UNITED STATES DEPARTMENT OF ENERGY

ELECTRICITY ADVISORY COMMITTEE MEETING

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P R O C E E D I N G S

(8:05 a.m.)

MR. COWART: Okay, folks. I think we are going to begin. I hope everybody had a brisk walk this morning. Our first panel is ready to begin. Mike, I think you're on.

MR. HEYECK: Good morning, everyone. For the record, I'm Mike Heyeck. I'm also chair of the Transmission Subcommittee. We have a number of items to discuss this morning. It's kind of ironic that our resiliency topic has been delayed due to the snow, government shutdowns and the like, so hopefully we'll have a full panel and computers working today.

The resiliency topic actually began with our subcommittee prior to Sandy, and it was an offshoot of the grid security recommendations that came out in October of 2011. The grid security recommendations were very narrow around physical security with high-impact, low-frequency events. Sandy widened the scope, and I think the topic is very relevant today given the chatter about

Metcalf and what we've experienced this winter.

One of the things about resiliency is you always hear about the events like hurricanes and things like that. They make the press. What doesn't make the press is the fact there are a lot of times our grid is -- the margins are very tight, and I think we're going to have some of the panelists to talk about some of the winter issues that we had where some areas were caught with their plants down, so to speak. So, even though we're summer peaking as a nation, sometimes when maintenance outages occur, the winters can be as tight as some of the summer events.

So, what I'm going to do is we're going to have the panel first, and we have a pretty liberal amount of time for that, a good amount of discussion. We will then tee up the resiliency paper, and we have basically five broad recommendations we'll discuss. And then we'll discuss the future work products of the Transmission Subcommittee.

I've asked Bob Curry to be the moderator

of this panel, and Bob doesn't need any introduction to this group. He's served on this group very well for several years. He is a recovering commissioner at the State of New York. I'm going to ask him to come up and introduce the speakers and moderate the session. Thank you.

MR. CURRY: Good morning. This is the easiest job that anyone could have given me, and so I thank Mike Heyeck for that. First I want to say a few words about Mike. When I first joined the committee I was, of course, commissioner, full of ignorance and lack of depth in this field. Thanks to a lot of the folks who are still on this committee and some who have departed, I was able to get up the learning curve enough to open my mouth once in a while, and now I'm incorrigible, and so I really thank Mike for helping me get started in that role.

And second, I thank him for letting me introduce the speakers here who basically have done so much in the area that we're going to discuss that I won't have anything else to do

other than sit down and drink my coffee. So, on that happy note, let me just quickly go through who's here.

David Owens, who's going to lead off. Many of you know him as the Executive Vice President of Business Operations at EEI. He is far more than that. He is a roving ambassador. He covers more ground than anyone that I know both geographically and substantively.

Ralph LaRossa, our close neighbor in New York from PSE&G who was given the unhappy task of trying to figure out what New York was like as PSE&G got closer to taking over the operations of national grid on the ground on Long Island. And those of you who have spent any time on Long Island know that that's, needless to say, a challenge and an opportunity in itself.

Steve Whitley, as many of you know, and certainly the TVA contention here both present and former, runs the New York ISO. Before that he worked in ISO New England. He has a unique perspective on seeing what was transpiring in the

New York City area while Sandy was ongoing.

And finally, Bill Bryan, Deputy Assistant, many of you know from other interactions through this committee and with the department.

So, to lead off I would ask David Owens to give his view from Washington, D.C., both of what transpired, what should have transpired, lessons learned, and anything else he'd like to share with us. David?

MR. OWNENS: Great. Thank you. Well, it's certainly a pleasure to be here today. I'm going to try to set the context for our panel, and give just a little bit of background about our Mutual Assistance Program and how we responded as a result of super-storm Sandy. So, I'm going to get fundamental in the beginning, but then I'm going to pick it up.

I'm also going to touch upon the issue of cyber security, talk about some of the things that we're doing. And if there's any major theme that I would have you walk away with, it's the

evolving partnership between the private industry and government, which I think is very outstanding. I had my doubts when I was involved intimately at Sandy, but I think you'll get a drift of what I'm going to say.

It's great to be here. I just made it. I was looking at my watch. I was on the Metro and I said what's wrong with this train. Speed it up. But again, thank you for giving me this opportunity.

So, many of you are aware that we do have a Mutual Assistance Program that's been in operation in our industry since 1955, and fundamentally what it does is companies sign a voluntary agreement, and when we have a major storm or some other major disruption -- it takes out a large group of our customers -- companies agree to assist one another in their restoration efforts. So, they share line workers. They share tree trimmers. They share data disasters and logistics managers.

At that time when Sandy occurred, there

were nine mutual assistance groups throughout the United States. This map gives you an indication of just the breadth of those mutual assistance groups, and when Sandy hit I had the opportunity of -- well, let me start this way. When Sandy hit we have to have the opportunity to get on the phone with the President of the United States who was very, very concerned about the potential ramifications of Sandy. We knew that this was a storm of tremendous magnitude; a storm that would span many states.

We anticipated that a lot of customers would be without electricity, and so the President said, "I'm going to remove all bureaucracy and red tape." We had our call on a Tuesday. We got a call with the President. We had all of our CEOs on the call, and some of our CEOs got on a little bit late. The President was speaking, and he was talking about how he would remove government bureaucracy in order to facilitate the restoration efforts. And I recall that as the President spoke, one of our CEOs spoke up and said, "Who was

that that was just talking?" (Laughter) He said, "The President." He said, "And what company are you with?" He said, "President of the United States." So, he got everybody's attention.

But in the midst of all of that I had to get on TV to do an interview with CNN, and obviously there was a lot of emotion that was occurring. At that time I think we had six million customers that were without electricity and began to evolve to be even more. And I was asked a number of questions when I was in that interview, and particularly about a Mutual Assistance Program, and in that interview I said in response to a question, I said, "All the red tape is going to be removed. We're going to be working directly with the government." And so the reporter said, "What do you mean you're going to be working directly with the government? I said, "Well, I just off a call with the President of the United States and he said he's going to remove all red tape."

So, really what it involved, it involved

a very massive effort, so obviously I was working with Pat Hoffman and her team and really Deputy Secretary Pondeman. I think I got a -- if there's ever been a public servant that I have a lot of respect for -- I worked for the government for a number of years, but he was so decisive and demonstrated superb leadership in his efforts. So, we worked closely with DOE.

You may recall that we mobilized over 67,000 workers nationwide. Recall that the storm spanned over 23 states and recall as well that there were almost 10 million people that were without electric service. So, it involved a very massive effort, and the President was right because he removed the red tape.

I was detailed by the President to work over at FEMA, so I was over at FEMA for two weeks, and I was witnessing first-hand the efforts, and I'll tell you the first two days it was extremely frustrating because I said to myself, "Boy, are we disorganized," because nobody seemed to be in charge, but as time went on we began to get more

focused and better coordinated.

Many of you are aware of FEMA. Under FEMA, the private industry -- we're not really able to get support from the federal government. Municipal utilities and co- op utilities do get direct federal funding. They get federal support. The Stafford Act is the legislative vehicle that permits all of that to happen.

But anyway, we had tremendous efforts with DOE. I was in the Emergency Response Center at FEMA for two weeks trying to negotiate and work with all our member companies. I had calls with Ralph LaRossa and others. In our industry I think it was really good, and we had calls every day with our CEOs and the Department of Energy and the other federal agencies, so it involved moving crews across many states, and you that. You have to through toll booths. You know you have to have weigh stations. So, in order to move those crews quickly, we had to have some waivers. Well, you can't get a national waiver per se, but the President had issued an Executive Order.

It required us to work closely with the Department of Homeland Security. We had workers that were coming across the Canadian border. We had to expedite their arrival. It required us to have huge staging areas. We were bringing crews from all over the United States, and it meant that we had to have places where the trucks could park, where the people could sleep, and because we never had this kind of a massive involvement, particularly in my memory, on the East Coast -- we had Horatio the year before but nothing of this magnitude.

It required us to use facilities from the West Coast, and I remember several instances where I got in an argument with a general when we were airlifting crews from the West Coast in bucket trucks from the West Coast to the East Coast, from Southern California Edison, from Pacific Gas and Electric, from SMUD, from LAPWP, even from Bonneville Power Administration. Bonneville has the kind of terrain that would exist like in upstate New York, so we had to have

workers. We had to have folks lined in that, were kind of familiar with that kind of topography, and it was just a huge, huge effort.

The National Guard -- we had to have the roads cleared. We had to have water pumped out of substations; tremendous massive effort. We needed to have mobile generators, huge fans, and so I was in the middle of trying to coordinate all those activities, and I will tell you I've got a tremendous appreciation for our people in the field for all the hard work and the dedication that they have.

So, after the storm we had a series of follow-up meetings with the Department of Energy. We call those hot wash discussions, and we looked at lessons learned. The government looked at lessons learned, and the industry looked at lessons learned. And several of the things that came out was the need for enhanced communication involving the government and industry. And so, the government made a firm commitment to embed someone at their national response center. That

was at DEO, but we were embedded at FEMA at that time. I recall that we were -- for New Jersey I recall your President Malvern was on the phone with me about fuel, so we didn't have enough fuel, so we had to have places where you could get fuel. So, coordination of our fuel -- all of those issues are very, very important, and that was a lesson that we learned as well.

We knew, too, that we had to streamline a way that we could get our crews across the nation, so we'd been working very closely with an All-Hazards Consortium. We have an agreement with the Canadian government so that in the future we can expedite bringing our crews across the Canadian border into the United States. We're working with the All-Hazards Consortium.

We're working with state governors so that we make sure that in the future that we'll have waivers so that we can get the crews, so we don't have to go to weigh stations, so we don't have to pay tolls, so we can expedite the transportation of those resources. We think

that's very, very important.

We're working with the Department of Defense. Right now there's a former DOD official, General Stockton, who we're working very closely with to expedite our dialogues with the Department of Defense. Recall that I said it's important that we have roads clear. You get the Core of Engineers and others to work on that.

But it's also important that we have logistics where we have another massive undertaking that we're able to have places where our crews can park their trucks, where people can live, and they can eat and so forth because you don't want to have your staging areas so far away from the areas that have to be restored. We had a situation where, in New Jersey and New York, we would have had to park the trucks about two hours away, and we said that's absurd because the workers would have to drive two hours, then they'd work for eight to ten hours, then they'd have to drive back. We said no, we just can't do that. So, we have hours of service exemptions and so

forth. Again, it was a very massive effort on the part of industry and government and one that I'm very, very proud of.

Now, what do we do at EEI? We said, well, the government acknowledges that there's some areas that need to be cleaned up, expediting the crews, weigh stations, all those things, but we as an industry also need to look at our house, and we need to look at whether we need to make some improvements as well.

So, the first thing that we looked at was our Mutual Assistance Group. We said how can we make it so we can allocate our crews much more efficiently? We said let's look at our spare equipment. Remember I said that Con Ed needed generators. They needed heavy-duty fans because their substations were flooded, and we could not find fans. We could not find generators. We ran out of generators and fans. We knew they were some place, so we said let's just get a better way now that we acknowledge where our spare equipment is. Let's do a better job in that.

Fifty-five percent of the workers in our industry who help in our restoration efforts are contractors. We said let's improve the logistics with our contractors. Let's improve our communications, and let's look at some best practices.

So the first thing we did, we said let's now find a way to re-allocate our crews, and so what we've done over the last year is that we focused on a new approach, and we call this a National Response Event. So, to the degree that we have a major event that causes widespread power outages impacting a significant portion of our population or several regions of the U.S. that requires resources from multiple regional mutual assistance groups, we said that we need to have a way we can do a better job, and so we created a mechanism called a National Response Event.

And when a National Response Event is declared rather than all the prior commitments that have been made -- recall I showed you those nine mutual assistance groups -- so, if you were

in a mutual assistance group and you're allocating crews, and you've already done that, and it turns out that the storm is great severity or the event is of great severity, and the event evolves from being a regional event to being a National Response Event, you made a commitment to allocate crews to a certain utility, you continue that allocation, but now the super-structure comes on top, and it's called a National Response Executive Committee and a national response team.

And what we do under that situation is, with or CEOs -- this is the new schematics -- if you look at the bottom where it says regional mutual assistance groups, this is how we do it, that is how we did it in the instance of Sandy.

But we said let's improve the allocation of crews. So, if you have a National Response Event it means that we need a national mutual assistance resource team. It means that we've got to look at all the crews that are available, and we've got to now allocate those from a national standpoint. And the goal is try to restore

service uniformly across the effective areas, so that's what we did.

And then we said somebody's got to deal with disputes. Somebody's got to deal with governors who are raising Cain and so forth, so we said let's have an executive committee that helps to troubleshoot what goes on, but let's have it all directed from the top down from the EEI CEOs, from all the CEOs in the industry working together and understanding how these crews are being allocated from a National Response Event. So, that's kind of what we've done. We moved it from bottoms up to top down, so we've converged it. So, we took the mutual assistance groups and to the degree that we have a National Response Event, we now have a very efficient way that we can allocate our crews.

We did something else. We looked at the Northeast. Recall that there were three mutual assistance groups. There was New York, New England, and mid-Atlantic area and we converged them, and we created the North Atlantic Regional

Mutual Assistance Group because we had a situation where crews were on the road and governors were raising Cain and so forth, and crews were not being efficiently dispatched or being efficiently allocated. So, now we've consolidated that regional mutual assistance group, and so (inaudible) now is a member of a huge mutual assistance group, and we created a much more efficient and streamlined process.

And we've communicated all this to the government, so we said to the government all the coordination with DOD, with DOE, with DHS, with FEMA, you're getting that in order so we can move these crews across states. We've got staging areas. We don't get stopped at borders, so we've done something too. We've improved our mutual assistance plan, so now it's a national plan, and we can allocate our resources on a national perspective. And we have CEOs, and we have an executive team that directs.

The other thing that happens is those CEOs will be in constant communication with the

government. So, in the past it was DOE Deputy Secretary, Dan Pondeman, and in the future it will be as well, but we'll have daily calls. We have calls 3:00 and 5:00. Three o'clock Department of Energy had their calls. Five o'clock we have a call with the CEOs, so it's tremendous coordination, so we got all of that done. So, that's what we've done with respect to our mutual assistance program.

We've also conducted a lot of drills. So, in the last year I've been involved in four drills that we've conducted. We're going to have a drill, I think, next week or the next two weeks, but we're really seriously testing the vitality of this new organization that we created where we've enhanced our mutual assistance program to now being a national response program, one that can facilitate and allocate resources in a much more efficient way.

But we're also doing something aside from the physical security area. You know this too that we're the only industry that has

mandatory cyber-security standards. And you know that we're moving through the SIPSI standards, critical information, critical infrastructure, protection standards at the FERC.

You also know that we take physical security very seriously, and you're probably aware as a result of Metcalf incident that the FERC has issued an order dictating that there be some standards that come out of the NERC within the next 60 to 90 days. But we've been doing a lot since the Metcalf incident, so we're taking those seriously too.

So, in the cyber security area and in the physical security area we've done something again with the government. We looked at the Electricity Subsector Coordinating Council. This is the council that many of you know that has 30 members in the council. You may also know, too, that is a council which involves industry and government working together, and what we've done there is, again, under the outstanding leadership of Deputy Secretary Dan Pondeman and Pat Hoffman,

we streamlined the process. We improved the process of the Electricity Subsector Coordinating Council. Very simplistically what we've done is, much like we've done with the mutual assistance program, we've made it CEO-driven. So, we have it so that there are 30 members. There are a -- one chair is from the private sector, the two co-chairs are from the public sector. We have all the trade associations that impact the electric structure involved. We have the RTOs involved, and we have a limited number of our CEOs involved. And then we had -- obviously NERC is involved, and we have the Electricity Subsector Information Sharing and Analysis Center, the ISAC, feeding into the Electric Subsector Coordinating Council.

And so what we've done is we've improved the process so now rather than the government meeting with individual industries, the government, all the agencies; DOE, DHS, they all meet with us. They meet through this Electricity Subsector Coordinating Council. So, we've improved the process of information flow and

response, and as I mentioned the government is involved. The electric sector is involved, and external groups are involved.

We coordinate information flow so, for example, in cyber security we're using the government's tools. Ralph is using tools. He'll talk more about it I would expect. We're using their technologies so that we can anticipate a potential cyber intrusion. We're getting security clearances so that we can sit down with the government, so DHS has expedited a number of security clearances so that we can have briefings. So, we've had a lot of dialogue, so we've elevated the conversation which involves our CEOs and which involve the head of the government agencies, so in the instance that unfortunately that we have a major cyber event that we now have a way that we coordinate and speak very frankly with the government, and then we're able to respond very quickly. We're able to look at how we're going to re-allocate our resources because you can't see a cyber event, and we've indicated a way that we can

resolve conflicts. And so we have SAT phones. We are fully equipped.

We've also had drills because you know, NERC had their Grid X2 exercise which was a physical and a cyber threat, and we were participating -- the Day 2 -- and all the government agencies and the CEOs of our companies actively participating in that. So, we've done quite a bit since Sandy heightened all our interests. Now that it's not just about a storm, it's also about other ways that our services can be disrupted.

The fundamental question, all of this, would be substantially improved efforts that we have with the federal government, with our local governments, the real essential questions are how hard and resilient should our systems be? We could spend a boatload of money. The FERC order has indicated that we need to do something in cyber security. For example, we had 55,000 substations in the electric system, so if that order says 20,000 of those substations are

critical. Folks, that's going to cost a lot of money. And we know there are not 20,000 that are critical. We know there may be, unfortunately -- some of the leaks from our dialogues that we had with FERC suggest that there are 150 of those substations -- but whatever the number is, it's going to cost money.

And so, one key question with our state regulators is always going to be cost recovery. We're going to do all we can to keep the lights on. We're going to do all we can to harden our infrastructure and particularly our critical assets, but it's going to require a careful balancing of what the federal government says and what our state conditions say and how we operate with our local authorities. Thank you for your time and attention.

MR. CURRY: Thank you, David, very much. I would ask that we hold questions until we go through the entire panel because David just gave us an excellent view, both of what transpired in Washington D.C. and through Washington D.C. at the

time of Sandy and then the follow- up at the national level.

Ralph, who was named President and Chief Operating Officer, Public Service Electric and Gas in 2006 is going to give a slightly different perspective of what it's like at the hardhat level as soon as Samir helps him do that.

