BEFORE THE ARIZONA POWER PLANT

AND TRANSMISSION LINE SITING COMMITTEE

In the matter of the Application of Tucson Electric Power Company ("TEP"), in conformance with the requirements of Arizona Revised Statutes §§ 40-360, et seq., for Certificates of Environmental Compatibility authorizing the construction of the Reciprocating Internal Combustion Engine Generation Project and the Irvington 138kV Transmission Line Relocation Project, including the installation of ten (10) modular approximately 20 MW reciprocating internal combustion engine generators and construction of approximately 2.2 miles of new 138kV transmission lines located within TEP's Irvington Campus, Section 3, Township 15 South, Range 14 East, Pima County, Arizona.	)	DOCKET NO. L-00000C-17-0365-00177 CASE NO. 177

At: Tucson, Arizona

Date: January 17, 2018

Filed: January 23, 2018

REPORTER'S TRANSCRIPT OF PROCEEDINGS

VOLUME I
(Pages 1 through 188)

COASH & COASH, INC.
Court Reporting, Video & Videoconferencing
1802 N. 7th Street, Phoenix, AZ 85006
602-258-1440 staff@coashandcoash.com

By: Colette E. Ross, CR
Certified Reporter
Certificate No. 50658

INDEX TO EXAMINATIONS

INDEX TO THE TOUR and PUBLIC COMMENT

INDEX TO EXHIBITS

INDEX TO EXHIBITS

NO.	DESCRIPTION	IDENTIFIED	ADMITTED
TEP-11A	Supplement to Proof of and Publication Posting of Notice of Hearing	53	148
TEP-12	Proposed CEC for Reciprocating Internal Combustion Engine Generation Project	10	illustrative purposes
TEP-13	Proposed CEC for Irvington for 138kV Transmission Line Relocation Project	10	illustrative purposes
TEP-14	Staff Letter to Chairman Chenal	10	149
TEP-15	Statement of Sierra Club	10	149
TEP-16	TEP Resource Planning Process	10	149

BE IT REMEMBERED that the above-entitled and numbered matter came on regularly to be heard before the Arizona Power Plant and Transmission Line Siting Committee, at the DoubleTree Inn Hotel, 455 South Alvernon Way, Tucson, Arizona, commencing at 10:12 a.m. on the 17th of January, 2018.

BEFORE: THOMAS K. CHENAL, Chairman
LAURIE WOODALL, Arizona Corporation Commission
LEONARD DRAGO, Department of Environmental Quality
JOHN RIGGINS, Arizona Department of Water Resources
GIL VILLEGAS, JR., Counties, Appointed Member
JACK HAENICHEN, Public Member
RUSSELL JONES, Public Member

APPEARANCES:

For the Applicant:

SNELL & WILMER, L.L.P.
By Mr. J. Matthew Derstine
One Arizona Center
400 East Van Buren, Suite 1900
Phoenix, Arizona 85004

and

TUCSON ELECTRIC POWER COMPANY
By Mr. Marc Jerden and Ms. Megan J. DeCorse
88 East Broadway Boulevard, MS HQE910
Tucson, Arizona 85701

CHMN. CHENAL: Good morning, everybody. This is the time set to begin the hearing on the application of TEP for the two CECs.

Let's start with a roll call of the members of the Line Siting commission who are present, starting with Mr. Villegas.

MEMBER VILLEGAS: Gil Villegas, present.

MEMBER DRAGO: Len Drago, present.

MEMBER RIGGINS: John Riggins, present.

MEMBER HAENICHEN: Jack Haenichen, present.

MEMBER WOODALL: Laurie Woodall.

CHMN. CHENAL: And Tom Chenal, present.

So we have a quorum. Certain of the members could not make this hearing. Others, Member Jones is on his way; he will be a little delayed. Member Palmer will be here tomorrow. We will have a few people in and out, but we have a quorum to start the hearing.

May we have appearances here.

MR. DERSTINE: Mr. Chairman, members of the Committee, Matt Derstine with Snell & Wilmer; Marc Jerden, senior counsel for Tucson Electric Power Company, and Megan DeCorse, regulatory counsel, Tucson Electric Power Company.

