lots of other decisions along those lines. The idea was just to talk now about what role we might want to play, but not do any work until we see how it all evolves, is that right?

MS. REDER: Yeah, that's right, 2016 to look at the role and to the extent that we might to move forward on one so this slide is a little -- missing the year by one. Anybody else?

CHAIRMAN COWART: It's an impressive amount of work and I hope we can mobilize the

brain power of the EAC to contribute really helpfully to the department and one thing I would ask our department partners is to give us and each of the subcommittees feedback on what looks like it would be most valuable to you.

MS. REDER: Thanks.

CHAIRMAN COWART: All right, thank you Wanda. I think we are at the end of the agenda for today. We managed to bring it in --

MS. REDER: On schedule.

CHAIRMAN COWART: -- and a very productive set of panels and discussion. Is Samir in the room, he's not in the room? This is the time where we start to tell you where we are going to be for dinner. What's that say? Maureen?

MS. MALLOY: Maureen, we are going to be eating at Il Forno again, the same restaurant we did the last meeting. Right around the corner yes. All AC and panelists are invited to join us.

CHAIRMAN COWART: We'll be convening over there at 6:00 but I suspect if we show up early they will -- the doors will be open.

Anything further anybody wants to bring up? As I said at the beginning of the meeting today we are set up to receive public comments at the end of the session tomorrow and if anyone has signed up then we'll make sure that the will have time to address the committee at the end of our committee meeting time tomorrow. Thanks very much, we're adjourned.

(Whereupon, the PROCEEDINGS were adjourned.)

* * * * *

CERTIFICATE OF NOTARY PUBLIC

COMMONWEALTH OF VIRGINIA

I, Carleton J. Anderson, III, notary public in and for the Commonwealth of Virginia, do hereby certify that the forgoing PROCEEDING was duly recorded and thereafter reduced to print under my direction; that the witnesses were sworn to tell the truth under penalty of perjury; that said transcript is a true record of the testimony given by witnesses; that I am neither counsel for, related to, nor employed by any of the parties to the action in which this proceeding was called; and, furthermore, that I am not a relative or employee of any attorney or counsel employed by the parties hereto, nor financially or otherwise interested in the outcome of this action.

(Signature and Seal on File)

Notary Public, in and for the Commonwealth of Virginia

My Commission Expires: November 30, 2016

Notary Public Number 351998