MR. LA ROSSA: Good morning, everybody. You know, David, I like to tell stories when I talk about Sandy, so I'll start out with a story. David talked a lot about the crews and how important it was to coordinate the crews. Well, only in New Jersey this story would happen.

We actually had a mayor in one of our towns arrest our crews, and keep them in the town because they wouldn't allow them to go onto another town to do work. So, when you think about New Jersey and what goes on there, the coordination of crews is even more important sometimes.

MR. CURRY: In the legal business that's called self-help.

MR. LA ROSSA: Yes, it was, until we got the state police involved, and then they figured there was some other law, but I'll let that go.

Let me just tell you a little bit about our company, PSE&G. Basically if you drew a straight line between the George Washington Bridge and the Ben Franklin Bridge down in Philadelphia and went 30 miles on each side of that line, we pack over two million customers into that small service territory, so very condensed, very congested area. In addition, we have large gas utility; 1.8 million customers on the gas side of our business there, and as Bob alluded to, since this presentation was put together a long time ago, we've added an appendage in Long Island, and now we have about 1.1 million electric customers out on the Long Island system as well. So, pretty congested area, and as you look at Sandy, one that was greatly impacted.

We do have a decent track record of reliability, and I won't sit here and pat ourselves on the back. This is a long history.

It was created by a lot of folks, but over the last 12 years we've been recognized for reliability, so I just give you that as a little context for what happened as we went into the storm, Sandy.

And it's not like we didn't have some practice before Sandy hit. There were two major events that impacted our specific area. One was Tropical Storm Irene where we had just under a million customers that were impacted. Mostly, customers were impacted due to overhead damage, so trees came down, and we were impacted greatly on our overhead system in that event.

We also had the early snow storm that came through right also in 2011, which was also an overhead event. If you recall, leaves were still on the trees. We had a lot of snow. Leaves and snow don't mix, so when they came together we had a number of customers that were impacted. That storm, actually while it had less customers impacted, it was more of a challenge for us because there were more damaged locations, and it

was more widespread, so again, a good learning for us. So, we had a large overhead system that was impacted during Irene and a more diverse impact through the snow storm that hit us later that same year.

You've seen this a thousand times, but I want to show it to you to give you a little context about where the storm hit us in New Jersey and our service territory. Remember that line that I said is between New York City and Pennsylvania? And most of our customers are on the northern part of the state of New Jersey, so when this storm came in and hit in the lower center part of New Jersey, we were in the highest impact area. So, the highest winds came in there, and you also had the storm surge that came up into the North Bay which you've all seen many, many stories about. So, when you look at what impacted us, this really was for us the worst-case scenario of what could happen.

That's our service territory and the counties that we have impacted, but you can take a

quick look at the damage that occurred for us. Over 90 percent of our customers were without power after the storm came through, and just take a look at where the heaviest damage was. It was right along the eastern coast of our service territory up in the North Bay area, and that was the first part of the storm, which was the flood surge and how it impacted all of our substations and switching stations.

I ask you to think about this now after we continue to have these conversations about resiliency and the grid and physical attacks. This is no different. This was physical damage that took place at these switching stations and substations and how we were impacted, so stepping back and thinking about everything that's been talked about with Metcalf and everything else, it's the same situation. Instead of it being a bullet into a transformer, this was water into transformers.

The service territory up in the top right -- obviously as you think about the wind

speed and everything else, not as heavily damaged. That's still 75 percent of your system is enough for me, but it was not as heavily impacted as the coastal areas.

These are the switching stations that were impacted, and they were all around that (inaudible) and North Bay area, and you may look at us and say, boy, a reliable utility. Why would you have all of your stations sitting down there?

So, let's think back 100 years when Thomas Edison literally helped lay out the system, and this was all about industrial load. So, if you think about the way the New York metropolitan area was built up it was all about shipping. The products would come in. They would be manufactured, and they would be shipped out, so you want to put your electrical generation next to your load pockets, and that's exactly what was done here. So, we had -- the stations that were built up right in that same area around the bay, and as the population grew we were landlocked, so there was really no place to take those big

critical switching stations and move them out. And I don't need to tell everyone in this room about the challenges we have with sighting and other things in areas, specifically in areas like the suburbs of New York and Philadelphia.

I do like to tell stories. This is a picture of some of the equipment at Sewaren switch, so if you go back to the slide here where Sewaren is, this is the equipment that was in that station, and this is the reason why there was no fuel in the New York metropolitan area. The Sewaren switch was the major supply to the tank farms around Newark Bay area, so if you fly into New York City, if you fly into Newark specifically, and you see all the tank farms there along the turnpike, this is the station that fed those tank farms. They were under water.

So, on the left is some equipment. You can see right there is the water line where the water came in; the storm surge. And these are control panels for that equipment, and that's the water line, so that's how quickly the DC circuitry

oxidized when that salt water hit.

So, when we talk about -- and with all due respect to the President behind the phone and everything else going on, you know what matters? Getting in there with toothbrushes, because that's how we solved this. There were literally people on top of people digging through this equipment with toothbrushes cleaning this all out. There's not spare equipment sitting around. There's no way for us to rebuild this infrastructure that quickly. We literally had to go with toothbrushes and rags and clean all those contacts up and put that station back in three days.

The blue-collar workforce and the work that these guys did -- we did a lot of good things from a white- collar standpoint behind the scenes and it was great coordination, but it was the men and women that were sitting in here that made all the difference that day and that week.

So, that was the storm surge -- came into those areas. We obviously had the overhead damage, and for us a tremendous amount of

problems. You've all seen these before, but again, in the congested areas it bears showing some of the damage and what took place for us in those congested areas in northern New Jersey.

Same story on Long Island, as we look back and see what happened. It was the same type of damage, same type of equipment, same type of storm surge that came to the southern shore of Long Island. Forty-eight thousand tree locations; that's why we needed all those crews. We had to clear off all that tree damage and put all those poles back up. I know this is an electric conversation, but if I could take 10 seconds to talk about gas; the gas system was tremendously impacted as well. As an electric and gas company we mobilely count on those gas employees to come over and help us out from the mutual aid sampling. They weren't there because they were worried about their own system.

At the same we were dealing with everything going on on the electric side, we had 48,000 homes that we had to go into to do

inspections and check piping for every single one of those homes. So, while we had 48,000 tree locations, we also had 48,000 locations that we had to get into on the gas side of the business.

And what does that look like? Well, those are all the meters that we had to pull out in the City of Hoboken because the cast iron system is low-pressure, so you have six inches of water column pressure in the gas system. You have more than 6 inches of water sitting on top of that cast iron, and you have areas of infiltration. You just fill up those mains very quickly. You have to pull out every gas meter and change them out because as you think about the time of year, we've got cold weather coming in. Once you have the moisture into the diaphragms and into all of the orifices of those meters, they'll freeze up, and you won't have any gas service to the customers. So, we had to go in and literally pull out every one of those meters, replace them, test all the piping, re-light all the appliances during that same time frame we were trying to manage

through the storm. There was no book on the shelf to figure out how we were going to get through this event.

So, I wanted to start talking now about what we're doing to try to get ahead of this for the next storm, but again I ask you to think about it in the context of what's going on and the conversations that are happening both from a physical security standpoint and from a cyber-security standpoint.

We are doing everything in our power to strengthen our system, so we made proposals to the New Jersey Board of Public Utilities for us to start making investments to raise substations, to rebuild some of the substations in ways where we have redundant feeds coming into stations that didn't have them in the past, to re- route some of our overhead systems. We put in a -- I think it was around a $3 billion program through the Board of Public Utilities for 10 years to try to get ahead of it. We're still, 18 months later, in conversations about whether or not that makes

sense to do or not.

I know it goes back to what David said about how much is the consumer willing to pay and when. So, we're trying to get ahead of the curve. We've got everything on the table. Those conversations are long and tedious. I would suggest that any opportunities that any of you have in conversations to talk about these things before the storms hit, the better it is. Learn from the lessons that we had in New Jersey.

I also will tell you that every time we look at this and every time we look at physical security in these switching stations that are talked about in the Wall Street Journal and every place else, stop thinking about the individual location. All you're doing is putting a flag up in it, on top of it. You can't raise a flag over a switching station, say here's the problem, without thinking about all the towers that go between here and there. All you're doing is raising a target on where that location is. Think about building redundancy into the system so that

station isn't the only way to get the feed. Build that redundancy into your systems and then you wind up not having some of the challenges that we wound up having.

The City of Newark would not have gone out of power if a station that we had proposed, along with PJM 12 months before Sandy hit, was in service. To this day I still can't get citing for that station, so those are the types of conversations we're trying to have with the policy makers both in this state and outside the state to try to drive some change. It's all about building redundancy into the grid. So, that's a little more detail than what we're doing on trying to make the system stronger.

I'll talk a little bit about making it smarter, so we're talking about cyber, and we're trying to bring in relays and everything else. Well, I'm going to tell you a little story, and I ask Steve before -- there's no press here, right? So, what we say will only stay here? Right?

MR. COWART: No, sir. It's on the

public record.

MR. LA ROSSA: That's okay.

MR. COWART: So, don't use those four-letter words.

MR. LA ROSSA: That's okay. Let me just say this. The Super Bowl, okay, the lights stayed on. It was a good day. It was a very nerve-wracking day, but it was a good day when it was done. I'll give you specifics about what we did.

After last year's event there was a lot of chatter that was out there about what we were going to do and how people might want to attack, and that day on social media there were folks all over the place. I'm going to dial in. I'm going to shut down the Super Bowl. You wait, blah-blah, at the McDonald's doing their ads about the lights going out again in the Super Bowl, everything else.

So, you know what we did in that specific case? We told all the consultants, "Thanks for your advice. We just pulled the pins

on SCADA." We pulled SCADA off everything on that day. There was no worry about cyber because we just disconnected from any opportunity for anybody to dial in. It was cheaper and a better solution to pay 12 blue-collar guys to work double-time on a Sunday in a station because we all know how to run the grid the way we did 50 years ago.

So, each one of these individual situations that you have, whether it be, again, a cyber attack or a specific thing like trying to keep the lights on in one building for one day, look at those things on an individual basis, and you come up with different and unique solutions. That came from the ground up in our organization. So, what were we worried about? (inaudible) were going to pay millions of dollars. Just pay us a couple bucks to work on a Saturday and a Sunday, and we'll solve this issue for you. And it took a lot of the angst away from the situations that we were having that day.

So, I do believe the time is right to make these investments, and here's why. This is a

slide that we use in New Jersey when we're trying to talk to people about making sense on making the investments. You create a ton of jobs. Prices are down. Just look at what the price for a consumer for an electric and gas customer was in 2008 before we found Marcellus shale and what it is today. We talk about Marcellus shale. We talk about all the benefits of it, some of the challenges that we're having on the environmental side, but at the end of the day prices are way down for consumers. Now's the time to make that investment on the infrastructure side. Keep in balance everything you need to do from a consumer standpoint; PC, you've got to keep everybody happy, but this slide here shows you everything you need to know about why it's the right time to make those investments.

Prices have come down dramatically for consumers. Even if we did all that work that we proposed and we project out, in '18 prices would be lower for consumers because some other things are coming off of the customer's bill. And if you

just kept commodity prices flat, which everybody thinks gas will stay around $4 or $5, we'll have these little spikes based upon winters like this, but we have an abundant supply. It's going to feed both the gas customer and have an impact on the generation side of the business as well. That's our story, and we're trying to stick to it. Thanks.

MR. CURRY: Thanks very much, Ralph. Our next speaker known to many of you is Steve Whitley who is, as I mentioned earlier has been running the New York ISO for the past -- going on six years. Steve is a balanced, capable executive, relates well to the Public Service Commission which isn't always easy. There are some annoying commissioners on the New York commission, but he managed to get past that, and you'll be fascinated by the view from up the river, as we like to say in New York.

MR. WHITLEY: Thank you. Good morning. It was good to be with David Till last night. He and I worked together a lot when I was at TVA, and

of course Gordon and I worked for a long time, too, and it seems like every place I go the mother of all storms happens. And at TVA I remember we had the storm of the century in '93 with a snow storm, the storm of the century in '94 with an ice storm. The snow storm took out the eastern one-third of the system. In '93 the ice storm took out the other side, so the good Lord came back and got even, you know.

And I guess it was the ice storm that hit western TVA that knocked out all the distribution everywhere, and we ran the war room at TVA, and Terry Boss and I ran the war room, and it was just the same kind of thing on a smaller scale that Mr. Owen was talking about that they were trying to do at the national scale in the Northeast. But managing crews and supplies, housing, is an enormous undertaking. Getting enough chain saws in our case down South was very important.

But Sandy was an even bigger event, as Ralph mentioned, and it certainly hit New York,

and I want to try to talk more about Sandy from the bulk-power system perspective. Ralph's talked about it from the customer side, the distribution side, and all the obstacles that were seen there.

But looking back at what the grid operator has to do at the bulk-system level, our mantra is as we go through outages, position the system so it doesn't become a cascading outage. And so whether it's a local event that might knock out one or two substations or a big storm event that can knock out numbers of lines, our job is to stay on top of that, get prepositioned for it, and be able to manage during the event to keep a cascading outage from happening, and then restore the system as soon as you can, honoring all the NERC rules and making sure you're always protected for the next contingency all along the way.

And Sandy was huge; estimated $50 billion impact to the east coast, 8 1/2 billion customers. Ralph mentioned the number of utility workers, and utilities across the country that participated.

But let's just talk about the bulk system in New York. We planned the system as planners and operate the system for, we think in New York we're conservative standpoint, we plan for actually N minus 2, so we can simultaneously under peak events lose two bulk-system elements at the same time, and still not have a cascading outage. That's our criteria. And most of the country plans to N minus 1, and you have a requirement to plan for N minus 1 minus 1 meaning after 30 minutes after you lose the first element, you have to be ready to lose the next most critical element in 30 minutes.

Sandy in New York alone, we had 90 bulk-system elements out of service as the storm progressed and went along its way. We lost all the tie lines into New York which were mainly DC tie lines which you think of -- those were pretty well protected for storm events because most of it is underground, but we lost every one of them into New York. New York City lost all of its ties to New Jersey.

As Ralph mentioned, there's a lot of resources along the coastlines; substation resources as well as generating resources because that's where the load is. That's where the water is. And it has been developed that way with good principles in mind, but this particular storm was -- brought the water -- just think of Fukushima, as well. That water knocked out every resource they had at Fukushima. They had redundant power supplies at Fukushima. They had batteries. They had diesels. Water just took it all away, and that's what water can do, wind and water.

And so, in New York what we did to position the system for the storm was we picked up a lot of additional generation ahead of the storm anticipating -- in most storms what happens is you lose a lot of load, and often you don't lose a lot of the bulk system. If you lose a lot of load and so high voltage is your biggest problem. You lose load, you have all this line charging on the bulk system lines, and you have a lot of high voltage, so we created a lot of surplus on the grid before

the storm hit to be able to absorb bars on the system to keep the voltage down.

And then as the storm unfolded, of course you start losing elements, and then you lose load. And so, our job in the control room was to be in a position to know what's going on and analyze the system as things continue to change all during the event to be ready for the next contingency, and that meant shed load if we needed to in some areas. If we got beyond limits, switch lines out, change generation patterns, whatever, all during this event to know what's going on, posture the system for the next event.

And so, what actually happened, as we lost all these elements, we lost a lot of load at the same time, and our engineers and operators were able to simulate the system conditions through the technology we have, posture the system, but we never actually lost synchronization of New York City with the rest of the grid. Even though we lost all of these elements interconnecting southeastern New York with

Connecticut and New Jersey and all the power plants along the coast there, the overhead transmission from upstate that comes down very high down into the city was all maintained, and so that kind of tells you the value of diversity. Not just diversity in power plants, but diversity in transmission to have multiple capabilities from many different sources; some underground, some overhead, and some on high ground, some on low ground. That really kept New York City synchronized with the eastern interconnection and kept even a bigger problem from happening. And we were able to restore service a lot faster to the bulk system, and actually the longer restoration time, of course, is all the damage at the distribution level.

So, all of those DC connections that we all thought were super-reliable -- if the terminal stations get flooded out they're useless and that's what happened. And so that's about the worst event -- I've never seen an event that takes that many elements out of service, and that's just

New York, and Terry has a similar presentation like this for PJM, and it was even worse over there, so this was a huge, huge event.

We experienced the lowest load in New York we had had in many, many years because of loss of all those customers, and it really was a great coordinated effort between the various transmission owners, the ISO, the generation owners. We were able to track the storm surge at all the plants and predict which plant was going to go off next, and having that information really kept our system postured in a good position to anticipate the next thing that was going to happen.

So, as the system operator we were positioned to shed more load if we needed to. If things got unbalanced and transmission security became an issue in a pocket of the system, we were positioned to shed more load but we didn't have to. We were able to handle it through generation dispatch and monitoring and switching when it was necessary.

All the communication system worked properly. It was excellent coordination within MPPC, between PJM and New York, and New York and New England, and certainly with the government agencies.

A number of initiatives have taken place. After the storm in New York, the governor actually formed three different commissions to investigate the storm readiness, the storm preparedness, the follow-up, the resiliency, and a lot of initiatives have happened in New York similar to the ones Ralph talked about. I know at Conn Ed they've done a lot of work already to secure sealed conduits to protect for water, and have relay panels that can be lifted above certain elements, and a lot of work has been going on.

And to further the redundancy and the diversity of transmission, there's a lot of work being done in New York now to bring additional capability from upstate to downstate, overhead down to New York City from upstate where there's a lot of surplus green resources that can't get

there now due to bottlenecks on the system, so a lot of work is being done in New York.

You probably heard the initiative, the governor's Energy Highway. It's a set of transmission projects that probably should have been built about 30 years ago, just to rebuild the existing right-of-ways with more capability to move power from upstate to downstate, and from the western part of the state to the central part of the state.

So, a lot of work also is going on in New York along the lines of the topics you all talked about yesterday; microgrids and distributed resources. Ralph Masiello is working with us in New York to help us out at our level in the marketplace to coordinate with what the PSE's trying to do, and so we're trying to figure out how to tap that resource both for storm events and both for day-to-day operations as well to optimize what potential there is there for grid operations and for consumers. Now I need to go to that other presentation.

Now I wanted to change gears. Mike asked me to talk a little bit about the winter. You don't have the latest presentation. Let me just go ahead and talk about the winter without the slides. I think Gordon may have talked to you some about it the other day, but I would classify this winter's cold snap, series of cold snaps, as a wake-up call for a lot of us in the eastern interconnection.