CHMN. CHENAL: All right. Thank you very much.

Before we begin, let's just make sure of a

couple ground rules here. I know the applicant has been to hearings previously, but members of the audience, we as members of the Committee cannot speak on substantive matters with the applicant, obviously, or parties or the public other than on the record, unless there are certain procedural matters that I can deal with off record, but then, when we come back on record, we will have to put that on the record.

I see we have a good sound system, and the logistics seem to be in order. Let's talk for a moment about the hearing, anticipated hearing time. And then we will talk about a tour, which, as people know, if one member wants to go on the tour, we will have the tour. And I know there is one member who wants to go on the tour, and that's me, so we are going to have a tour. You are all invited.

But Mr. Derstine, if you could just kind of give us, the Committee, kind of an anticipated hearing time for this hearing and when the tour would take place, that would be helpful. Thank you.

MR. DERSTINE: Okay. Mr. Chairman, our suggestion to yourself and to the members of the Committee is to proceed with a short opening statement from me, and then to move on to a Google Earth simulation of the project, which I think would give some

context and an overview for a tour. So our suggestion is to do the Google flyover ahead of our suggested tour, and then we may have time before the lunch break to start with some testimony from our witness panel. First up would be Mr. Beck.

And then my understanding, our suggestion -- and I think we have discussed this in our prehearing conference -- is to break for lunch and then to do our tour after lunch. It is approximately two hours. So the tour would run from 1:00 to 3:00, approximately, and then we could reconvene, move forward with the presentation of our case and our witness panel, and then we would break, I think at 5:30, for public comment.

So that's today. And then depending on how far we get today, I think we are certainly going to, you know, use up tomorrow. Mr. Beck has been optimistic that we may go faster than anticipated and we may not need the full three days; we will have to see.

But I think certainly we will use up all of tomorrow to get through our case in chief, talk about a CEC, and kind of do that process of working through the conditions for two separate CECs, which can take some time. We are going to try to do it as efficiently as possible, screening through both CECs and conditions.

So certainly today and tomorrow that's the

outline, and we would finish up either with testimony tomorrow and working through CECs on Friday, or if we are able to get through our case and get to the conditions, we may possibly get done tomorrow.

CHMN. CHENAL: All right. Very good.

Can I have a show of hands who may be interested in going on the tour.

All right. Let's go. Thank you. So we will have a tour.

MR. DERSTINE: All right.

CHMN. CHENAL: I forgot to mention we will take a break every 90 minutes, give Colette an opportunity to rest her hands.

All right. One housekeeping item. We had a potential intervenor, the Sierra Club, who appeared at our prehearing conference through attorneys appearing by telephone. But they have decided not to -- Sierra Club decided not to appear as an intervenor, but has filed a statement in writing, which the statutes authorize.

So I will make that a Chairman's exhibit, and I will ask the applicant to address the substantive matters as set forth in the statement in writing from the Sierra Club.

I will also have an exhibit, the standard letter that I write to the Corporation Commission, and we have

a response from the Corporation Commission with respect to this application, and I will make that an exhibit as well, Chairman's exhibit.

And thirdly, I will have some suggested, I don't want to say changes, but suggested language that we should discuss as part of the CEC deliberations. And since we have two CECs, I have some copies that I will, after I make them an exhibit, I will pass out and people can have a copy in writing, and I will provide the applicant with a Word version of it.

And then we should discuss as we get closer to the deliberation phase kind of the procedure we want to follow for -- as how we deliberate and go through the CEC, because we have two of them. And I think, you know, I think through trial and error we may have figured out the best way to do this, but we want the record to be clear so anyone looking at it later can read the transcript and understand what documents we are looking at. So I think we just have to be careful how we do that.

MEMBER WOODALL: Excuse me, Mr. Chairman.

CHMN. CHENAL: Yes, Member Woodall.

MEMBER WOODALL: Is there a way we could get copies of the Sierra Club statement? Perhaps the applicant could do us that so we can see that. And if

we could have copies of your proposed language before we enter deliberations, like sometime tomorrow, that would be helpful.

CHMN. CHENAL: I will certainly do that, yes, Member Woodall. And I think the applicant indicated they would get us copies of the Sierra Club statement.