Even though we've had colder individual cold snaps in the Northeast, at least in the history I've been looking at, we haven't seen as many that are as sustained as the cold snaps we've had this winter. And Gordon and I experienced the cold snap in 2004 when it got to be minus 10 for about 5 days in a row in New England with very heavy winds. This time we've had a number of cold snaps.

In fact, five since January that have really stressed the infrastructure, and we've all been concerned about the gas infrastructure. In fact, Pat Hoffman has helped us sponsor a big

study that we're doing with New York, New England, NYISO, PJM in Ontario, and TVA, looking at -- the study's aimed at looking five years out when there's even more gas plants on the system and even more gas demand to evaluate the coordination between the pipeline system and the electric system to see what kind of problems will exist. And it's a dynamic analysis looking at what happens when you suddenly lose pressure or lose a pipeline. I think we got a preview of what that study's going to show us by what happened this winter.

So, a lot of systems, because of this cold weather, set new all-time peak winter demands. In New York we set a peak, as well as NYISO, PJM, TVA, and Southern Company, so the Polar Vortex was very wide and went very deep. And I think what has been pieced together now is that with the demand for natural gas in November was higher than normal. And December was higher than normal. January was higher than normal on steroids, and so the ability of the supply to keep

up with the demand through depletion of the storage really has caused a lot of problems. And so we've had to rely on alternate sources to get through these kinds of conditions, and because it's been sustained, it's really stressed the system. Gas prices, of course, have gone extremely high; so high that actually oil is cheaper than gas.

In New York we have a lot of duel fuel capacity in New York. We have 20,000 megawatts of gas power plants, but 17,000 megawatts of that has duel fuel, but the duel fuel isn't designed to sit there and operate for 90 days. It's a very limited supply to get through a cold snap and get the fuel replenished.

But this event was so long and gas supply was so short that we had to run oil a lot, and so our operators had to manage the day's supply of number of unit hours left at each facility, treat it like a limited energy resource, understand from the power plants what deliveries they were going to get for oil. And, of course,

that was a probabilistic prediction because nobody really knew, but you got some pretty good ideas. And then day after day the trends started getting established, and we were able to predict that with certainty and really manage the fuel that we had, many times having to go back to gas to preserve the oil that we had to get through the next few days of cold snap until more deliveries could be obtained.

We have some plants in New York that you don't get new deliveries until May because the lake's frozen over, and you can't get fuel to it. So, it was a real wake-up call. It really tells us the kind of world we're headed to when everybody's on gas, and any time you're on a one-fuel resource, you're looking for trouble. And so I think we've got a lot of work to do and a lot of lessons to learn from this.

Climate change certainly has affected the peaks in New York. The previous summer we set a new all-time summer peak with six days in a row of 100-degree weather in New York. And then this

winter we set an all-time winter peak. So, the summer peak, performance of the resources in New York was outstanding. We actually went through that summer peak, and on the peak day which was a Friday in July we only had one unit in New York that was unavailable to run to meet the load during that summer peak. So, the availability of the fleet was just outstanding.

Not as good this winter. The winter weather was very stressful on equipment, operations, and almost everything. I don't know if you saw the picture in the Wall Street Journal. Niagara Falls froze, so we actually lost a lot of megawatts because of that. Circuit breakers in Canada, SS6 circuit breakers -- the gas liquefied and we lost substations that impacted interchange into New York from Canada. There were key problems on a DC lines into New England that we all had to work together to make sure the power flow would stay at a certain level to keep that line in service.

But there was really good coordination

between the ISOs. PJM really was stressed more than any of us because these equipment issues were so widespread, and it was maintenance season for them. I think they had like 40,000 megawatts out of service when this hit, and so they got very tight. We were tight, and Gordon wasn't quite as tight and was able to pick up some additional generation and sent to us, to PJM. We actually interrupted our DR on the worst day to send more power over to PJM so they could maintain their reserves.

So, the coordination between the ISOs was excellent, but this was a very widespread event with cold weather all the way from the Midwest to the East Coast, and it was sustained. So, I think it's really a wake-up call for all of us to look for lessons learned and other market policies we may need to implement, reliability policies we may need to implement to help protect ourselves from these extreme kind of weather events.

FERC is having a technical conference I

think on April 1st to start looking into this, and I know the ISOs are getting together to do the same thing ourselves with our operations folks. So, I wanted to throw that in there, and if you think about Metcalf, you think about the storm events and the extreme weather events, you can see that the bulk power system can get stressed many different ways. And at the end of the day though, we have to depend on our operators and the tools they have to understand in real time what's coming at them, be prepared for that, and be able to respond, and operate their resources in a way to minimize the damage and restore the system. Thank you.

MR. CURRY: Thanks very much, Steve. That was very instructive. Now, Bill Bryan is up. He's Deputy Assistant Secretary for Infrastructure Security and Energy Restoration in the DOE's Office of Electricity Delivery and Energy Reliability. The Office of Infrastructure Security and Energy Restoration works with the National Security staff, other government

agencies, and international partners to enhance the security and resiliency of critical energy infrastructure and facilitate the reconstruction recovery of damaged and disrupted energy systems. Bill?

MR. BRYAN: Thank you. Thank you very much. Good morning, everybody. Thanks for the opportunity to be here. Welcome to my colleagues at the table. It's always an honor and privilege to be with them, and the good news is I have no slides. Right? Bad news is I can get long winded. When I know we're under time constraint, I'll do my best to get through this as quickly as I can. But I also have to tell a story.

You know, when you watch a movie and, you know, imagine these movies where they jump into the movie. You're right in this plot, right, so right from the bat there's excitement in this movie. And then so long into the plot you get this little subtitle that says "Two weeks before," or "One week before." So, there's a context to this plot. They want to get you in on it. David

Owens launched you into a plot during Sandy, right? He was thrown into this plot.

What I'm going to is I'm going to put that subtitle under that plot that says "24 hours before." He was right in that the event he walked into was chaotic. Twenty-four hours prior to him showing up, here's how the day went.

"Bill," -- I was talking to Deputy Secretary Pondeman. He says we're going to have this emergency response team. In a few days we're going to set this thing up at FEMA, so the invitations went out for everybody such as EEI and others. The (inaudible) PPA was invited. NERCA was invited to participate, right? So, we're going to have this energy response team show up at FEMA.

I said, "No problem, sir. We'll make that happen." The invitations went out that night. The Deputy Secretary calls me up, 10 or 11:00 at night. He says, "Now, Bill, we're good for tomorrow, right? We're going to have this team in place?" I said, "Yes, sir." He says,

"You're going to run it, correct?" I said, "Yes, sir. I'm going to be there. I'm going to take care of it." He said, "Great, we're ready to go. I'm going to be in the morning. I'm going to kick it off with Fugate and then you're going to handle it, and I'm going to leave." I said, "No problem. We got it."

Well, let me tell you what happened the next morning. The next morning people started meeting, and I told the Deputy Secretary, "All right, sir. You're going to kick this off. I've got to go into a VTC."

So, I went into the room with Secretary Napolitano and many of the other interagency partners around this VTC. Pat Hoffman is in the VTC back at the Department of Energy, and she and I are actually texting. And I'm saying, "Hi, Pat. Here's what we're going to do." So, Pat's going to kick off the VTC in front of Napolitano. She's going to pass it over to me during the VTC to give an update. I was in the room with Secretary Napolitano, so everything was going well.

Just prior to that VTC kicking off, I get a White House representative stick their head into the room, and he does one of these numbers, so I go out into the hallway. I say, "What's going on?" They say, "You've got to get to the airport now." And I said, "I can't go now. My boss is on a VTC. You know, we have this emergency response team." No, no, no. Rich Serino, who was the Deputy FEMA Administrator, is on the runway at Reagan National with a two-star general from the National Guard, and they want you to be part of this team that's flying into the region, and you've got to go right now." I said, "I don't have any luggage." "That's fine. You've got to go."

So, I had no opportunity to tell Pat I was leaving. I had no opportunity to tell Pondeman I was leaving. And so, I'm in this panic trying to communicate with them, and no one's answering anything. I couldn't get through to anybody. Pat was on the VTC and says, "I'll turn it over to Bill," And Napolitano says, "Bill's

not here." Right? Where'd he go? So --

MS. REDER: You're lucky you didn't get fired.

MR. BRYAN: That's was going to be my next point because when I finally got through to Pondeman it was on the runway, rolling down the strip, and I had my phone, and I get this text from the Deputy Secretary. He says, "Where are you?" That was all it said. That's not a good message to get from the Deputy Secretary, and it actually took John Brennan to bail me out from the White House saying this was our idea. Let him go and go his thing, so that's how that happened.

And from that moment on Deputy Secretary Pondeman kind of absorbed that role being in the FEMA running the ERT, and I was downrange in the field for 10 days, still without luggage, by the way, absorbing all that was going on and working with some very fine folks, Bill Aboss being one of them from PSE&G, and the work he was doing at Hoboken and getting some of those substations back up and going again, so it was tremendous.

But again, I want to thank you all. Of course, my role in the department as one of Pat's deputies is infrastructure security and energy restoration. We accomplish that through partnerships, through emergency preparedness, and response activities dealing with all hazards, not just weather events, not just FEMA-activated events. We're very involved in the propane shortages across the country this winter, so we involve ourselves with events even though we're not activated from FEMA.

Sandy, though, was very unique. It was unique on several fronts. Number one, I don't know if you did the math or not, but there is a figure, a calculation for a meter to a person. You know, how many people equates to a meter being without power? In New York and New Jersey, because of the dense population area that factor changes a little bit, and by some estimations 18 percent of the population of this country was impacted by that event. Eighteen percent of people; not meters, but people were impacted by

this event. That was huge.

The largest mutual assistance deployment we've ever seen, as was mentioned earlier. It was also coupled with a snow storm after the main event, which didn't help restoration very much. And the impacts of the supply and distribution of fuel really exacerbated the problems, so it was not just a big electricity event. It was a big fuel event as well; a shortage.

And, of course, it was also a week before a national election. Don't think for a second that that did not have an impact on how people responded to this because the President got very involved, and I was actually sitting in a meeting with the President and three cabinet secretaries and Fugate when the President looked at the cabinet secretaries and said, "Your only job until this is fixed is Sandy." And he pointed at Fugate and said, "That man's in charge, and you'll do what he needs you to do." It was a very telling event.

So, you know what? Senior people who

normally wouldn't get involved at that level in these events got very involved in this event. And unfortunately, a lot of them don't recognize the processes and procedures that are in place when these things kick off, so it was an experience that we endured and we had to go through.

But our goal at the Department right now is to become more prepared and more adaptable to be able to handle these events as we go forward. We're seeing more intensity and more frequency of these events. The good thing is we're almost in the springtime, so we only probably have seven more weeks of snow left before we get into the spring. I don't know.

All right, but we are taking this responsibility very seriously, and I'm going to share a little bit about larger categories of what I see on the ground and then what we're doing as a department not to repeat the fine work from industry, and I've got to tell you, I will stand up and fight anybody that says industry's not doing their share to try to fix this problem. I

truly see it. I'm part of it. A lot of people just don't understand all that it requires -- industry to get involved in doing this, but I salute all of you around the table for your efforts and work and pushing these things forward.

So, three big categories of observations I made when I was on the ground. First, legislative and regulatory issues. There were a lot of regulations and legislative activities or laws in place within the states that made things difficult to move product back and forth between the states and to get some things done. Right?

Now, the response is at a regional level, but you've got all these states with different rules and regulations, and it was actually slowing some things down, which is one of the areas that we hope to really fix going forward. New York and New Jersey both took steps regarding getting gas stations on high-evacuation routes ready to go to receive generation power during an outage going forward, right? So, they've taken some big steps already to fix some

of that.

The second one was policy and process issues. A lot of them were local. There was information and communication issues as part of that, right. Inadequate situation awareness of fuels, and I was visiting mayors in several different communities and while I was on the ground, at first I've got to tell you I didn't know why I was being sent. I really didn't know. Why am I being sent with this team to go down there?

And all of a sudden I'm sitting in a car with Rich Serino and the general from the National Guard, and I had a White House liaison in the car with us. And next thing I know the White House liaison would tap me on the shoulder, and he says, you've got to go to Colt's Neck, New Jersey, or you've got to go to Hoboken, or you've got to go to this location in New York. And I'm saying where you getting this from? I had no idea where this was coming from.

Well, come to find out, the President

has stood up an emergency number, and he told the mayors and community leaders that if you have a problem, any problem, you call this hotline. And I've got to tell you the hotline worked because when they called the hotline, the hotline called this guy sitting in the car next to me, and he tapped me on the shoulder and said go find out what the problem is and get it fixed. And he just happened to have an (inaudible) I said how do I get there. He said we got a car for you. It's right behind us. And so, they brought me a car and a driver to make sure I could attend to some of these problems, so it was very effective and frankly very efficient.

So, I had the opportunity to talk to several communities and mayors and leaders and local leaders, and one of the issues that they had was situational awareness of timelines and restoration. That was troublesome for them. They were trying to move goods and services to take care of the people, and not saying this happened in every case, but some of the ones I was talking

to, they were being told that substation A would be up and running soon, but no one could tell them what substation A provided power to. And not saying they couldn't have. They just didn't. And so, some of these mayors were very confused and concerned about how they staged equipment and materials if they didn't have that kind of situational awareness.

Frankly, many local communities didn't even know how to assess their own critical assets. They didn't know where their large loads were. Right? They didn't do that time to preplan before an event and work with the utilities to kind of figure that out. So, we showed up with generators. They had no idea how to prioritize where these generators ought to go. So, there was a lot of developing of the process on the fly as we moved along.

There were also some issues with access and resources. Mentioned crews coming in across the border, crews getting into certain areas, crews getting arrested and being held back in

certain locations because the mayors didn't want to let them go, or the governors didn't want to let them go to move on, so we saw a lot of that. We saw generators being diverted because of conflicting priorities. People come to the federal government and want us to prioritize, and you know what? The states prioritize. And even when the state, counties, and cities have to put their requirements into the governor, and they make that call, and I can tell you I was sitting in Hoboken, New Jersey waiting for generators to show up on three different occasions and see the entire convoy get re-designated to go someplace else. I'd say where (inaudible) happen? Right? But it happens. It happens. So, we saw a lot of the conflicting priorities and frankly, states have to work that out. They've got to work that out.

There were some equipment staging and lodging areas for crews coming in, and another big thing is the shortage of electricians and pipe fitters. I will tell you, people, citizens, do

not know how much industry did to actually bring in electricians into that process where really, frankly, in previous was not really their job to do, still isn't their job to do. I think some of them are re-looking this. But we certainly see a need to have almost like a mutual assistance core of electricians and pipe fitters that can go to these events to certify if these places are able to receive gas, if they're able to receive electricity, and it would really speed up the restoration process.

David talked about the steps made in mutual assistance, and I, myself, personally, saw a convoy of 30 trucks alongside of the road for three days, and they never moved. And I didn't stand watching for three days, but in the course of my travels I passed them three days in a row, and I actually stopped and asked the guy in the front, what are you doing? He said, well, I'm waiting for direction. Have you told anybody you're here? Uh, no, they should know I'm here. Who you working for? I'm not really sure. That's

a problem, and the thing of it is, that is not -- those are bits and pieces of what happens. That's not the big picture. I view the mutual assistance program as a tremendous program, but that is what gives it a bad name, and it's unfortunate but it happens. Right? So, I'm glad to see steps are being taken to manage that a little bit differently going forward.

Of course, the third piece was the need for a lot of the equipment hardening and you've gotten the talk about what the utilities are doing in that area, so I'm not going to beat that to death.

But going forward, what are we doing? The Department, led by the Deputy Secretary, is standing up an Incident Management Council. It was recognized that the office that Pat has and the team that I have, you know, frankly, the expectations are growing increasingly on what we need to do, and it's no longer just a situational awareness capability, but there's an analysis capability. It is much more than just storms.

It's all hazardous events that we have to deal with.

We have expertise within the entire Department of Energy that needs to be better leveraged and used in these events, and one of the ways that the leadership within the Department of Energy is getting the attention of these other program offices is they to have this Management Council. Pat is de facto executive secretary for the Council right now, and they're looking at the wide range of how we manage incidences across the board no matter what they are, from a Deep-water Horizon to a disaster of a hurricane to a Fukushima event. So, it's pretty broad and it's big, and this council is represented by all the folks -- all equal to Pat Hoffman's rank as an assistant secretary, and it's going to prove to be very valuable.

The CEO calls Dave mentioned, they're a good thing. And all you around the table that are in leadership positions and CEOs of companies, where do you get your information from? You get

it from your folks. You get it from your teams. Right? And you get that information so if you bring it into these CEO calls, let me tell you what happens on the other end. My secretary and my deputy secretary, want to know, "Bill, what are they going to talk about in this call?" I don't want to be surprised. So, we have a problem if the first time he hears from the CEOs of what the CEOs need comes from them rather than coming up through the channel, we're behind the curve 24 hours because he's going to turn around, and he's going to say how come we didn't know about this or how come we haven't started working this. So, you know, Gordy Howe -- and I know I'm running short on time. I got the sign, so I'm getting the sign. But I've got to share this.

Gordy Howe was once asked -- Gordy Howe is, as you know, a Hall of Fame hockey player -- was once asked what makes you a great hockey player. Now, I've used this illustration before but -- what makes you such a great hockey player? He said a good hockey player skates to the puck.

A great hockey player skates to where the puck is going to be. Right?

We have now the expectation to identify where that puck is going to be. We don't have the luxury of just telling the leadership here's the situation. We have to tell the leadership here's the situation. Oh, by the way, if we don't fix this today, in three days from now this is going to be the situation, and we have to get ahead of that.

For the sake of time, I can't go into too much detail. We were very fortunate in this current FY15 budget request to potentially have some added resources that we're going to be able to put out to the field to streamline our communications process back and forth. There needs to be permanently assigned people in the people interacting with industry, bringing industries, local governments, and utilities together to be better prepared going forward.

What can the communities do to better prepare themselves? Also look into build an

energy resilience and operations center within the Department of Energy as an unclassified ops center open -- because when we have -- when the ERT has occurred at FEMA, well, now it started happening within the Department of Energy, so we need a state-of-the-art operation center with all the right feeds coming in and to accommodate industry, to accommodate our interagency partners, and to build that environment for better analysis to be able to feed the leadership and the White House going forward.