MR. DERSTINE: Mr. Chairman, Member Woodall, we filed, the applicant filed a supplemental set of exhibits on January the 16th. That supplemental set includes the Sierra Club's written comments filed on January 12th; that's TEP-15. Our supplemental exhibits also include Staff's letter to the Chairman; that's TEP-14. And our proposed CEC's for the RICE project and the transmission relocation project were filed with our original exhibit binder that should have made their way to Committee members by mail from Docket. And those are identified as TEP-12 and TEP-13 in the first exhibit binder.

So you should have two binders, our original exhibit set that presumably you bought with you -- and if you didn't, we have additional copies here -- and then we have a supplemental exhibit filing that was before all of the Committee chairs here on the desk there, and you should have that. And that includes the Sierra Club comments and Staff comments.

MEMBER WOODALL: Mr. Chairman.

CHMN. CHENAL: Member Woodall.

MEMBER WOODALL: So you are saying you made the filing yesterday with Docket Control, and you thought we might have it here today, or you have copies for us today?

MR. DERSTINE: Member Woodall, we made the filing yesterday and you have it before you in that binder. And it wouldn't be the binder you brought with you. It would be the binder sitting in front of your chair when you arrived this morning. If you don't have one, we will get you one.

MEMBER WOODALL: Then I don't have one.

I am happy. I require only one.

MEMBER HAENICHEN: We are swimming in these.

MEMBER WOODALL: Thank you very much.

CHMN. CHENAL: All right. Thank you.

Well, in that case I won't make the Sierra Club, ACC documents Chairman exhibits. They will already be in the record.

I noticed that we have some iPads here. Perhaps we could get an explanation of how the documents that are loaded in it, how we can access them before we begin with the opening statements.

MR. DERSTINE: You bet. So we have got on the

left screen, that should be what you see on your iPad when you pull open the cover. And you will want to click on the Adobe icon. And once you do that, you should see the screen that's there. It is the main directory of documents contained in the iPad.

And then if you click on any of those items -- and why don't we, Ranie, why don't you click on the supplemental exhibit filing. That will take you to our supplemental exhibits filed on January the 16th. And then if, once that's opened to that page, click on the book icon on the bottom right. That will show you the sub directory of the items contained in that exhibit filing. And that will give you access to TEP-4A, which is Mr. Beck's hearing presentation that he will use today to support his testimony, as well as TEP-6A, which was Ms. Darling's supplemental hearing presentation that she will use today, and 8A, which was Mr. Spencer's hearing presentation. It will also be under that sub directory that will give you access to Sierra Club comments and Staff comments that we just discussed.

Does that seem to be working for everyone?

But again, we have good old-fashioned paper exhibits. If for some reason you don't have the two binders, the original binder that was sent out by Docket, as well as the supplemental filing, please let

us know; we have got exhibits or extra copies. We also have extra paper copies of the application if someone would prefer to review that or take a look at that.

CHMN. CHENAL: All right. Any questions on the iPads or the documents loaded in there?

I think that's very helpful. Thank you. I applaud the applicant for that. That's very helpful.

All right. Are there any questions from the Committee before we begin the opening statement and start the hearing?

(No response.)

CHMN. CHENAL: I don't see any.

Are there any other housekeeping items, Mr. Derstine, we should discuss or that the applicant wants to raise before we begin?

MR. DERSTINE: I don't think so.

If you didn't know, we had breakfast just down the hall. We will also have lunch in that same room before we take the tour at 1:00. And I guess breakfast will be served tomorrow, and assuming we proceed on Friday, same schedule, breakfast and lunch, no dinner. We won't force you to eat the hotel's food three times in a row, so you are on your own for dinner. And I think that's it.

Oh, I am sorry, and then there are refreshments,

coffee, et cetera, here at the back, and snacks for the 90-minute breaks that we are taking throughout the course of the day.

CHMN. CHENAL: All right. Very good.

Member Haenichen.

MEMBER HAENICHEN: Regarding that subject, you are just talking about -- tonight is going to be a problem, though; there won't be time to go out and eat, right?

MR. DERSTINE: There will not be time to go out to eat between when we finish at 5:00 and the public comment at 5:30. But we moved it. We had been waiting until 6:00 to start public comment. What we thought we would do is push the public comment up and so that, you know, you would still be able to get out at a reasonable time for dinner.

MEMBER HAENICHEN: Okay. Thank you.

CHMN. CHENAL: Okay. I think unless there is anything further, Mr. Derstine, we can begin with opening statements.

MR. DERSTINE: All right. Let's see if I can navigate my pointer here. There we go.

Mr. Chairman, members of the Committee, good morning. I was reminded yesterday that the lawyer is not the show, that the witnesses, the exhibits, and the

record are what is important. So I will try to take those comments to heart and give you a short opening statement. But at the same time, I think it is important to give you an overview of our case and how we are going to present it to you today.

If I think about some of the recent cases this Committee has heard, you know, two large interstate transmission projects that were merchant projects that were pushing wind from New Mexico over to the Palo Verde hub and into the California market, and most recently the case that we participated in. We had a case that involved a merchant element. That is the DC interconnection that opened the door for bilateral power sales with Mexico.

This is not a merchant case. This is a case about reliability. It is a case about how Tucson Electric Power Company can continue to provide safe and reliable power to its customers with the increasing use of renewables, the intermittency that those create on the grid and on TEP's system.

The applicant, as I mentioned, is Tucson Electric Power Company. And in the Nogales case you heard from the applicant -- well, one of two applicants was UNS Electric. UNS Electric is a sister company to Tucson Electric Power Company. UNS Electric serves

Santa Cruz County and portions of northern Arizona. Tucson Electric Power Company serves generally Pima County and the City of Tucson.

As the Chairman mentioned, our application requests two CECs for two projects, so one applicant, one application, but requesting two CECs for two projects.

Let's see if I can get this thing to work right. I just bought this clicker on Amazon, so I am still working through it.

The two projects, the first project is a generation project. It is referred to or known as the reciprocating internal combustion engine generation project. We will refer to it as the RICE project and the individual engines as the RICE units.

The second project is a transmission project. It is known as the Irvington 138kV transmission line relocation project. We will refer to it as the transmission project, or the transmission relocation project.

So the RICE project is ten individual RICE units, or RICE engines. Each unit is rated at 20 megawatts, and they are natural gas-fired. That's what one looks like. You can get some sense of the scale from the stairway for the access, as well as the

size.

It is housed inside a building. It is essentially, as it has been described to me, and Mr. Spencer and Mr. Beck will go into greater depth and detail about them, but it is a big motor not unlike the one you have in your car, and cooled by a big radiator. So it is a closed cooling system.

The transmission project is 2.6 miles of 138kV line and structures. And the transmission project is being built to allow for the relocation of a substation and to increase and modify the substation to have greater capacity, so breaker and a half capacity from the original.

And there is -- you can see in the orange, and you will get a much better view of it from Mr. Beck's testimony in terms of where those 2.6 miles of transmission line and structures will be located and how they are routed.

You will note that what you don't see there is a bunch of alternative routes. What you oftentimes see in our cases and other cases are blue lines, green lines, red lines for alternative routes. We are proposing essentially one route and a 500-foot corridor. And the reason for that is this entire project is being located on land owned by TEP, on TEP's Irvington campus. The

campus is used for -- houses the Sundt generation system as its TEP control operations, and various other business operations.

That's where the Irvington campus is located. You will see it kind of sits between the Davis-Monthan Air Force Base towards the east, and bounded on I-10 the southwest, and runs along Irvington Road. That's the access gate, and that's where we will be entering when we take the tour.

That's what the Irvington campus looks like. It is an existing industrial site. It is located in Tucson. And again, it contains currently four steam generators, two combustion turbines and various other operations, including a concentrated solar facility.

So what is the purpose and need for these two projects? The RICE project provides flexible generation needed to offset intermittency associated with renewables. You will hear extensive testimony from Mr. Beck and Mr. Spencer about the intermittency of renewables and the challenges that Tucson faces in dealing with renewables already on its system, as well as the increasing use of renewables out into the future and the challenge in terms of Tucson achieving its goal of 30 percent renewables by 2030.