And also very recently we just piloted an app called Lantern. It's an application. We had Presidential Innovation Fellow. He developed this app for us, and this app is going to do several things. Number one, it's going to put power in the hands of the citizen to be able to identify what gas stations are opened and closed and report that via Twitter and other social media feeds, and we're going to be able to map that. It's also going to allow them to take picture of infrastructure that's damaged and downed power

lines and get that geo-located on a map, so industry will be able to pull from that and see what images are coming in of these things. It's also going to allow citizens to look at what -- it's going to automatically default to -- based on where their phone is, to who provides power for that area, and it's going to divert them to the website of that company, so they can actually see the outage map and the website of the company that's putting those numbers out there.

So, it's a pretty good tool put in the hands of the citizens, and we're piloting it now for the next two to three months. I talked to Matt Rosenbaum. I'm going to give him the link, and all of you are invited to download that app and be part of that pilot and provide feedback; what you think it could do better if you have problems with it and ask questions about it. And then we'll seek to build that into the app and make it better and stronger.

There are some other things, but for the sake of time I'll put them off, but I want to

thank you for the opportunity to be here, and enjoy the rest of your session. Thank you.

MR. CURRY: Thanks very much, Bill. I think -- I'm a little bit astounded that I -- oh, Claire's finally getting a card up. It's the first card to go up. By all means, Claire, why don't you start off with questions?

MR. MOELLER: Thank you. As always, disaster recovery is an interesting topic and something we all need to pay attention to. The question that I'd like to ask is kind of a question about a question. The lessons learned all seem to be appropriate. It all seems to be good stuff. What lesson should we take from the fact we did not learn these lessons from Katrina? And so, what should we be doing to move forward and not just learn the immediate lessons from this, but instead think about why did we not learn these lessons in 2005, and what lessons are we missing as a result of our focus on the immediate issues that Sandy represented?

MR. CURRY: Does anyone want to field

that one?

MR. LA ROSSA: I'll give it a shot. I think -- we need to talk about what's gone on at the distribution level maybe. And I think the reason is is because Katrina was looked at as a state event, right. So, I'm going to draw the flip of that which was the blackout that took place in 2003, which was a federal event, and FERC stepped up, and in my opinion did a fantastic job of setting the tone for how that was going to be fixed. And so, industry responded to that.

When there was an incident that took place in Louisiana, the folks in New Jersey said, "That happened to Louisiana." And what we've got to do is we've got to get people to think about it more generically as an event for each one of the states rather than wait for the federal government to -- I mean -- say this the right way. We all have to take individual accountability. We can't wait for the government to come in and solve all our problems, and once we as a society get -- I don't want to get too philosophical -- get over

that, we're going to be able to do more things like learn from the lessons that happened in other places.

MR. OWENS: And I would just augment what Ralph said. I think going forward -- I explained the national response event, so in retrospect, would we have considered Hurricane Katrina a national response event, and I would say because of the wide-scale disruption and loss of customers, we probably would have. We clearly would have. And we would have mobilized a very lot differently. We would have been involved with FEMA.

In Katrina we were isolated as an industry; that privately owned utilities were not able to get government access to anything. Going forward, however, we believe that we will. It is our responsibility, but I think the partnership helps us to enhance our restoration efforts.

MR. HEYECK: I agree with the other comments that were made, and also want to mention that one of the things I think that's been a

lessons-learned is the importance of doing drills. And the DOE did a big analysis of the 2003 blackout that laid out a whole lot of actions that the industry following including putting in the PMUs and so many different actions that were taken at NERC and FERC and everywhere else.

But after Katrina, I don't think the rest of the country did a really good job of looking at that event for their areas and doing drills. And now we're doing this GridX event every two years and looking at multiple contingencies from different kind of directions. In New York we're going to do a similar kind of drill on the odd years just focused on New York alone just to continue to keep the awareness up and have the operators test their procedures, but when you go through these events and they're 10 years apart, you get turnover in personnel, turnover in government. People forget that they have these different positions.

I was going to ask Bill if the -- Bill and I are both Army guys -- if the reserve liaison

officers were in place during this to help coordinate between agencies? That's one of their jobs, and I bet they weren't. I bet they weren't effectively utilized. So, there's so many things that we already have in place that we don't test very often until we have a big event, but I think these drills are real critical to us.

MR. BRYAN: Keep in mind the federal government can't launch into an event without a request from the states because during at least a FEMA event, the states are on the hook for 25 percent of the costs, right. So, the government can't just jump in there and force the states to absorb a cost that they're not willing to absorb.

And I will tell you that FEMA has gone through a significant overhaul from lessons learned from Rita/Katrina and then the follow-on Ike and Gustav in 2008. They've been going through a transition, and it took about five to six years, the last five or six years to really fine tune where they're at today -- is a much different environment. We're much forward leaning

now in working with the states. So, I would say that that is one of the big lessons learned.

Obviously, if this event, Sandy, would have occurred in the South, they would have been a little more prepared because they're a little more used to getting those kind of events, and there are a lot of things in the South that they're just prepared to endure that the Northeast was not. And I can assure you that if we have another Sandy up in the Northeast, things are going to be a little bit better than they were last time. So, I'm encouraged by that. That was a big lessoned learned from the federal government from Rita/Katrina.

MR. CURRY: Ralph and then Tom.

MR. MASIELLO: Since people are telling stories, my own anecdote was nine days on the other side of the equation waiting for the lights to come on, and not PSEG territory -- in PECO's. But an observation, I had ample opportunity to chat up the different crews driving up and down the street, and I think in our territory PECO had

help from Entergy.

One thing that became very apparent; there's no interoperability of the mobile workforce apps in the trucks, and so the foreign trucks were really having to rely on paper maps. And more than once one of them would holler out to you in the yard and ask for help; where is what? And I thought I heard rumors the industry was starting to tackle that. That's going to be a very difficult interoperability problem because all of those mobile apps are non-standard from company to company.

And then related to that a thing that they told us was the Asphlund -- it was Asphlund in our area -- crews that were clearing the trees and the damage often couldn't get to work until a lineman showed up first to clear the downed lines, and the reason was too many backup generators that came from Home Depot or wherever just a week before, as people did their own prep, and were improperly connected in the homes. And I don't know what the industry can do about that problem,

but one guess is that improperly connected backup generators are going to be more frequent going forward. So, those were, as I said, stories.

MR. LA ROSSA: So, those two stores are pretty accurate. First, I'll start from the back end. The safety concern is real on the backup generators at the local levels. We're seeing feeds coming into the system that you just can't -- you don't know where it's coming from, so you're getting stray voltage coming in.

But I have to tell you one of the proudest things I am of the industry as a whole -- we did not have a fatality during that incident. And if you look back over prior events, many times we lose a worker because they're not familiar with the location, so if we went a little slow because of that, I won't apologize. I think the industry did the right thing there, but it's real and we have to test. And we've got to find ways around it, so what do we need to do?

Definitely we're thinking about splitting crews up with a troubleshooter with each

tree crew, so they can test. We can clear. We've got to have more testing equipment available, so folks that maybe don't normally put a split core on can do that. We're working through those issues.

But the interoperability is another huge issue for us, and it's not just at the mobile data terminal level. It's also at the radio level, so we need to find ways to get that solved in the near term. We're going to have redundancy in the NDT and radio world, so we're going to double down on what we're going to have available to our crews so that our -- we have bird dogs that take these crews around to these locations, and those folks will all have NDTs and radios.

MR. MASIELLO: On the flip side, our community figured out real fast that instead of arresting the crews, people competed to who could offer cookies and donuts and (laughter) sweet talk them in to do my street.

MR. LA ROSSA: That's the difference between New Jersey and Pennsylvania. (Laughter)

MR. BRYAN: I will touch on the interoperability piece as well. The technology exists right now for us to be able to provide a capability for any mutual assistance worker coming to an area to download a credential or an application that will allow the bigger management of the that team to be able -- almost like New Force tracking that they use in the military -- and it's digital, and it links to their mobile device.

But think about all the ramifications of people being tracked. That's a problem, and so even though it exists, and we are willing to work with industry to develop solutions in this area, they really need to come to us and say we're ready for this. Help us. Work with us. Figure this out. But it exists, and we're more than willing to help assist in the funding of pilot efforts and so on and so forth. But there are some privacy issues that have to be addressed before we go down that path.

MR. MASIELLO: I had one other question

for Ralph. Did anyone look -- oh, I guess it's not relevant, but if the AMI systems had remote disconnects, has anyone looked at whether they could be used to help with that backup generation issue? In the state of New York where the Public Service Commission didn't approve the disconnects, it would be a powerful argument going forward.

MR. LA ROSSA: That's absolutely right. It just gets down to the cost issue. So, regulators like in New Jersey, they don't even see the value yet for AMI across the board, so it's a cost --

MR. CURRY: Before Tom answers this question I just want to stick one item in because you mentioned New York and AMI. I was one of the commissioners who made sure that didn't go through, okay, because we were asked to approve a pilot program of a billion dollars without adequate prep from staff. They had a turnover on the commission. It came up on the agenda, and everyone from the effected utility walked away and said, "God, we'll never get this thing through,"

instead of asking the question why did this thing not get through. I was asked that question at NARUC down at the Renaissance Hotel in February by the effected utility, and I explained because we were not primed for it, and no one in their right mind's going to approve a billion dollar pilot program without adequate prep. So, Ralph was giving a dig. I'm giving it back. Sorry, Tom?

MR. SLOAN: I just don't want to get caught in the crossfire between you two. I'll start with Ralph, and David may want to weigh in. I understand that while you're trying to restore service, it's like draining the swamp, and you're up to your ass in alligator thing. But do you have a plan that you can do necessary upgrades, if not at that moment, then as your crew comes back through to, I'll say, finalize the temporary repairs and such, so that since you're going to have a willing commission and such to recover your costs that you are actually upgrading the way you wanted to or need to?

MR. LA ROSSA: So, I think the question

is as we go are we upgrading?

MR. SLOAN: Well, as you go and then maybe the next week as you go back and do things better?

MR. LA ROSSA: Yeah, I would tell you that at the moment when we're cleaning out those controls, we're just getting service back, but as we go we certainly upgrade the system along the way. We're not fundamentally removing overhead wire and making it underground, but we are upgrading all the cross arms, all the insulators, all the other work as we go through there, absolutely.

MR. SLOAN: So, would you have a storm resiliency plan that would include if we lose this line or this substation or whatever, these are the upgrades that we want to do?

MR. LA ROSSA: No, because each one of these situations is so unique, right, so depending on the tree that comes down, the location that it is in. Is it behind a fuse? Is it on the main line? So, there's a little different decisions

that are made as we're there, but there's a standard replacement for that type of asset that we go through each time, but there won't be a unique upgrade that will take place. You'll absolutely slow down restoration if you were to take that approach, at least from my opinion.

MR. SLOAN: No, I was thinking more in terms of -- I understand you've got to get service back up, but I also have experienced in my part of the world that a week later crews come back through to tidy up or finalize things, and I'm wondering if there's a plan to use that as an occasion to upgrade?

MR. LA ROSSA: And again, that's a standard based upon that type of asset that was damaged, we'll go to standard replacement.

MR. CURRY: Let me lead the thanks of the committee to this panel, both for the work they did at the time, the work they did on reflection in looking at ways of taking best practices and lessons learned to today, and their grace under fire of two missed opportunities to

talk to us and now finally getting here. Thank you all very much. (Applause)

MR. COWART: I'll add my thanks to the panel for the fact that they were on tap twice before to come and talk to us and still managed to come the third time.

MR. SUCCAR: As we turn things over to the Transmission Subcommittee, I just wanted to make a quick announcement. We're circulating this sign-up sheet for the committee work products, and so this will go around. And if you're interested in participating, if you've already indicated that you are participating in the relevant work product, you don't need to sign up again, but the committee always appreciates efforts to put pen to paper and active participation, so please take a look and I'll turn it over to Mike. Thanks.

MR. HEYECK: That was a very good conversation about this, and I know that it's running long in the morning here. We have two other items to discuss. One is the paper itself that we submit to you as the Transmission

Subcommittee for your approval. I'm going to go over some of the recommendations that we have made, many of which we've learned from Sandy but also some other events on the system.

I really want to thank the Subcommittee for putting this paper together. It's a good tome on the issues of aging assets and also on the issues of resiliency and security. And I want to particularly thank Clark Gellings and David Till who actually put some of the framework together for the subcommittee to massage and deliver.

As I mentioned that this paper actually builds upon the paper that was submitted in October 2011, and you'll see some of the overlap. In fact, attached to the paper is that 2011 Grid Security Paper. We're focused on the Department of Energy, and Bill Bryan gave you a thumbnail as to what he's doing from his perspective, and everyone knows that the grid is very important to economy, very important to the livelihood of people, but it's remarkable how many things are just in time.

Go to your neighborhood gas station and ask them how much fuel they have in their tank. If you ever operated an airport, ask them how much fuel they have in the tanks at the airports. I will tell you that it's probably in the order of 24 hours or less, so the grid operates in the same way, very much just in time, so we need to identify the vulnerabilities and be able to identify the sparing gaps and best practices.

The industry does spare transformers through EEI called The Spare Transformer Equipment Program, and a lot of signatories on that; some shared, some volunteering their own equipment. But for my former company, we signed an agreement of how many transformers we're going to have on our system, and if something fails we have to have one on order, so it is a very active program. But having said that, there are some other issues besides transformers that you need.

If there's any available funds, recommendation number two is use available R&D funds to support projects and fill gaps in the

resiliency work of others. This is really a partnership. DOE does work with NERC and EPRY in efforts and if there's any gaps in the R&D area we like those to be identified and filled along with the industry partners mentioned here and others.

Recommendation three is really convene some technical conferences and technical meetings about this. It's a very difficult subject because you don't want to sit here and identify the 30 most critical substations and what's most critical about them. You really need to cloak that, and there may be some opportunity for closed sessions regarding any critical energy infrastructure information. But we need to identify what the issues are and adopt their improvements.

From the preceding, develop recommendations or presentations, basically an information exercise on what's being done. We're not going to be 100 percent resilient, and resiliency's not just steel towers and raising substations. It's also response and being able to quickly restore and/or isolate the issue, so those

are the types of opportunities, but information is very important, not only at the federal level but also at the state and local level.

Cost recovery -- Ralph's slide is very interesting; Ralph La Rossa's slide regarding actually being able to fit these costs within the paradigm of what the cost of electricity is today versus what it was before.

One of the things that you've heard me mention many times and a lot of the Subcommittee members mention many times is the grid is an aging beast at this time. A lot of the lower-voltage facilities were built at times when FDR and Wilson and Harding were President, and they need to be replaced, but as we replace them, is there something incremental that we could do that won't break the bank or won't break the back of the consumer? There are opportunities. One of the examples I share with folks in Transmission is that when rural electrification occurred in the '40s, some of those facilities actually still exist today, and it would take an extraordinary

amount of money to replace all that, but would you want to start with a terminal switch structures, for example? Those three terminal switch structures? Those things that get blown down that take a long time to be put back up again, which is different from just the tangent poles which are easier to put up? So, just incremental investments that we have today.

Certainly DOE's efforts regarding Smart Grid distribution automation and so on ought to be recognized and thought of in the vein of vulnerability and resiliency.

You all have the paper as part of the meeting materials, and I welcome the committee's consideration of that paper for approval.

MR. COWART: Any discussion? Pat?

MS. HOFFMAN: And I guess I'd like to ask the committee one question. In some ways the way we've been organizing the risks around the electric sector or the energy sector -- let's even broaden it -- but for this conversation let's just leave it at electric is basically climate/

weather/weather events, physical, cyber, infrastructure interdependencies, aging infrastructure, and I debated -- in some talks I'll say I'll bring the supply chain issue in there, but supply chain could be a subset of the above. Would you change that logic structure, or would you say anything differently?

MR. HEYECK: Let me start an answer, and if there's someone on the Subcommittee that would like to add. Yeah, there are various ways that the infrastructure could be breached, and we're hoping that a lot of that is overlapping, that you could actually develop something that not only satisfies a particular vulnerability but also addresses solar magnetic disturbances and high-altitude electromagnet pulse.

Example is one of the applications we did at AEP was any time you retrofit in a control building, it is very costly, and old control buildings have things like asbestos and lead and other things, and why don't you just build a new control building in a factory, bring it in, put it

in in a crane? And you address many of the issues for NERC compliance, geomagnetic induced occurrence and so on and so forth. So, trying to do it in a smart way that addresses many, but not all will address all. Does anyone on the Subcommittee have any other commentary on that? Thank you.

MR. COWART: Any further conversation? Paul?

MR. CENTOLELLA: I would just respond a little bit to your question, and in thinking about this last panel is one of the things that I think is important to pay attention to is the fact that electricity is an open system in the sense that it connects with lots of other critical infrastructure. And so, even if you're protected in resiliency in the electric system, if you're not also protecting in all of these dimensions -- in natural gas, in water, in telecommunications, you know, creating a secure electric system, if you don't have security across all of these things and resiliency across all of these things is

potentially not sufficient.

MR. COWART: And that actually goes in both directions.

MR. HEYECK: One of the things that utilities have, Paul, is these lists of critical loads, and there's definitely crossover, but those lists tend to be archaic -- you know, where the hospitals are, where the water plants are. You miss the station where you're providing electricity to a gas entity, a pumping station or something, and you miss those, and I think that there needs to be -- in this investigation, identification of those gaps of what is a truly important and critical and what can -- like hospitals. They do have generators. Some of these other installations may not.

MR. CENTOLELLA: I'll raise just an example that is one that comes to mind from some of the recent cyber attacks, the cyber attacks on Target and some of these other places. They started with HVAC vendors. If they can get into the payment systems, they also could get into the

operating systems and potentially have impacts. And so, when I say the electric system is an open system, it's open in many directions, and one really needs to take that into account.

MR. COWART: Anjon?

MR. BOSE: I think these interdependencies are very important and not well understood, and part of the reason you're recommending this line of thought is to try and identify these things more clearly and be able to model them and analyze them and so on.

And what always concerns me is that much of the discussion has been on the threat side and not on the solution side. Today I think Ralph LaRossa pointed out that there's a way to run the electric grid without the computers and the communications. We knew how to do that 50 years ago, and the question is that when we're talking about all the Smart Grid stuff, how dependent do we become on the computers and communications to the point where restoration becomes a problem because during the restoration times, you're not

worrying about the computer displays. You're worrying about getting the customer back online.