Now, the transmission project, as I mentioned,

accommodates the relocation of the substation, an existing substation on the Irvington campus, allows them to move it and build this new larger substation, again on the same project campus.

And although both projects are being built on an existing industrial site, TEP went through the same environmental analysis, you will hear from Ms. Darling, in terms of the biological, land use, archeological, all the environmental impacts and the factors that are in 360.06 that this Committee is charged with taking into account, considering we did all that work, we performed all those studies, and I think what the testimony you will hear will establish is that these two projects will have minimum environmental impacts, and they will allow Tucson to expand its use of renewables.

So in terms of the case presentation, I gave you an outline already. We will have a tour; that's already been decided. The tour will roughly take two hours. We will show you the existing substation, where the new transmission lines will be located on the Irvington campus. We will show you the proposed site of the RICE generation units, as well as the other features of the Irvington campus.

Mr. Beck will walk through the proposed tour, but that also involves a stop at Tucson's control center

so you get a sense that Tucson acts as its own balancing authority and what happens there and how that function is being performed.

Our witness panel, you see these smiling faces there, that's Conrad Spencer, who is the director of Tucson power generation, he is also the project director for the RICE project; and Ed Beck, who you know is the director of transmission development; and Renee Darling, who is our senior environmental planner.

As I suggested, we would like to do a Google flyover -- I'm at the conclusion of my opening statement here -- and give you a sense of -- you have seen some photos from my opening statement slide presentation, but I think the Google flyover will give you a context and greater understanding of the project area and what we are proposing to do through the application.

We have gone through the iPads and talked about the exhibit binders. Again, if you have any questions or you don't have a particular exhibit, let us know, and we will get it for you.

The placemat, it wouldn't be a siting case without a placemat. And on one side it shows the transmission line relocation project, and the other side has the RICE project and some of the features of that. And you can use that for reference. That's the purpose

of it.

I don't know how long the Siting Committee has been using the so-called placemat. Maybe Ms. Woodall does.

MEMBER WOODALL: I actually do know. It was Ken Sundlof's idea for SRP. And he should be given full credit, and every opportunity that I have I do so, because he is not going to do siting cases anymore. So...

MR. DERSTINE: Oh, okay.

MEMBER WOODALL: So hip hip hooray for Ken Sundlof.

MR. DERSTINE: Kudos to Ken Sundlof.

And I guess on that note, not doing siting cases anymore, I just wanted to make a note that Marc Jerden is here. I announced his presence. He is the gentleman sitting back here at the table. Many of you know Marc. But this will be Marc's last siting case for Tucson Electric Power. He is passing the baton on to Megan in the role and handling siting issues for the company.

And so it has been great to work with Marc. I think Marc -- Marc doesn't forget much, but I guess, as the phrase is, he has forgotten more than I will ever know about siting issues. So we wish Marc the best of luck in the future.

So we talked about that that's our case, that's how we are going to present it. And again, it is a reliability case. It is different than many of the cases you have seen before. This project is entirely to be sited on an existing industrial site, a generating station and other land owned by TEP, approximately 365 acres. The RICE units are needed to deal with intermittency and allow Tucson to provide safe and reliable power to its customers.

And at the end of this case I am going to ask you for two CECs, one for the RICE generation, one for the transmission. And we think that the record amply supports the need for this project and that it has minimum environmental impacts.

Thank you.

CHMN. CHENAL: Thank you very much.

Any questions by the Committee?

Member Haenichen.

MEMBER HAENICHEN: Thank you.

Mr. Derstine, maybe I just didn't remember or read properly, but is there a new substation to be built for this as well?

MR. DERSTINE: Yes.

MEMBER HAENICHEN: Because a moment ago you said that the CECs would be for a transmission line and for

the RICE, didn't you? Where was the other one included in the --

MR. DERSTINE: So the substation is not formally included in the application. Substations -- although switchyards are called out within the language of the statute, substations are not. So we have not applied for authority under our CEC to construct the substation. But we certainly will present evidence and inform you about the substation, the need for relocating the substation, as well as increasing the capacity of the substation, not only to support the RICE project but also to support TEP's system in general.

MEMBER HAENICHEN: I must confess I wasn't aware of that. Thank you.

CHMN. CHENAL: Member Woodall.

MEMBER WOODALL: I would appreciate it if one of your witnesses could explain why you are using multiple 20 megawatt units rather than a single 100 megawatt unit. And I would also appreciate it if someone could tell me if each of these units is a separate thermal generating unit with a nameplate rating of 100 megawatts or more. And if you could explain that, if someone could explain that to me, that would be helpful.

MR. DERSTINE: Okay. I can address the second point. Mr. Spencer will address your first question

about why we are using ten 20 megawatt rated units as opposed to one big 100 megawatt unit. We will present that in the testimony.

As to your second question, I assume what you are addressing may be the call and the coverage of the siting statute.

MEMBER WOODALL: I am, sir. I just wanted to get something on the record of proceedings about that issue.

MR. DERSTINE: Well, and it is an interesting point you raise, and one that was not without debate internally at the company. And we even had conversations with Staff. And I think it was even raised maybe informally with the Chairman at one point long before the filing of this case.

But you are right, that in terms of the definition of plant, under the siting statute it is for a nameplate rated generation of 100 megawatts or more, and these are not. But we were left with the question of we have got ten -- we want to install ten 20 megawatt units in two phases, or presumably maybe all at once.

And Mr. Spencer can speak to the timing, how they are going to be installed, but ultimately we are putting in 200 megawatts of new generation in a load pocket within Tucson. And rather than face arguments

potentially from Staff or others that, hey, you should have sited those units, we presented them and the case for them in our IRP, in our recent IRP filing.

But we are proud of this project. We think it serves an important need. And the decision was ultimately made to bring this case forward as a siting case, even though, as Mr. Jerden has pointed out to me several times, the siting statute does not require us to seek a CEC, at least in our interpretation of the statute.

Now, I will tell you candidly that Staff feels otherwise, and believes there is precedent for, if you are installing multiple units that rise to the level of the 100 megawatt nameplate, you can't get around the siting statute by installing 95 megawatts, or that would be a way to circumvent the siting statute by going just under the 100 megawatt nameplate rating. Bottom line, we decided to bring this forward through this process.

MEMBER WOODALL: Thank you for that clarity. And now it having been discussed on the record, I will have no further questions about it. Thank you very much, sir.

MR. DERSTINE: You bet.

CHMN. CHENAL: Well, let's begin with the case then, the applicant.

MR. DERSTINE: All right. I think we will start by swearing our witness panel. For efficiency we can do it all at once.

CHMN. CHENAL: Yes. Would you please raise your right hands.

(Edmond Beck, Renee Darling, and Conrad Spencer were duly sworn by the Chairman.)

MR. DERSTINE: I passed the pointer baton to Mr. Beck. I am sure he is better at using it than I am, but I think, as we suggested, this would be the appropriate time to have Mr. Beck run through the Google simulation, the flyover. And with your permission, we will proceed with that.

MR. BECK: Chairman Chenal, members of the Committee, this is a Google flyover presentation that we have put together for both projects. We have several segments of this flyover that we are going to do, but just as a starting point, on this slide you will see the project layout, the overview of the Irvington campus. You are going to see this same picture throughout our hearing process.

The RICE project is in the relatively mid portion of the southern edge of our property. Right next to it will be the new 138kV substation. And then we have transmission lines extending from the existing

substation, which is on the western edge of the campus, to the new site, as well as we will talk about a triple circuit that we are tapping into the new site as part of the project.

So with that, we will move on to the flyover. The first segment will be regarding the RICE engines themselves. You will probably see this view again in a few spots that we started with. Here we are flying over the RICE location. This is where the generation will be. This diagram is actually showing the individual units. And we will talk a little more later, but they will be contained within a building or a shelter.

We are going beyond the RICE and substation site just to give you a little bit of context regarding the campus itself. Unit 4 of the Irvington generation site was burning coal up until recently. This area here was the dry stack coal storage area. This was the offloading structure for coal.

We have a rail yard or a siding that comes in along here. The coal trains would come in, each unit would end up in that building. It is a rotary car dumper where the whole train car would be turned upside down to dump the coal into a huge pit that's underneath this building, and then it could be dry stacked out to dead storage, or it could go up the conveyor to the

generating unit.