And I think some of these -- I always get concerned when -- right now the focus is on trying to identify the weak substations. That seems to be the wrong type of thing to go after. In fact, that's the kind of thing that the National Academy has tried to stay away from in their terrorism report is to identify specific targets.

On the other hand the process of determining criteria which needs to be met so that these kinds of resiliencies and redundancies are built in are probably the right way to go.

MR. WHITLEY: I'd agree with that. This document is very general and vague in identifying the vulnerabilities, but I can't get over what Ralph LaRossa said. If we can build that substation, we could actually provide some redundancy, but we can't build it because the public memory of the issue is gone. Building redundancy in a system, putting more substations

in, putting more lines in, obviously you have to develop that on a criteria basis, but those are the things that I heard today that are much more relevant than just putting up steel poles and reinforcing the stuff we have.

MS. REDER: Yeah, Mike, I'm speaking in favor of the paper, so I congratulate you and your team on a good piece of work. If anything about this, I keep coming back to the whole issue of hardening, and how hard is hard enough? And I don't think we really have -- we haven't really settled on that, and until we get to that point we keep kind of circling the wagons. And without a plan it's real easy to just go back and in the heat of the moment get everybody online and go through the drills and kind of continue to do like-for-like. And I think we really need to step back and do it in a planful way.

Pat, your hierarchy of what you're doing for second, third, fourth seems reasonable, but ideally you'd be able to get as much bang for the buck with one effort, but that takes a lot of

planning, and I'm not sure we really are rolling in the technology to the extent that we should in that thought process.

One of the things that I've been pondering is you look at these hurricanes and big events that are hitting the coastal areas where there's really dense loads, and I'm wondering if we should be investing more in submersible technology? I mean if this climate change really is going to bring a lot more water and a lot more weather into high-load areas, what can we be doing in order to really change the game? So, it's something to think about. I really think it's important to kind of take it to the next step.

MR. HEYECK: A very good point. Something I shared with Ralph prior to his speaking today was, I think center point in a way, to deal with substations is to elevate them. And elevating an asset that people don't like in the first place is going to be interesting, but in the name of vulnerability or resiliency you'd like to do that. I said, 'Well, I guess in Long Island

you're going to have a few problems with doing that," so your point is well taken.

Let me just give you a micro-sense of that. Epery is doing work in coatings and things like that to be able to at least resist the spray. It won't resist the inundation of salt water, but at least the spray. It will be able to at least reject some of the issues of that electrical equipment doesn't like in the first place.

MR. COWART: Clark?

MR. GELLINGS: So, on one of those three commissions that was mentioned, I was a commissioner, and specifically the recommendations that we made regarding Long Island was to raise the substations. And the reason is that the cost of replacing the existing asset with one that is underground or submersible in any way is absolutely phenomenal, so when you're considering even a green field site, cost is one of the dimensions that we have to consider.

MR. COWART: Any further questions, commentary? Are we ready for a motion on this

report? Ah, if you have a --

MR. CURRY: I just have a quick comment. In New York City, because of the problem with substations, Con Ed actually constructed in the South Bronx a substation that looked an awful lot like a bunch of row houses, so much so that they had to have a full-time employee stand out in front for the first six months and say, "No, these aren't row houses. There's nothing for rent here. This is an electric substation." So, there are ways sometimes of dealing with local distaste. In this case it was a pretty creative approach.

MS. REDER: I move to approve the paper.

MR. COWART: Is there a second?

MS. WAGNER: Second.

MR. COWART: Thank you. Any further discussion. All in favor say aye. Any opposed. Thank you very much. It's adopted. Thank you. Mike?

MR. HEYECK: The next subject is the work plan, but I'd like to go to my seat.

MR. COWART: All right.

MR. HEYECK: There are two other items on the agenda, and I'd just like to collapse them into one because I think there's something much more fundamental. You've all received the 2014 Draft Work Plan for the Transmission -- what we're calling Transmission Subcommittee, but we're adding the words "Power Delivery," and I'll get to that in a moment.

The work plan conceptually is to build upon the President's initiative to modernize the grid. There was a memo out actually before the QER memo regarding grid modernization, and to that end there are six colors that were developed by the grid tech team what we'd like to attack as well. These are broad subjects so we'll have to narrow them, and the one subject we'd like to do is we'd like to have a joint effort with the Smart Grid Committee on the R&D roadmap that I think Clark has got the pen on.

Something like I'd like to broach with the committee, we discussed at the leadership, is the future of the third committee. By statute

there's supposed to be an Energy Storage Committee and somewhat of a Smart Grid Committee as well.

The Transmission Subcommittee began back in 2008 when the Energy Policy Act and follow-on implementation actually created some issues that needed to be addressed, and the DOE has been very active in those. We've had several recommendations since 2008 that the DOE has seen and acted on, and I think the Subcommittee is pretty proud of that.

But some of the gaps that developed is the distribution end, and then Wanda and I started to discuss overlap with respect to Smart Grid and distribution, and what we don't want to do is create two committees that you don't know what they mean any more. Smart Grid is left to the imagination of the beholder. We don't want to create another committee that is so broad, and I think Granger at our last subcommittee call said something very profound in the way we ought to organize the third committee.

There's a yin and yang to the Smart Grid

Committee and the Transmission and Power Delivery Subcommittee, and his approach was the wires are the top down and the Smart Grid is the bottom up, so you get the end use. You've got the customer. And you've got the smarts and the communications bubbling up hitting the -- as I affectionately call them the dumb wires, and so our proposal is really to go forward with a third subcommittee focused on power delivery, basically transmission and distribution, and to take the Smart Grid Committee and adopt as they have the customer end of things. And I don't know if you want to add to that, Wanda?

MS. REDER: Yes, I think a coordinated approach makes a lot of sense. We clearly continue to talk about the systems of systems aspects and the need to look holistically, and I think that's a tremendous opportunity for the EAC, so it's seems that this top-down group would continue to embrace those kinds of issues. And on the Smart Grid piece there's a lot of work to be done on microgrids and how that ties into the

distribution system, the technologies involved there. I think there's always going to be a little bit of overlap, but there's enough folks that remembers that straddle both committees that we'll work through where there's overlap, and we'll tie it all together.

MR. HEYECK: One other point to make is we really would like to embrace -- our focus has been the Office of Electricity, and we would also like to embrace EERE to make sure we cover those topics from a renewable energy standpoint and from an energy efficiency standpoint. And so, what we're submitting to you, Rich, is to have some dialogue around the repurposing of the two groups for the future.

MR. COWART: We'll take other comments on this, but just to let people know what we've decided to do, tentatively anyway, among the leadership committee of this committee is to go forward as just suggested with -- you might need to rename the committees in order to make their purposes a little more clear, but essentially, as

Mike said, one committee focuses on bulk transmission, and to the extent that we're reaching out to EERE, that could also deal with the interconnection of renewables at grid scale, utility scale renewables. And the other subcommittee will be sort of bottom-up, customer-up focusing on Smart Grids, customer loads, load management efficiency, and perhaps also highly-distributed generation.

So, it's a pretty logical way of approaching the topics, and there's a place in the middle where they connect. And I guess I would only say in response to something that Mike said that I'm pretty sure we don't regard the bulk transmission system, the high-level transmission system as dumb wires because, in fact, the interjection of Smarter technologies at that level is also really important.

MR. HEYECK: I always do say that transmission's already smart. We're just trying to make it smarter.

MR. COWART: All right. Well, I'm sure

Clark will appreciate your correction there.

Chris?

MR. SHELTON: Yes, a comment on the transmission system and being Smart, and I would say it's probably the smartest part of the grid. It has the most visibility and control of the whole system at this point.

I wanted to ask kind of in this discussion of buckets of work where interconnection is? Interconnection standards or informing that? And any work that DOE could do in that area because I've heard a lot of folks in -- well, Terry Boston has talked about this quite a bit, and also folks at the California Commission are just very concerned about some gaps that are there, and they're not seeing action from sort of the society groups that we have, and they feel like they can't wait to address a lot of issues on interconnection. So, I wonder how are we addressing that as a committee?

We brought it up in the Storage Subcommittee a few times, this topic, so it's

really the idea that there are a lot of opportunities that are being -- sort of lost opportunity that are happening at the interconnection level where we're not really getting full benefit of these distributed resources being connected, and also we're not seeing very rapid movement on those distributed resources, so it's an efficiency as well as standards and making sure we're getting everything we can out of those resources.

MR. COWART: Wanda?

MS. REDER: Yes, I would suggest that from a distributed interconnection perspective to the extent that there are gaps in the standards which I acknowledge there are. There's boats of opportunity for recommendations, that we should bring those forward, and there's - between the connection with the labs and IEEE and other standards, development organizations, we can certainly pass those recommendations on and expedite the process.

MR. SHELTON: Since you brought up IEEE,

I think IEEE is the issue that has been raised by the people that I'm hearing from. It's not -- it doesn't affect me directly or anything I've worked on, but that seems to be where the gap is. IEEE's not interested in progressing in the arena that the regulatory folks need movement.

MS. REDER: Yes, clearly an opportunity, and we can talk offline. I can help there.

SPEAKER: I guess just my one comment --

MR. SHELTON: But my question was where are we addressing it and where, under this committee?

MS. REDER: Yes, I would say for the distributed interconnection which is distribution interconnection standards which -- that's largely where I think there's opportunity that would fall into the Smart Grid area.

MR. COWART: Clark?

MR. GELLINGS: Yes, I just want to add to this that we have to keep in mind what it is we're able to do. So, 1547(a) which is the proposed revised 1547 doesn't mean a thing until

each state and each state commission basically says that's what we're going to use in this state, so getting that done is an act of almost 50/49 if you like. Or not 50 but BC jurisdictions, and that's not a slam dunk. I don't know what we can do to influence that. And also that there is really no coordination between that and what NERC is doing, and there really is a strong need for some guidelines between the two. And so the point I'm getting to is that involves both what we are now calling Smart Grid and bulk transmission.

MR. COWART: It might be a good topic for the Subcommittee to address, Clark, your question actually. That is, what could we do? What could we encourage DOE to do that would accelerate that process? Any further comments on the report? Mike?

MR. HEYECK: I'll just let you know that I'll talk to the department. (inaudible) and I will collaborate. We'll try to suggest some slight reconstruction of the committee names, but frankly I don't think it's going to make a big

difference in the way we've been operating as subcommittees on this -- as part of the ESE.

I would agree that we went full circle because we were considering -- Wanda and I were considering the merger of the committees, and so we went full circle, and I really thank the comments from the subcommittee.

And Chris is right. There are other areas, too, that haven't been -- there are gaps, and even if you get into grid security there are going to be some outside micro-caps that have to be addressed as we go forward with the recommendations that were already approved.

MR. COWART: Okay, we don't need to take a vote. That's not an action item for the full committee, just to let you know how we're going to proceed. Any further discussion, Mike, on any aspects of your work program?

MR. HEYECK: Just to acknowledge our next product is going to be the collaboration on the R&D roadmap. That will be our focus. We will lead this larger draft of work plan in suspension

until we -- we're going to have a change in leadership on this third subcommittee, and I really want to make sure that we can get some new blood on the committee and new leadership with some overlap to consider that.

MR. COWART: All right. Thanks very much. I think we are now at the point in our agenda to take a break. We're doing fine in time.

(Recess)

MR. COWART: All right, folks. We're going to begin as soon as Sonny sees who's out in the hallway.

MS. HOFFMAN: We're ready to get started. I'll go ahead and do the introduction, but I think most of you know Dr. Imre Gyuk from our program at the Department of Energy. Imre has done a fantastic job of leveraging resources, looking at where we need to go with energy storage, some of the challenges that are in the industry, and there's a lot of opportunities in this industry and moving energy storage forward.

So, one of the recent accomplishments,

among many which Imre will talk about is we did do an Energy Storage Program or Plan for Strategy, I guess it's called, for Congress, for Senator Wyden. He requested that out of the department, out of the secretary, but there's a lot of opportunities, but there's a lot of advancement, so it's really good to see the advancements that are occurring in the energy storage industry but recognize we're not there yet, and there's still quite a few challenges that we have to move forward on. So, with that, Imre?

MR. GYUK: Well, good morning. It's pleasant to be here and talk to the Advisory Committee and tell you what has happened during the last year. Of course, I can't cover everything, but I will try to give a survey of some of the things that we've been instrumental in bringing about.

I called it (inaudible) with commercialization because that is basically what we have in mind. We're not doing science for science sake. All that's very pleasant to do,

too, but this program is geared clearly towards commercialization and to having energy storage out in the field as part of the grid and part of our energy balance.

More and more energy storage is becoming a reality. Five years ago, maybe two years ago, it was sort of an interesting dream that some of us believed in and others did not, but it's really coming along. We have major projects that have been built over the last 10 years or so. We have progress.

The Chinese Energy Storage Association has a nice way of tracking things, and between May of 2011 and December of 2013 we have gone from 370 megawatt installed to 738 megawatts. Other organizations do these numbers in different ways, but I like to work with theirs because they track most of the major projects. This may not include really small projects.

Anyway, to help this process along, we have had the stimulus program, the ARA program, with storage demonstrations, and we received $185

million, but what is interesting about this and what I'm proud of is that we were able to secure $585 million in cost share. The cost share is the important part because we are just providing a stimulus that we want industry to be part of this and provide suitable funding because we want to do projects that eventually will be useful and be part of the grid. Four of the sixteen projects completed with another four projects are nearly completed, so progress is going very nicely.

What do we want to do with this program? First of all we want to show technical feasibility. You need to have a portfolio of technologies which actually work. We want to gather cost data. These projects do not necessarily have to be totally cost effective, but they should be as good as we can make it so we get appropriate data from them.

We also want to stimulate regulatory change because the regulatory environment is not set up for energy storage. I think we have been fairly successful. By we I mean the whole

industry in stimulating that, and it's a process that is ongoing and continues.

And finally I want to generate follow-on projects. I'm not content to just fund a project which gets built and then just sits there. I want the companies I'm involved in to look for more business and to generate projects on their own which I need not necessarily be involved in.

So, I'm going to take you through a number of the areas that were involved in the ARRA stimulus funding, but I will not restrict myself to that. I will bring other projects in as well. We'll do them by area of interest.

To start with, frequency regulation. There are two projects there which basically provided the basis for the -- to establish pay-for-performance together with projects by AES which came at the same time. One of them was a Beacon Flywheel Project, and it was under to DOE loan guarantee originally, but I take credit for it because the technology was essentially developed under our funding and in close

conjunction with us. In spite of certain problems it was commissioned July 2011, and by now it has delivered 275,000 megawatt-hours of frequency regulation delivered. So, the thing works. It's drawing revenue. It's there as the first big example of frequency regulation.

This is followed up by a second project which is very similar to it, ground breaking in 2013 and we have 10 megawatts installed so far. Expect to get it finished in June, and it's already drawing revenue. Now, the interesting thing is this was project two, but I am told that it is 30 percent less expensive than project one, and this is, of course, what we're after. We want to bring the cost down. We want companies and the industry as a whole to gain experience and build more cost-effective projects.

Now, the result is that frequency regulation using energy storage is now a commercially viable business in FERC compliant regions, and projects in frequency regulation are relying for their main income on frequency

regulation are springing up, and this is becoming a viable part of the industry.

And then there's ERCOT. ERCOT is, of course, not under FERC rules, and so in order to stimulate a pay-for- performance type of regulation we have the Duke Energy Project, 36 megawatts, 40-minute battery plant remotely operated. It does man-control smoothing and in particular frequency regulation, and is linked to a 153 megawatt wind farm at a place called No-Trees, Texas. The ribbon cutting was last year, March 2013, and this project was crucial as a pilot for ERCOT's concentration to establish pay-for-performance.

Again, I should mention AS has a project in the same region. And this is just as well because as we find from a study about PNNL, the more wind we get, the more frequency regulation we're going to need. In fact, for every 10 megawatts of extra wind capacity that's beyond what we have now, about one megawatt of inter-hour balancing will need to be added. The inter-hour

balancing can come from energy storage. It can come from demand management or it could come from very fast diesels.

Flow batteries -- We've been fairly active in the field of flow batteries. Our big project in this is a 25 megawatt 3-hour battery plant which is planned from Modesto, California, and it will essentially provide flex capacity of a 50 megawatt gas turbine, which however would cost $73 million.

The utility has made a comparison between doing the job with storage and doing this job with gas turbines, and as you can see the storage wins. The storage is cheaper. The ramping is faster. There is, of course, no carbon dioxide, and the area is one-quarter of the area of a gas turbine installation. And their calculation is reasonably reliable because they already have gas turbines in their system, so they know exactly what it costs to install them at random.

Now, the project is progressing, but

meanwhile they have spun off to other projects. This is the energy pod down there, and the power box, and one of the projects they have spun off is a Marine Corps Air Station. This is an ESTCP project. It's relatively small, 250 kilowatt, one pod to match 230 kilowatt PV into a micro grid. It should be completed during this year.

The reason for this was because this is a small Marine Corps Air Station in the vicinity of San Diego, and they found out when San Diego has a problem and shuts off the electricity, the base doesn't work. So, it does not fulfill its mission due to external disturbances in the grid. So, they wanted to be grid independent. They put up the PV, and they found, of course, that PV alone will not make a microgrid. You can microgrid all you want if you just put PV in it with nothing else, so of course that needed diesel backup or whatever it is. Well, they didn't want to rely on the diesel backup, and now they're putting in the battery system which was developed under our funding.

The second project is with Puget Sound, and this is interesting because the technology which was funded by us. BPA and Puget Sound are providing the funding, but PNNL, with money from us, is doing the analysis program to select a cost-effective site and the right scale to optimize the value stream. So, in this project we did the analysis first and chose the site accordingly, which I think is the way one should do it. Sure, if you have a site available and it's particularly useful, build it there. But it's better, in order to optimize that storage, if you have an analytical program that tells you what the value stream will be at various sites and various scales that is preferable. So, in this case on the left you can see if you add all the various value streams together you get something that is cost effective.

It's interesting to sort of look at the diagram of how all these projects are inter-related. The zinc chlorine technology was originally developed by EPRI. Now they're using

zinc bromide, but that was the original plan.

Then we have the ARA demonstration for 25 megawatt working closely with Modesto, California Irrigation District. ARPA-E did a small project, helped them develop long-lasting electrodes. Bosch is working with Primus Power to do the integration. The spinoffs are the Marine Corps Base Project and the BPA Puget Sound projects with PNNL site analysis. So, these projects are not in isolation. They are part of a whole web of interrelationships.