All of these facilities are going to be removed ultimately as we further develop the campus. This tower is going to be the first portion that comes up where our structures go. We are dismantling the conveyor belt that currently leads, or did lead up to the Sundt unit. That's being done.

You also see some evaporation ponds here in the picture. When we go on the site tour you are going to see they are not there anymore; at least a couple of them are completely gone. Because these, as you can see on the edge of this picture, that's going to be part of the 138kV substation.

So we are just going to kind of circle back around. Again, this is the RICE location right here. In a little bit of distance you will see some mirrors for a concentrating solar, supplemental heat source to the power plant. You will see that on the tour this afternoon.

As I mentioned, these units in this particular diagram are shown as the individual RICE generation units. And so that's why there is, if you want to say, so much clutter in this particular drawing. As I said, these will be enclosed by buildings, each set of five. And there will be another structure in the middle for

some of the electric components that connect everything.

All of the units will exhaust out to their stacks, which will be located basically just to the north of the power block area. There will be individual stacks in each of those locations, 160 feet tall.

Here is the siding that was part of the coal delivery for the plant. And it will provide an ideal spot for us to bring the units in, the RICE units, and offload the components. They are very large, very heavy.

So now we are going to talk about the transmission facilities that we are going to construct. We have an existing triple circuit. You may or may not be able to see right here is the existing triple circuit lattice structure. It is in the underlying Google map system. The blue is the representation of our model. And that's the starting point of where we put this Google flyover together.

So we are going to fly in this direction, towards the RICE units. We are making no changes in this portion of the line. The only change will be made -- well, one change that will be made is going to be right here where we will put two turning structures into the existing line. We will remove the existing triple circuit lattice, and the three circuits will come

in and three circuits will go back out. That's to connect the substations. All of these lines are part of our 138kV system throughout Tucson. In my testimony you will see a little bit of that, what that 138 system looks like. But this is the tap in of the triple circuit structures.

We are going to kind of loop around and then just continue on that existing triple circuit alignment. Through this area you can see the triple circuit lattice structures; again, no change throughout this area. It will be the last structure on our campus right here, there is a lattice structure right here that will be removed. It is going to be replaced by this turning structure, just to provide a little more clearance and room for equipment to move through. And then we connect back up to the lattice that's on the other side. And we will make no changes to the lattice off campus. So that's one segment of what we called kind of the repurposing or reuse of the 138 facilities.

Here again, you are seeing the plant. Just point of information, this is the Sundt Unit 1, 2, 3, 4. When it was converted to coal, we put in a large stack for the coal. There is other stacks that are harder to see, but they are for Units 1 and 2 and 3. And then Unit 4 is the very tall stack. It is 240 feet tall. So

you will hear later about the relative issue of we are penetrating airspace for the DM air base with 160 foot tall stacks for the RICE units. But we already have 240 feet approved with DM. So it just gives a little bit of context.

Again, on the tour we will talk about some uses for these oil tanks. We are getting some revenue off of those.

Right here you see the 138kV existing yard. And I will point out this is the original 138kV yard. That is a main and transfer construction. When we wanted to add some more circuits into the Irvington complex, new transmission lines coming in, it is hard to see, but back in here a ring bus satellite extension of the yard was built. And it allowed us to put a couple more connections, but there is no more room to build, to expand whatsoever for the 138 system there. And we will also -- I will talk later about the conversion to breaker and a half, but very confined as far as space goes for any 138kV work. That's part of the reason for relocating the 138kV substation.

So we will continue on along this path here. We are going to come here. We are extending some of the existing circuits and also connectivity into existing plant facilities along these multiple lines. We are

going to fly along this path, which is a double circuit 138kV.

To the point that was made by Mr. Derstine, we don't have alternative routes shown. We did the best we could to identify the best locations for these alignments across our existing site considering all our future plans and uses, as well as existing uses and travel patterns that we have on the site. That double circuit will come in, drop into the station here, provides two more points of connectivity to our system.