Another technology which is almost ready for commissioning; this is Enervault with an iron chromium flow battery. It will be in conjunction with tracking PV in an almond grove, up at the right, and the tanks are installed, and the thing will be ready to be commissioned in the very near future.

At PNNL we have been working on a number of flow- battery technologies which has led not only to scientific papers, but the mixed electrolyte technology for the native batteries

has yielded two times the energy density of a single electrolyte. Now, grid energy density means smaller tanks or more bang for your bucks. We have licensed this technology to three companies already. In fact, that's as many as we will license it to; Imergy, Joule-Watt and Uni-Energy Technology.

We have also worked on the V/FE flow battery technology, and this has been licensed to a company called Aartha US, and they will provide $1 million for PNNL to develop an up-scaled prototype.

We do a lot of other research both at Sandia and PNNL. Every time I hear an announcement out of MIT or Stanford or whatever it is, I sort of say been there, done that because, well, we just don't have the PR, but we are working on the same sort of technologies, Prussian Blue and what have you. They get a lot of press.

Right now the Washington State Clean Energy Fund has a solicitation out for $15 million for utility energy- storage projects, and PNNL

will participate in three of the proposals providing citing analysis and benefit optimization just as it did for Primus Power. They know the area. They have programs to do that. And these are the three projects. All of them involve Uni-energy Technology and PNNL. And next week I'm going to be in Seattle at the invitation of the Clean Energy Fund and the Washington State Energy Storage Alliance to do a presentation much like what I'm giving you today. And with some luck the governor will announce the awards and, well, we will see.

Advance batteries -- Technology which I find interesting and in which we now have some experience is lead carbon batteries. In actual fact these two systems that use lead carbon batteries are not pure systems. They're hybrid systems. They're hybrid system between lead carbon and lead acid. One of them does the energy hauling. The other one does the power.

And the nice thing and interesting thing with lead carbon batteries is they're very much

like lead acid batteries, so it's -- you know, we know the problems. We know how to construct them. We have large companies that can do it. Costs a little bit more but not much more, but they last 10 times as long roughly as lead acid battery, and that's a huge advantage if you happen to be up in Alaska or wherever.

So, the two projects we have, one is with Public Service New Mexico. That was commissioned September 2011, 500 kilowatt, 2.5 megawatt hours. Clearly this is an energy setup, and what we're doing with this site is Public Service New Mexico, Sandia National Lab, New Mexico State University, and the University of New Mexico are all jointly working together at using this system as an experimental setup. And what they're doing is they're trying to build a big model that will take into account the state and perspective state of the grid, the state of the batteries, the forecast insulation, the weather in general, and the economic situation; the current cost and projected cost of electricity on the

grid. The idea is to find optimum algorithms for running and discharging the batteries for maximum benefit. And the operational procedures are as important as the actual technology because you have to know how to run these things.

The other one, the East Penn one is bigger. It's megawatts. It's used for frequency regulation, or it could do 1 megawatt of load management which they do occasionally, but mainly they're running it for frequency regulation. And they have over 700,000 kilowatt hours of regulation. Service is delivered to PJM. The integrator for both of these systems is company called Ecoult.

Now comes the spinoff. Hydro Tasmania has Australia's largest battery on King Island. It was installed December 2013. It's very much like the one at East Penn. It's 3 megawatt, 1.6 megawatt-hours, and it basically integrates the renewable resources to produce a totally green island, at least under good circumstances. Basically they have managed for extended periods

to run the entire island without diesel, and in general they would expect to reduce diesel by more than 65 percent. The system works. It's running. It's a useful demonstration of technologies that we have funded, and it doesn't cost me a penny.

Another advanced technology which we have been involved in is the Aqueous Hybrid Ion Battery by Aquion Energy. Got about 85 percent round-trip efficiency, has demonstrated the reasonable amount of cycles. It's targeting pricing at a scale of less than $250 per kilowatt hour, but the main thing is it's very simple and inexpensive in the manufacturing. It's an easy thing. It uses precursors that are commonly available chemicals; salt basically. And they are intended to -- well, they've already started high-volume manufacturing. The nice thing is that our $5 million from DOE has attracted $75 million in venture capital, and they have over 120 employees and growing.

Compressed Air -- Well, compressed air can be very big or it can be smaller. One of our

compressed air projects with New York State did not pan out. Sorry about it, but the geology just wasn't right. Other people who have tried compressed air have had the same experience of the geology in spite of all the good indications, not working. The PG&E project which is going to be 300 megawatt is churning along. It will probably take a while to complete, but it is active, and we expect it to succeed eventually.

However, we have also worked on an advanced version of compressed air, and this is a totally green, isothermal compressed-air energy-storage system using hydraulics, and the reason why they can do this without extra natural gas is basically because they save the heat of compression, ingeniously, and use that as input for the compressor when they produce energy.

So, it's a system that is self-enclosed. It uses off-peak electricity, let us say, at night. Texas, for example, electricity prices are often negative, a real bargain, and then it compresses the air. It has stored compressed air

in pipes or underground, and then it releases that, and there's no natural gas required, and it can basically arbitrage the system.

This is the energy. This is one megawatt-hour of storage tanks, so it's commissioned. But the interesting development is that we are working on an MOU with Korea to do an installation of the technology in Korea at Korean expense while keeping our IP. The funding will come from POSCO, a very respectable company, $10 million, and the Korean Ministry of Trade, about $4 million, and a token amount from the Department of Energy. So, this will hopefully be the first online grid scale installation of this compressed air energy-storage system.

One of the topics that really excites everybody, but particularly the storage world is resiliency, okay. If you look at the graph of the annual temperatures in Washington, D.C. you can see a trend. This may not be apparent today, but large-scale fluctuations are part of the trend because the weather just doesn't get warmer. It

gets less stable.

The number of natural disasters exceeding $1 billion in damages by year, that number has been going up too. The trends indicate the situation will get worse, not better. I mean natural disasters are with us, and other than following the ambitious goals of reducing climate change, we really need to know how to handle this.

Now, an interesting result that has come out of Sandy is that every $1 spent on protection measurements can prevent $4 in repairs after the storm. Investments in resilience are likely to pay off extremely well. Of course you're playing probabilities, but probabilities are good that we will have more hurricanes, more coastal storms, more blizzards, and what have you.

So, what have we learned from this? Well, one of the things is that 50 percent of the diesel generators failed to start during the Sandy emergency for a number of reasons, one of which is that in order to really be sure that a diesel will start up you have to run it regularly every now

and then. You can't just have a diesel and say, "Well, I'm prepared for an emergency." The other problem, of course, is that they got waterlogged, but they were not the solution that they were hoped to be.

Well, the one way of attacking this is to make microgrids which can provide essential services over an extended period of time, and if you have renewables and storage you can do that. In addition to that, during non- emergency periods the storage can provide demand management for the user and compensated services to the grid. So, you have a system that can make money when it's not being used for emergency, and it can provide essential services, mission critical, just like on an Army base, and keep running for a long time.

You could do those all over the place; apartment buildings, campuses, schools, shopping centers, community centers, nursing homes, hospitals, police stations, gas stations -- an important one. Well, not the individual gas station, but in a complex.

So, the idea of a microgrid with storage and renewables is a winner, and whatever is not immediately cost effective is clearly made up for what you will gain when you do have an emergency. And we have an example coming up of that type.

We are working with the Vermont Public Service Department and basically we stimulated them into doing a resilience-type project, and a solicitation was issued by the Vermont Public Service Department, and Green Mountain Power got the contract. And the funding, of course, will be joint. Vermont Public Services is contributing $50K. We contributed $250K, and Green Mountain Power puts in $3.4 million. And this is going to be in Rutland, Vermont. We have lots of political backing for that. The mayor of Rutland is very pleased with the idea. So are the various -- the senators and the congressional representative, so we've got all the political backing in Vermont. And it's going to be 2 megawatts with 3.4 megawatt hours of storage integrated with 2 megawatts of PV, and Dynapower will do the integration.

By the way, half of it is going to be lithium ion, half of it is going to be advanced lead acid. And this can provide ancillary grid services, peak shaving during high-low periods, and the system can be islanded to provide emergency service for a high school emergency center, local gas station, and a fire station.

Getting to be an important issue: Safety. We don't like to see that. So far we have managed to get over various emergencies reasonably well without attracting too much odium in the press, but each one of those events, and they needn't be that big, harms the industry tremendously.

So, energy-storage safety is an essential concern, and recognizing this we held a workshop, that is to say Sandia and PNNL under OE funding just last month, and we got together everybody who is concerned with the issue. Now, this is different because we just don't talk to the industry of storage providers. We had the utilities there, of course. We had state

regulators. We had building inspectors, fire marshals, insurance people. There's a whole universe out there that we have very little experience with in general, but all of these will have to be involved from the ground up in order to make storage safe and successful. And if you don't have safety, you don't have a system. So, lack of safety obviously endangers life, leads to loss of property, damages the provider's reputation, leads to costly litigation, and decreases confidence in storage by any vendor.

We can increase safety through careful engineering, extensive testing of systems, establishment of safety protocols, development of regulatory standards, guidelines for accident responders, and understanding of failure mechanism. I should point out that none of these are currently done in a fully satisfying way. It just isn't there yet, but all of it needs to be done.

And the importance of safety consideration is now particularly enhanced as we

see wider application of storage through mandates like those of California and New York. If you're going to have 1.3 gigawatts of storage rattling around California, we had better be very sure that everybody involved knows exactly what they're doing. We do not need a major disaster. Not all the companies that will be participating in this boom are necessarily as experienced and cautious as most of the companies that are involved in the current scene. I'm really worried about this.

But anyway, as part of the OE storage program, we have a safety initiative and we have accepted an industry mandate to develop a National Energy Storage Safety and Strategic Plan, industry mandate as per our workshop which has a very nice cross section of the industry.

Lastly, we are not just in the business of developing Q-technology or having interesting applications. We're really interested in developing the entire industry, and to help this development industry-wide we have a number of tools which we've been working on. Again, not a

total list, but here are a few.

One of them is the Energy Storage System Analysis Laboratory where we can handle (inaudible) and systems up to a megawatt. I would like to see as many technologies tested there as possible. For example, we have a GS-YUASA there and we have a Milspray and other companies like Redflow and so on have been tested there as well. And we can do this up to a megawatt, and we will do safety analysis there as well as technical analysis of running time and what have you.

We have developed a protocol to measure and report performance of energy-storage technology. This is the first in this field. It's being very well accepted. It was developed by a working group of over 100 members, release date October 2012, and it is going to be the basis for a new IEEE standard as well as the Department of Defense forward operating base standards, available for free on the Internet.

We finished the DOE/EPRI Energy Storage Handbook with the participation of NRECA in who's

pleasant facility we are in the moment, and this is the definitive energy storage handbook written from a user's point of view. It's not just a compendium of technologies available. It's from the point of view of the user. I want to install storage. What do I do?

We also have a number of conferences which we have organized, particularly the ESAT 2013 Conference which drew people from 13 countries, and I'm organizing a succession storage track for the Clean Tech Conference here in Washington next June.

And much of this is reflected in the daily international energy storage database. There are now 844 energy storage projects from 49 countries, at least the last time that I looked at it, and some 50 energy-storage technologies are represented. Storage is not only a growing industry in the U.S., but it is present internationally, and we will see progress if we are careful and watch our safety and continue to do responsible work, bring down the cost, improve

the technical efficiency and continue working on developing the regulatory structure. Thank you.

MR. COWART: All right. Questions? Comments? Gordon?

MR. VAN WELIE: Thank you. That was a very interesting presentation. I'm curious about something. You didn't mention liquid metal batteries, and I had the opportunity to tour the Ambri facility out in Boston which is a spinoff of MIT --

MR. GYUK: Yes.

MR. VAN WELIE: -- and it seems a very creative and exciting technology. I was just wondering what views you might have on that.

MR. GYUK: Yes, it's very creative. MIT comes up with many creative technologies. The idea started out by looking at the aluminum smelters because the idea was that you really need a large-scale storage unit if you're going to make any difference, okay. So, aluminum smelting is a large-scale technology. So, what if you basically run an aluminum smelting plant backwards? And

that is the (inaudible) idea. You have (inaudible) metals. You have them separated, and you essentially run it back and forth. It's very nice, and they do have a desktop unit, and we'll see how it works out.

MR. VAN WELIE: What's intriguing, I think it remains to be seen how it will perform in the field and what the cost effectiveness of it is, but the thing that I found intriguing was that they basically put in aluminum smeltering into a 4-inch cube, and it's a totally inert system, and the lifespan of it seems to be -- they're predicting a 30-year lifespan. So, if they can make the thing work, economically it's going to be a real breakthrough.

MR. GYUK: If they can make it work technically and economically, it'll be very interesting. The energy involved in it is not that much different from the energy in other batteries. It's just yet another proposal.

MR. COWART: Paul?

MR. GYUK: Actually, I had intended to

fund them, but ARPA-E got ahead of me, so.

MR. CENTOLELLA: Let me pick up on this discussion because I'm also familiar with AMBR-E but I want to broaden out the question, and it partially relates to things that you have done, but it also is a broader question for the Department. So, we have in batteries some very interesting, highly-advanced work that ARPA-E funds. We have at the other end some close-to-commercial or commercial demonstration projects such as the ones that you've talked about.

And what I keep coming back to is how do we manage things to make them progress through the middle? And it's difficult because if you look out in the venture world, venture capitalists will say, well, we have a three to five year time window at most, and most of the technologies that are coming out of ARPA-E have oftentimes -- if they can get down to that timeframe, it's a real challenge, and oftentimes it's a longer timeframe.

And so, I'm pleased by some of the

things I saw on your slide presentation, particularly, for example, the cooperation with Korea. And I know Korea has a big storage program, and I'm wondering whether there are international opportunities to try to tackle this problem? I was pleased to see the Sandia Test Facility. I think that's another interesting piece of this.

But I'm wondering are there other things, whether it is in funding simulation modeling of different technologies or regional innovation institutes, or are there other ideas that you've looked at or the Department has looked at for trying to tackle this problem of the middle piece between the really advanced R&D and how we get things to the point where we're having commercial or near-commercial demonstrations?

MR. GYUK: Okay, there are at least three questions in there. I'm going to tackle the hardest one first, okay? And that is how do we get from advanced projects in ARPA-E, and by the way we have just as advanced projects through SBIR

and at Sandia and PNNL, but we have these things. Well, my philosophy is that you need to start a project and then see it through, and abandon it if it looks like it's a dead end.

But you have to provide funding all the way to near-commercial including chatting with venture capital and whatnot and bringing in international opportunity on other things. It's the responsibility of the people who pick this technology. Well, ARPA-E and we have said from the very beginning that we had the model that, you know -- promising technologies developed in the office of science in ARPA-E, in OE, through SBIRs, all to continue and be developed towards commercial or near-commercial readiness. Well, the trouble is the money isn't there. It's a funding question. We're all willing to do it, and where we can -- I showed you're the Primus Power with malice aforethought, okay? It was our system, but they had the opportunity to develop electrodes, and that is a project that could be done in isolation. Okay? And it's now part of

the system, and it's good to be commercialized. I would love to do this for a large number of technologies, but funding is limited.

Now, let's see what other questions. You brought up the international things. Well, the Korean one was perhaps the most spectacular one, but it's not the only one. The iron chromium technology that I mentioned is licensed to an Indian company for use in India, and in order to -- maybe to a telecommunication business -- in order to get ready for deployment they are letting PNNL develop the technology to the commercial point, which is of course exactly what we would be doing ourselves anyway if we pursued that. So, we're bringing in India and the amount of --

We have another project with Korea where we are working on an idea which was originally supported by ARPA- E. This is on a high-temperature sodium system. We picked it up for a while, and we continue to work on it, but the Koreans are working on a similar technology and seeing that we have expertise in it, we have

taken on the work for a charge to develop that. We're now abandoning our own line and continue. So, we are fully -- I should also mention that the first project with UNE Energy is in Germany with Bosch in a wind plant somewhere on the border with Denmark.

So, we are quite aware of the international scene. I get invited to international talks all the time. They are keenly interested in what we are doing, and we are learning from them and finding opportunities for deployment abroad.

MR. CENTOLELLA: I mentioned the possibility and I know that there's been limited work in other parts of DOE of looking at simulation modeling and (inaudible) ways of liberating technology development.

MR. GYUK: We have plenty of simulation models. In fact, the energy-storage hub is borrowing our simulation model. We have a fairly well defined simulation model for building a flow battery, the (inaudible) zinc (inaudible) et

cetera, and it costs all the components and the efficiencies and the design. The flow patterns throughout the thing are designed hydro-dynamically, and it's a very useful model which guides our design of more effective systems, and the hubs folks, Argonne, are borrowing it for their purposes.

MR. CENTOLELLA: I guess my bottom line is are there recommendations that we could make as an advisory committee that would look at institutional ways of expanding the reach of the Department in this middle space of technology development, whether it's partnering with states or foreign countries or reorganizing what's going on? Are there ways that you can think of that we could make a useful recommendation in this area?

MR. GYUK: Well, the recommendation which I cannot make is to have more funding for proving out advanced-storage technologies and bringing them to the point of a commercial model and possibly deploying them in the field to -- because that's the proof of the pudding.

MR. COWART: Ralph, you want to go next. I think you and Chris.

MR. MASIELLO: Yes, just to answer Paul's question, we did produce a document two months ago that tried to address issues beyond the technology development, let's say. Unfortunately, a lot of those issues don't fall under DOE. They fall under FERC or state utility commissions, and since I've got the microphone, California, of course, is as usual out in front with the mandate for planning for the 1,300 megawatts with a lot of methodology behind it up to the point where they picked the number, right. And Imre can comment but DOE is co- operating with the California Energy Commission on things like technology maturity models and so on. When we talk about the EAC work plan we can come back to some of these questions.

MR. GYUK: There is no accident that California happens to be the state where we have a majority of projects which of course provided the base for the audacity of requesting 1.3 gigawatts.

If you hadn't had any project in California, they would have anything to build it. They wouldn't have had anything to build on.

MR. COWART: Chris?

MR. SHELTON: I think we really should thank Ohio and West Virginia for the progress, as well. I mean those are some of the largest battery projects in the world. The largest one in the U.S. is in West Virginia, so I think that informed what happened in California as well, so I think we can thank FERC and PJM and the ISO market structure for that as much as anything, as well.

So, one thing I wanted to comment on and I interjected this comment here because of the last comment, but we would love to participate in these safety forums, so we have with our -- we have 200 megawatts of storage resource in commercial operation. We've had it now for five years. That fleet's been developing. We have a lot of stories and knowledge and experience we could bring to bear in a forum like that, so we're happy to participate.

The one thing I wanted to say there is I think there is a big difference between the industrial realm -- sort of that large project's exist in like some of the ones that were funded under the DOE program like -- an example would be the Tehachapi Project. It's a large industrial site being done by utility partners that was funded under your program.

I think that's an example where the parties involved have all kinds of things that they need to deal with to build the project, to permit the project, to meet safety standards. And I'm sure they're going through the process of meeting those. We do that when we build a project, so we're talking about folks who are investing tens of millions of dollars into projects at this stage, maybe upwards of hundreds of millions of dollars, and in our company we've invested and committed $150 million in this area, and we very much focus on safety. It's our number one value. It's embedded in everything that we do.

And we also, as an industrial player in developed markets, know that we have to deal with and focus on a lot of standards. One of those would be the Superfund Act that deals with some of the environmental and disclosure aspects as well as the engagement of the fire professionals in the markets that we're in. So, there are a lot of established approaches and rules that are developed by the regulatory regime that capture these projects today, so part of that safety initiative I think should, one, make sure we focus on industrial versus customer side or load side because I think there will be a big difference in how things are focused on in terms of safety. And I think we should look at and catalogue all of the pieces that any upstanding industrial citizen would be obligated to comply with, and perhaps in some other projects for whatever reason those things were not addressed or properly dealt with, and that may have led to some of the outcomes that we've seen with those other projects.

So, an example would be not properly

training a fire department on what to do when something happens, which we do on all of our projects, so it's just something that, you know, making sure that the existing established programs are being followed, and maybe pre-educating the community for that would be a big component of that safety initiative.

And the reason I raise that is I'm concerned of unknown future regulation fear, right? So, the idea that if I'm going to build a project today, the best way to chill the commercialization of this area is to have a big cloud of uncertainty around what all the obligations are going to be in the future because that will make sure that we don't continue to invest until that's all figured out.

MR. GYUK: Good points. And by the way, the plants in West Virginia and Ohio are much admired AES plants, which are a model for where hopefully we're all going.

It's always a fine balance between required regulations which pens in the possible

abuses of the system. Or on the other hand, becoming a hindrance to developing a system or even if you have a system built you suddenly find the regulations that have been enacted since you built it, and now what do you do?

I'm not so much worried about the large companies that know what they're doing, but we're going to have a lot of smaller people enter the field, and a lot of the regulations at the moment are really not -- take no cognizance of storage as such, and so we'd like to do a review of all the applicable regulations and suggest best procedures to go forward with things. And AS is, of course, invited to participate in the production of the National Strategic Plan for Storage Safety and beyond that developing a safety initiative.

MR. COWART: Merwin, do you have a comment?

MR. BROWN: Thank you, Imre. Good presentation on bringing everything together here. I have kind of two different questions. One of the has to do with -- I see a lot of similarity

between your program and a solar electric program in the sense that you're sort of after one thing; collecting electricity, storing it, and turning it back out as electricity. But you can do so by very many different chemistries, by many different physics, methods, et cetera, and then you've got the whole development chain that you're dealing with, so I see a lot of similarities.

The one thing I wasn't -- and so you're doing a lot of the same things that the solar program does to go from basic technology to commercialization. The one thing I wasn't too clear on, you sort of hinted at it when the discussions at MIT and other university work came up. How much work are you doing or would you like to do at the very fundamental physics and chemistry level to look for new kinds of storage technology similar to say, photovoltaic tape type conversation or use of biotype systems, organic systems for photovoltaics, et cetera. Any comments on that? And then I'd like to ask another question, if I may.

MR. GYUK: Yes, the answer is lots.

MR. BROWN: Okay.

MR. GYUK: It's exciting to develop new systems, but the important thing is to always keep in mind the eventual application because if you just do it as a scientific exercise, you have all the fun in the world, but it may become evident pretty soon that this is not likely to end up where you (inaudible). Some pruning of the tree is necessary in directing it toward eventual commercialization and -- well, it's not even just cost effective because there are other applications; space applications and whatnot, military application where the metrics are not exactly the same as for utilities. But keeping -- I want it to be goal oriented, but as far as being able to play with new ideas, given the funding, I would love to because -- or collaborate with those who already have projects going on.

MR. BROWN: Okay, thank you. That answered it. The other question I have is going to be addressed a little later, in a few moments,

having to do with -- I take it from your presentation you called it utility applications, I guess, of energy storage. And what have you done, and what do you plan to do in the area of what we, I guess, call distributed-energy storage which seems to be beginning to come alive in a few commercial ventures here and there? And if my observation's correct, what distinction do you use to separate utility-scale storage from distributed-scale storage? Do you have any kind of clear definition in mind?

MR. GYUK: No.

MR. BROWN: Okay.

MR. GYUK: The boundary between distributed energy and "utility" scale is fluid, and you will notice that a lot of my applications or the size of the technologies are in the one megawatt range or so. Those are generally distributed, not necessarily on the customer side of the meter, but at the substation or whatever it is. Now, customer side of the meter, I'm not particularly interested in strictly domestic use.

I'm not convinced that that is an effective way of doing it. If the customer happens to be a university or a shopping center or a large commercial building or a bank, that's a completely different situation. Then, you know, you need sizable storage, and that's perfectly good game for me.

Many of the things, particularly flow batteries could be scaled up easily into, say, the 75 megawatt scale, and be deployed on the transmission side, certainly to begin with on smaller but longer lines like the Fairbanks plant in Alaska. I mean that's definitely a transmission project, but that's because they have this tremendously long line.

Storage isn't -- I mean it's a war. We have our strategic objective. We want storage to be wherever appropriate, but at this stage you can't do it like a war. You have to do hand-to-hand combat. You have to weigh each situation, each state, and then it becomes more and more as people see examples, and there's

competition and the cost goes down. It's a whole process. So, I'm not too worried about distributed energy versus more utility scale. When I say grid scale I mean worthy of attention of a utility company whether it be through a third-party provider, by the utility itself, or by an entity such as a university.

MR. COWART: Carl?

MR. ZICHELLA: This is a really interesting conversation. It seems to me maybe it's a function of working and living in California where because we have procurement mandates we're starting to see a lot of innovation; some of the ideas that you outlined, and then some others that are now in demonstration and getting into more commercial kinds of scales like gravity energy storage for electricity. We're seeing hybrid projects coming forward using small combustion turbines and some compressed air or battery combinations, new compressed air technologies that are coupled directly with wind turbines that, you know, these are not yet in full

development, but they're the kinds of ideas that are coming forward because there's been a market space created for them, and people are looking at the investment in them. They're not really connected somewhat with the programs that you've described, but I'm just wondering to what extend are you collating some of these ideas for some -- perhaps a future development or attention?

MR. GYUK: Well, I get asked to a large number of conferences to do keynotes. People proposing running railroad trains up an incline, you know, putting cement plugs down the hole, et cetera. They present at these conferences, and to the degree to which they are coherent I talk with them. I give them advice. I steer them into areas where they might find support. I point out problems, if necessary. And occasionally I manage to support them.

For example, the idea of underwater compressed- air storage came up. You build a big rubber balloon basically somewhere down and you utilize the natural pressure of the sea water. I

had an SBIR solicitation for projects along that line, and I supported two or three companies that were interested in developing this notion.

So, I keep track of them, but they're sort of kind of not in the mainstream. They may get there. Who knows.

MR. COWART: Any more questions or discussion? I'd make an observation about this schedule. I think if we just proceed with the Storage Subcommittee's Report and discuss the work plan, I think we'll be able to adjourn without taking a lunch break, and we can adjourn this entire meeting.

MR. GYUK: Okay, we're done with questions?

MR. COWART: I think so. Thank you very much, Imre.

MR. GYUK: Thank you.

MR. COWART: If there's anyone -- any member of the public who is here in order to make a public statement -- I understand no one has signed up -- then we will be able to -- the one

that you told me about. Okay. We'll be able to deal with the public portion of this meeting right at the end.

But the next topic then would be to turn to Ralph.

MR. MASIELLO: And maybe it's the first comment. When you look at Imre's presentation you have to think that overall this is a successful program where it's a lot of things being developed, and the conversation on energy-portfolio planning has been altered. Plenty of folks beyond DOE have been part of this, but the reality is storage is now part of the whole conversation in a way that was not true in 2007, so it's noteworthy.

So, the work plan -- and Richard, I guess, it's also a good opportunity to announce that after this next half-hour the baton gets passed to Merwin, correct? Merwin will be --

MR. COWART: I thought you were actually going to have a baton.

MR. MASIELLO: No, this is a virtual

world.

MR. COWART: Okay.

MR. MASIELLO: So, number one is the legislation that said there has to be a storage committee also stipulated that every other year the committee would produce a report on the state of affairs with storage, which we did in 2009 I want to say, and then again in 2012, and no one -- the Justice Department didn't come after us for the extra year.

But it's due again at the end of this year, and the copies of the 2012 report were distributed to the group last week, correct? So, all I can say is it's a considerable amount of work to prepare that document, and in 2012 we took the approach of not only reporting on DOE activities but reporting on other activities in storage; private industry, academic, et cetera, so it was my opinion, therefore, a fairly complete statement at the end of the effort.

And so, my only comment is we need to get started now if we're to have that done in

December. And the first goal, Merwin, is to find people who will draft for your draft sections because Tom Sloan and I will not be drafting sections this time.

Second, not part of the forward work plan, but we did put out this National Storage Strategy document at year end, and I guess as the EAC or as EAC members we can't take it to other venues, but as private individuals we can as people feel appropriate. For instance, I know the Energy Storage Association took it to Senators Mikulski and Wyden for better or worse, and that was part of the plan when we drafted it.

Merwin's going to discuss the distributed energy storage paper, and let's talk about storage testing and safety, which was a white paper we said we wanted to do as of November-December. And can you put up the page outline for that? Yeah, so this was an outline that we talked about as a subcommittee on a conference call a few weeks ago, slightly modified after some conversations yesterday.

And I guess the question now is that there is a National Storage Safety Initiative started as of February. Do we still want to do this, and what should the objective be in light of the fact that DOE has picked up the ball in this space? Because, Imre, I think your plan is to have that strategy in place by year-end, correct?

MR. GYUK: Yes, we hope to have it in place by June.

MR. MASIELLO: By June. So, it's not obvious that this wouldn't be a redundant and less well-informed, even, document if it stays on this path because when we talked about it in November, that initiative wasn't on the table. So, no one wants to write something that is beside the point. Comments?

MR. LA ROSSA: The question may be for DOE. Would it be more expeditious and helpful to have the committee available by conference call and use them as a sounding board given the timing?

MR. GYUK: Yeah, obviously we have expertise and knowledge in here. Chris has given

us a few pointers. I would certainly welcome having input from this body and any other. It's going to be an open process. We want to involve as many people as possible in the procedure.

MR. MASIELLO: I'm always in favor of less work. If we could scroll down to the bottom --

MR. COWART: Especially less redundant work.

MR. MASIELLO: Yeah, exactly. This was a white paper that accomplished it objective without being written. (Laughter) So, it's a new hallmark in efficiency. And here I'm going to put Carlos on the spot because we had a conversation last night that led to these bullets at the bottom, and this would be, I think, something different than and apart from the Safety Initiative, but the suggestion was that there may be a material science development that could be done to achieve a degree of intrinsically safe technologies.

And as Chris said, it's one thing if

you've got a few megawatts of storage inside a substation fence with appropriate measures taken, but if the technology's going to go in a garage -- and there are developers offering lithium ion storage in conjunction with photovoltaic, so if it were possible to have a battery that physically, chemically, could not create an uncontrollable fire, this would be a very desirable outcome. But I have to -- now I have to kind of shut up because I've exhausted the little knowledge that I have of it.

MR. GYUK: As a matter of fact, we are planning a kind of follow-up workshop to the safety workshop later this year on battery degradation and associated material topics.

MR. COE: Imre, the basic idea that we were looking at is something that DOE resources could make a major contribution to or some breakthroughs in material science or supporting material science research that's related to this kind of general topic; improving the intrinsic safety of -- we didn't pick lithium ion as the

chemistry -- basically across the board to find out first of all what are the safety risk issues by chemistry, how to address those safety -- at a materials level, at the cell level. And that's something that, you know, people have looked at performance, and people have looked at cost arena.

We probably spend too much time working on safety at the systems level and not back at the basic material science. And this could have widespread -- if we had some breakthroughs, it would have wide impacts on not just our industry and that but also where other storage devices are being used.

MR. COWART: I'm turning to you. Are you asking the committee simply to discuss this? There are a number of other items on this page that would -- I'm wondering how you'd like to proceed, Ralph?

MR. MASIELLO: Well, a white paper from the committee out at the same time as the strategy document?

MR. COWART: Oh --

MR. MASIELLO: It doesn't make sense to me.

MR. COWART: I think everybody -- yeah, nodded their heads on that one.

MR. MASIELLO: Yeah, now -- and we all know that it takes considerable time to get a document drafted and to a point where the whole committee can be in consensus for approval, right? Would it make sense to draft a document that (a) endorsed the safety initiatives, and (b) encouraged the Department to contemplate development of intrinsically safe technologies, because that we would do in a page or two, have ready for June approval. Does that make sense?

MR. COWART: That seems like the direction you're headed, and makes sense to me anyway. Merwin?

MR. BROWN: Yes, absolutely.

MR. MASIELLO: Okay, good. We'll find a way to get a draft out to everyone in short order.

MR. SHELTON: I would say to that I would add the framework discussion that I was

raising of industrial versus load side --

MR. MASIELLO: Yeah.

MR. SHELTON: -- as well as an understanding or a perspective that I think we would want to encourage which is -- at least this part of the industry would want to encourage, which is let's catalogue what is already required. If somebody's not doing what's required, that's a separate problem versus whether there are really holes in the regulatory framework at this point to address these topics.

MR. MASIELLO: Okay. You know, I guess all regulatory initiatives are started with the best of intentions because all we need is one front-page article about a battery burning down a house in Los Angeles to throw a chill on things, right? That was, I think, the primary driver for this safety initiative.

MR. COWART: TESLA and the dream liner. Yeah. I mean, those are -- we don't need a headline like that.

MR. MASIELLO: Okay, noted.

MR. COWART: Anything further in your report?

MR. MASIELLO: No, over to Merwin.

MR. COWART: All right.

MR. SHELTON: I think for the record on the whole -- all the TESLA comments that are made, I'm not sure what you're referring to. Those were car accidents, right, that caught on fire, so I'm not sure what the issue is if you want to make a specific clarifying statement?

MR. COWART: Clark?

MR. GELLINGS: It's just public perception of that. To manage that alone is a real problem. The fact that they happened to have lithium ion batteries, I agree with you. Just, it's coincidence of sorts, if you will. But we still have to worry about that when you talk about introducing new technology.

MR. SHELTON: No, that's good way to clarify that. That's what I was trying (inaudible).

MR. COWART: And for what it's worth, I

was making the same point.

MR. CURRY: I would just note in passing that those of you who have FIOS in your home, the fiber optic cable, in New York we had three incidences of houses burning down because the FIOS cable was not properly grounded, and it took the IEEE a couple years to get their regs around it. And it was almost impossible to get Verizon to acknowledge that they had a responsibility for doing it, and they tried to get the Public Service Commission to give them a pass on this. So, new technology does have its interesting moments.

MR. MASIELLO: Well, the AMI industry has had its share of incidents that blow up in the public opposition through bad information.

MR. COWART: It does make sense for us to be proactive with respect to safety, appropriate standards, what have you. There are so many instances of this. I was recently in Australia working on an energy-efficiency program, and this wasn't even new technology. This was the installation of regular old fiberglass insulation

in homes, and a few years ago there had been a really badly designed program in which utilities were very rapidly going around and insulating homes, and they had done a poor job of it. And there were some fires that resulted just from the improper installation of fiberglass insulation, and for that reason there was huge public opposition to any more insulation programs in Australia, which makes absolutely no sense whatsoever, but it was a barrier that they had to figure out how to get past. That's not even new technology.

MR. SHELTON: I, just for the record -- I support the safety initiative. I'm talking about how we think about it, so that we don't create undo fear of unknown future regulation. That's really all I'm trying to address.

MR. COWART: Thank you. Merwin?

MR. BROWN: Okay, thank you. I think I've dropped the virtual baton already. Just to get us re- grounded, I'd like to go back to this work plan outline, and we've covered mostly the

first two points already. I'd like to talk some more about the next two, the last two. And yesterday we were supposed to cover number three and that's been put off today. I'd like to put it off for another minute or two and talk about number four, the bi- annual storage program report that Ralph introduced the ideas; one of the major work products of this subcommittee that we've got to get out this year.

And I tried to put together a few introductory -- or thoughts on how to get started on this when the -- well, I listed here basically the laws that have brought about the requirement of this committee and the committee doing this effort. And as I understand the law, last year that report that this subcommittee put out covered two of the articles of requirements. The one was the every two- year review and also the five-year sort of more general assessment and recommendation kind of program. So, this next year what we're looking at again is the two-year review assessment for this effort. And so, if I'm wrong on that

assumption, I guess now's the time to correct that. And so, I referenced that report there.

And then, I guess the only other thing I can say at this point because I'm not sure what I'm doing here yet is it looks like we need to have something ready in the way of a reasonable draft by the October -- is it October or September for the third meeting of this meeting? It's in September. It's near the end of September, isn't it? Okay.

So, by that meeting we need to have this committee looking at a reasonable draft. That even shortens the fuse on getting this done. And I didn't put this in writing because this is probably not the kind of thing I want to put in writing, but I would make a plea. I do need help on just exactly what is the report supposed to do? What's it supposed to look like?

And, Imre, I would look for some help from you as to what would be most useful to you in the way of a review, so that we can focus on something that's a useful product out of all of

this. And so, for the moment, that's all I have to say about this particular effort. The members of the subcommittee are going to have to convene fairly quickly and begin to talk about what we're going to produce here and how we're going to go about doing it. Any comments or thoughts at this stage from anybody?

MR. COWART: I guess not. Thank you. We're impressed by your -- by the density of your slide.

MR. BROWN: I'm sorry. What did you say?

MR. COWART: I said we're impressed by your slide.

MR. BROWN: Oh, okay. Thank you. I want to go to this now, this other white paper report that has been mentioned, talked about, introduced a few times now.

Okay, on this title slide you'll note that what we're talking about here is a white paper on distributed- energy storage, and it's a proposed to be a joint effort of both the

Subcommittee on Smart Grid and the one on Energy Storage, with the Smart Grid Subcommittee taking the lead in this particular effort.

I'm now going to try to explain more about what's meant by this. The title, by the way, is a title that was borrowed from the report that the Energy Storage Subcommittee just got through publishing, so to speak, and was approved by this committee in a virtual meeting about three or four weeks ago. And so, as we'll see in a minute, I see this to have a lot of parallel to that particular report.

And so, the purpose of this study and the white paper would be to sort of get a status on the distributed energy storage technology and industry and users and applications and give recommendations to DEO regarding distributed energy storage. And based upon Imre's answer to my question, I think there needs to be some soul searching on just what would this paper do that would be of value and of help. And at the end here, I'll make a little comment on that.

The genesis, as I alluded to, in the title slide is that this will link to and build on the report that the subcommittee just finished and had approved, adopted by this larger committee on a National Grid Energy Storage Strategy, and in that particular document we had discussion about the distinction between what we call utility scale storage and the distributed scale storage. And while we didn't come up with a clear distinction, we sort of all felt there were two separate entities involved here and decided to focus on the utility scale which left the distributed scale unaddressed.

A number of people on the committee though have encountered in the recent year or two a lot of activity in what you would probably call distributed energy storage, and the storage is beginning to be applied behind the meter or at the meter, and where the choice to use energy storage is driven more by the consumer of electricity than the utility industry that is the provider of the service and the electricity. And at the moment

that seems to be the simplest distinction among the two, but as Imre says it's pretty cloudy as to know when one would end and the other begins.

But the reason why this was brought up as a subject of interest is that even though a utility may not even have a say or at least not be involved in the part of the decision-making to put one in, unless this is a totally remote application disconnected from the grid, it's going to influence and impact the grid.

So, in many ways there's some close parallels here to photovoltaic generation in which we see both utility scale with utility involvement decision-making and those that the customers are putting in that are now becoming large enough in their penetration to have an impact on the grid, and so it's become a subject of interest of this committee as well as a lot of other people. And so, I suspect they're sort of the same thing here happening with energy storage.

The format, if we go ahead and do this paper, we see it as being a white paper, whatever

roughly that means to all of us, but again something similar to the paper that was just recently produced and approved by this committee on utility storage. And the end date that we're shooting for would be the end of this calendar year. I'm not sure how that would -- that would probably mean we'd be bringing this to this committee probably in the spring meeting sometime would be my guess.

And the likely focus, again taking a cue from the paper which is the cousin to this, would be a broad analysis looking at institutional/technological customers -- and by the way, safety -- we weren't going to cover on this because we were going to do a separate white paper on that. Now, that's even been replaced by work that DOE has in mind that apparently -- we'll probably address this. I guess we'll need to raise that question whether it handles the distributed energy storage or not. That's something to watch for, and of course, it would have a DOE perspective.

Now, having said all that, I'm going to do a very hazardous thing and say what I think one of the outcomes of this work will be is that we'll probably find, just like we did in the other report that looked at utility scaled storage, that a lot of the things that's preventing the technology or at least hindering it from becoming more widespread in commercial application other than the usual cost issue, or institutional in nature, which sometimes or many times fall outside the purview of DOE via influence what DOE can and should do in the way of development of technology and tools that are needed to be able to develop and deploy the energy storage.

So, that's just a prediction on my part, but I think Imre kind of alluded to it. This is the technologies themselves will probably not look a lot different whether or not they're utility scale or whether they're distributed. It's going to be more, I think, who is deploying them and for what purposes and what applications that they are, and it's probably therein lies the differences and

the issues in bringing about this use of energy storage.

So, that's it for now. I guess the question before the committee, and I don't know whether this needs to be a formal question or not, but are we insane in trying to do this, or is this something of value and should be done?

I might add a note on the work that goes into these things that Ralph raised. The caveat I would give to this, which really I didn't think was answered too well yesterday is to what degree will the resources of this committee be directed to working on the QER? And since I see this study as a discretionary study, one that has no real deadline involved as opposed to the bi-annual report which we have to have done, if we feel we need to reserve some resources for the QER, as an example, then we might want to slip this schedule, but I haven't heard otherwise. I don't know what the demands of the QER are going to be on this committee, and so with that caveat the proposal is is that we proceed with doing this paper, and the

two questions I guess are should we devote the resources to it given this uncertainty with QER, and secondly, is it a subject of importance and interest to only DOE?

MR. COWART: A quick response. Clark will have a comment, and then I'll respond. Go ahead.

MR. GELLINGS: Thank you, Merwin. Very interesting suggestion. I find it difficult to suggest that we proceed without seeing some rough outline, and the reason I say this is because there's a great concern over and among utilities, and actually in others, about the demand of electricity from grid-related services, and obviously the availability of distributed storage would have a big impact on that.

But having just said that, perhaps obvious but there's an enormous amount of distributed storage already being, you know, penetrating the market, so much so that I'm not sure just what it is we're going to do when we do this particular white paper except to maybe wander

around some of the issues, but I'm not sure what we're going to accomplish with it. So, I would, before -- if I had to vote, I'd say show me the outline.

MR. COWART: Okay.

MR. BROWN: I wasn't going to get into this because the timing and the nature of this, but there has been some work done on that. If we go forward with this, these would be the next steps. One, we get agreement to proceed. Two, form a task force, and I already have a number of names up here of people who -- even Hanna Day wanted to be involved in this. Some have also made some fairly strong statements they wanted to be involved.

And first thing we need to do is we do have a draft outline. It was included in the pre-meeting material that was sent out to you. The credit or the blame goes to Wanda. She put together a good deal of it, but we did meet as a committee. Many of the people you see listed up there went through the outline and have amended it

some and changed it some, so it does represent a committee thinking. So, there is an outline that has been put forth that maybe you want to take time now or later to go through. And so, there is an outline proposed for this thing.

And I think one of the other first things that needs to be done with regard to this outline is really define what's meant my distributed energy storage for this study, and that means contrasting it with utility scale storage which is what we looked at in the prior paper.

I gave some examples, some questions we might want to answer is are we going to look at only those that have a direct impact on the utility electric system, look at only those technologies that are electricity in and electricity out? Let's say, for example, electricity in for thermal storage and then thermal comes out or something like that. And we've got to look on both sides of the meter, and what voltage are we talking about? Is that an

important distinction on what particular storage technologies and applications we need to be looking at?

And we had a panel yesterday that did talk some about the aspects of distributed resource integration, and some of them touched on storage -- at my request that if they had anything to say about energy storage we would like to hear it. And if we go ahead with this I would propose that we have another panel in June, again if the agenda allows it to look specifically at distributed energy storage.

And I've already been in contact with a few people out there who would like that opportunity to talk about the trials and tribulations that they're having in being able to deploy distributed energy storage as a business. And so, there are people out there who could give us some guidance and advice on what is needed in this area and what the issues are.

So, that's a very simple action plan because I've only been at this job a couple weeks

now, and so, Clark, did that kind of address your concern about having an outline?

MR. GELLINGS: Not yet, and Merwin, I mean really what I heard you say is a size of distributed storage that would influence -- could potentially influence in an obvious way the grid, okay --

MR. BROWN: Yes.

MR. GELLINGS: -- but I want to tell you that it's a lot broader than that, and so what I was suggesting, and I should have been more specific, is that we have to decide just how broad we make it, and we should do that. We should do it early on in this process so that we can capture all of the distributed storage and understand its usefulness, and I'm even thinking here about all of the dialogue we've had about the DC home, the DC building.

I mean, this subject goes a lot deeper than just to think about storage as it now exists. Clearly the use of vehicles to the extent that vehicles have storage on them, but I'm also

suggesting that as we make a ubiquitous connection between major appliances and the grid -- another issue, right, then even enhanced storage and such as refrigerators and the like kind of fall into a category of storage devices that we may in some small way control.

And so, this could be one really interesting and very broad project, and therefore very time-consuming and laborious. So, no, you don't satisfy me, although I think it's wonderful that you raised the subject. It's just we need to decide early on what the breadth of this is.

MR. BROWN: We are in violent agreement, and that's why that one bullet is up there. We've got to define what we're talking about and figure out how we keep it in a scope that we can handle, but I agree with you. I could argue that the distributed storage in your computer has little or no impact on utility, but as an aggregate load it does have an impact on the utility. It changes load behavior by -- if you have enough of those in there, and you go from an induction-resistance

load to an electronic load, so it does have an impact. Do we want to look at that, or no, that's too mundane. There should be some other things. I agree with you that we'd have to look at that early on.

MR. COWART: All right. So, it looks like we have some interesting comments. Other people who want to talk on this topic? Mike and then Ralph.

MR. HEYECK: Since it's March and June is not far, I don't, with all due respect to my colleague here, I think we need to move forward because every one of these topics has a world hunger and world peace part of it. But one thing I'd make is that the first step would be a deeper outline in June. From my perspective that would probably be a good compromise.

Just two things to add. Storage by itself needs a companion, and sometimes that companion can make a better economic model. For example, PV panels by themselves are good, but they can be better. You don't need as much main

plate on top of your roof if you have a storage battery, for example. And the economics of electric vehicles changes if you could actually use them for other uses rather than the subsidized approach we have today. So, those are the types of things of -- this could be a breakout game changer, but I would advocate for a deeper outline in June.

MR. COWART: Ralph.

MR. GELLINGS: We are in violent disagreement.

MR. MASIELLO: Our panelists today and yesterday (inaudible) showed the evolving net-load curve, right, load minus distributed renewables and the peak they get out there in the evening. I'm surprised you didn't call it the duck curve which is what it's become known as, but imagine if you had 3- or 4,000 megawatts of distributed storage. That would solve that evening peak.

And seven or eight years ago photovoltaic, or ten years ago, it was where storage is now. But if storage becomes

economically effective, it will have the same phenomena as photovoltaic does, which is the customers take matters into their own hands, and it could become widespread.

So, one panelist -- then Steve Whitley commented before he left that he really wished all the buildings in Manhattan would put in thermal storage and mitigate the air conditioning peak. Now, it's not electrical, but it's the same load-shifting behavior as a distributed storage device. So, there's two data points from the panelists saying we need distributed storage, so I'd argue for pushing forward.

MS. HOFFMAN: So, one of the things I guess I would ask you to think about as you move forward to the next version of the outline, and that is as part of a 2015 budget request DOE looked at potentially taking some of the comments that Mike brought up and saying, okay, you've got PV, you've got storage, you have other DC loads. Is there something to looking at a small DC type system as we evolve the building and

infrastructure in the United States? What is the impact of that? So, I guess I would, you know, from the vehicles and et cetera think about it from that point of view as well.

MR. COWART: So, let me -- I'm sorry. Tom?

MR. SLOAN: Thank you, and I don't really want to waste another three months and have an outline come out in June. We can have an outline distributed electronically in two weeks, so that June's meeting is productive because those of us who won't be here after that can still contribute between now and August 1 or whatever it is. So, I would suggest that the outline be in two weeks, electronically distributed.

MR. COWART: All right. Any additional comments? I think just given the way we have proceeded in the past, it would be consistent with the committee's general practice for those members of the subcommittee who are working on a paper, and in this case it's two subcommittees, to do just what Tom said. Circulate what you intend to

do and what your thinking is to everybody, get everybody's feedback, and then proceed. And then because we don't meet often enough in order to try to hold up everything for every stage of approval, we can engage in electronic dialogue in the meantime, but the people who have the pen write the paper. And then we can talk about something more substantial in June. Maybe it's not a final draft. Maybe it's something else, but in any event, it will be more progressed than an outline at that point, and that seems acceptable. So, that's what I'd recommend that you go ahead and do.

And for what it's worth, I personally do agree with Steve Whitley that thermal storage needs to be part of this picture, and it isn't just electricity in, electricity out if you're trying to what at RAP we now call teaching the duck to fly. You're going to need thermal storage, not just electrical storage in order to do it. Carl?

MR. ZICHELLA: Yes, I think one of the

questions that Merwin asked would be really helpful and those of us who are going to be working on the outline and eventually the paper, and that is what does DOE seem to think would be most useful to it? There's this -- as we've just heard this could be -- it's like the Smart grid. It could be a lot of things to a lot of people. What is most useful? Are we looking at things on the distributed side that influence behavior on the broader grid? What's the goal here, so that we can get our minds around putting together first of all a useful outline? What's in and what's out?

But also part of that exercise can be identifying things that we may not study in this paper, but which deserve future attention. So, I think it would help us a great deal to know a little bit more about what DOE thought we could advise them on too. So, I'm going to maybe ask Pat or some of the other DOE people here if you can give us a hand understanding what you think might be most useful for us, so we don't spin our

wheels and come up with something for June that actually doesn't hit the mark.

MS. HOFFMAN: So, I'll let Imre and others comment on this, but first of all, we're not looking at -- you know, as Imre talked about his program, distributed energy storage, right now. It's just not within the portfolio, so it's something that may provide us input in future years and things that we potentially could look at, but right now it's not going to directly impact our portfolio.

Now, that being said, I did bring up the opportunity that we are looking at from a DC microgrid building kind of point of view is how do you integrate those loads at a building enterprise? And that is something that we are looking at as part of the microgrid- type activity. So, with those boundaries, other than that, if there is a golden nugget there, I think we should look at it.

MR. ZICHELLA: Thanks, Pat. I mean, I'm just thinking that there are aspects of this that

have much bigger ramifications. In California they're looking at trying to get some visibility to the system operator which we heard about yesterday, having that maybe be approached through zoning distributed generation and associating that with storage. There's a pilot project on replacing the energy and grid services from SONGS that are focused on locating the round that are locationally based is basically what I'm thinking. And we can take this to such a small level, but I guess that's just something we should suss out and see what people think as we go, but it just strikes me that's closer to the mark to what DOE might be interested in than the household level.

MR. COWART: Any further comments on this?

MR. BROWN: If I may make then kind of a summary comment, sort of what I'm sort of thinking at the moment? Number one in response to Tom's recommendation, and then follow-on comments. Everything was fine about getting a refined outline out except I don't think two week we'll be

able to do that. It's hard to get committees convened and having anything put out in that time period, but certainly before June, and hopefully in a timely manner we'd get something out that would further define this.

The second thing that kind of comes to mind, I originally picked a title that paralleled an earlier report. It was called a National Strategy for Distributed Energy Storage. I'm beginning to suspect that may be a bit premature given what we know. It may be more of a survey paper or a situational awareness paper where we define the problems and opportunities more so than come up with strategy per se because you guys are confirming my suspicions. This is pretty deep swamp. Pretty big swamp to get into, and so we may have to be a little less ambitious in how far we'll get into it. Okay.

MR. COWART: All right, Merwin. Thank you. Anything further from the subcommittee? Okay. Well, I'll take the opportunity to announce a couple of things. You've heard from both Mike

Heyeck and Ralph Masiello that they're term-limited characters, and I just want to say as chair of the committee for the last little while -- I've been on the committee a shorter amount of time than either of them -- how much I appreciate the wonderful leadership they've provided and the work that they've done for the committee. And they have taken the proactive step of trying to pass the baton to the next generation of subcommittee chairs, and I'm happy -- you've already seen the fact that Merwin has accepted the baton and is already running, which is terrific with respect to the Storage Subcommittee.

On the Transmission Subcommittee, I'm happy to announce that David Till has agreed to become the next chair, and Carl Zichella will be the next vice-chair, and that they're already in baton-receiving mode there, Mike, so I think it's up to you. But I really do want to thank both the people who are -- not immediately, but in the relatively near future terming out, so thank you so much for your service. It's been terrific.

(Applause)

MR. HEYECK: I've already informed Mr. Till of the proper procedures for compensation (laughter), and I really appreciate the kind comments. One thing is I'd like to, as part of my comments before, consider it the Power Delivery Subcommittee.

MR. COWART: All right, well taken. We're now at the public comment portion of this agenda, and my understanding is that we had one request for public comments, and Sameer has been asked to speak to that.

MR. SUCCAR: Right, so Katherine Hamilton, who's the Policy Director of the Energy Storage Association, has submitted comments to the committee. I'm not going to convey the full extent of what she submitted. The full text of these comments will be circulated to the EAC and posted with the materials for this meeting, but I did want to provide an excerpt of what she submitted, and as I said, we'll be circulating the full text shortly.

So, paraphrasing, the ESA recommends that DOE- funded efforts should be actionable by states and utilities in policy, planning, and procurement. Once such focus could be a system-wide benefit analyses in key states like California, Texas, New York, Hawaii where aggressive energy-storage policies are being instituted. It will significantly impact the deployment of these technologies. The energy-storage industry understands the cost to deploy certain technologies in specific applications. What we need, however, is assistance with identifying and quantifying the benefits, especially non- market benefits that are most effectively done by those like the National Labs who have access to sophisticated modeling tools.

One such analysis was completed by the National Renewable Energy Laboratory for two balancing authorities in Colorado. Replication for additional regions would be enormously helpful. By modeling the system-wide benefits of

energy storage and using actual data from projects that are in the ground and operational, state regulators and utilities will be far more able to justify and build these investments, build those asset investments into the overall rate base.

Also key to the success of (inaudible) energy storage effort will be ensuring a more coordinated approach between those offices within the agency. The quadrennial energy review effort being led by the Energy Policy and Systems Analysis Shop will be an opportunity to demonstrate cross cutting efforts in research development demonstration. Their focus on infrastructure, all the more reason for multi-disciplinary effort on energy storage. As the energy storage industry and its market potential grow exponentially we believe DOE has been a critical early investor in these technologies, and with the National Laboratories continues to play an important role as a trusted resource for research, testing, demonstration, verification, and analysis. VSA requests that the

EAC, in turn, look to the industry association as a resource as the committee considers and develops recommendations for the DOE energy storage program. And with that, back to you, Rich.

MR. COWART: All right. Thank you very much. Is there any further business to come before the committee today? All right.

MR. CURRY: I move to adjourn.

MR. COWART: Thank you very much. Is there a second?

MS. REDER: Second.

MR. COWART: Thank you, Wanda. All in agreement, say aye. All right. We are adjourned. Thank you very much.

(Whereupon, the PROCEEDINGS were adjourned.)

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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.

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