Now we are going to loop around through the 138 station, and we will go along the northern circuits coming out of the yard. Again, this is the 138kV substation. Now we are following this path here. We come and parallel the solar facility, and then we come up along one of our roads here, come in behind some cooling towers, up to a point at this corner.

At this corner, even though this is not part of the case, but it is a point of information, these are 46kV structures. We are relocating both our 46kV and 138kV substations to be adjacent to each other near the RICE structures. This big lattice structure, this here, as well as another on this corner, that one, will ultimately be removed as part of the overall project as we go forward. So it is going to clean up the view or

the viewshed considerably on the corner of our property. And again, you will get to see those this afternoon.

You will see here the corner of a parking lot. This is the parking lot for our employees for the plant. And adjacent there is another parking lot which is for the control room personnel, which is what we will be visiting this afternoon.

And that was our Google flyover. Any questions relative to what you have seen? I know there is a lot of information there, but...

CHMN. CHENAL: Member Haenichen.

MEMBER HAENICHEN: Thank you.

Mr. Beck, I have a series of questions that I have, came up after looking at the fly, flyover.

How is heat rejected from these 20 megawatt units?

MR. BECK: Mr. Chairman, Member Haenichen, the heat, it is a closed radiator system, so it is very similar to your car that you drive. So rather than having cooling towers and all the steam and the resultant loss of water that goes with typical steam generation, this closed system will just continue to reuse that water. The radiators are just an air cooled, very similar to your vehicle, just much larger.

MEMBER HAENICHEN: But isn't it true that the

conversion efficiency of fuel to electricity is lower when you cool with air as opposed to evaporating water?

MR. BECK: That is true of gas turbines. These engines and this generation is made to be operated in this fashion. It is not made for wet cooling. It is strictly designed and engineered for a closed loop radiator system.

MEMBER HAENICHEN: Okay. Well, given your statement that you just made, if you had used combustion turbines instead of the ones you have selected, what is the efficiency of the two compared -- comparatively overall efficiency? BTUs in, into BTUs of electricity out?

MR. BECK: We will have some of that in both mine and Mr. Conrad's testimony. But just at a very high level, I believe the heat rate for the RICE units is in the upper 8,000s, 8500, and the gas turbines are in the range of 9,000. So there is slightly less efficiency from that standpoint for the RICE units.

But as you will hear in our testimony, the ability to turn these units down and operate them at a much lower level is a big economic savings overall for our customers.

MEMBER HAENICHEN: And you can't do that with a combustion turbine?

MR. BECK: Correct. They have a limited amount of turndown they can do. And they are usually larger units. Even if you could turn them down to 50 percent, you are still much higher output than what TEP requires for a minimum gen requirement.

MEMBER HAENICHEN: So when you finish this system and operate it, presumably this is, what, a backup for the intermittency of renewables you are planning to add? Is that the main reason for doing this?

MR. BECK: Primarily. And you will hear again in our testimony we have a minimum gen requirement in the city. And we anticipate having one unit operating at about half power, 10 megawatts, probably almost all hours of the year. And that will meet the min gen requirement we have for voltage support for our system. That is compared to today where we are putting one of the Sundt units on and running it at its minimums, which the minimum is much larger, much greater than that 10 megawatt value.

MEMBER HAENICHEN: Okay. Shifting gears here, on the flyover, that existing transmission system that you are going to use for getting energy from the RICE project to the substation?

MR. BECK: Right.

MEMBER HAENICHEN: -- you said there will be no changes to it. So was it built with enough capacity to handle another 100 megawatts? Is that what you are saying?

MR. BECK: Well, let me put it this way. The transmission lines that we are modifying and extending are really to change the connectivity of all the circuits coming into the plant site from our other substations. So we are relocating those to the new substation, as well as providing connectivity for the Sundt generating units themselves, as well as gas turbines back to the new substation. The RICE units will connect into the new substation.

But today we have the two Sundt units, 1 and 2, that total 160 megawatts. So we are going to be adding 200 in, but doing away with 160. So it is only an additional 40 going into the substation spread across all of the lines that we have. So capacity-wise, yes, we have enough capacity.

MEMBER HAENICHEN: Okay. Thank you for that clarification.

Let's see if I have anything else here. Assuming this project were to be approved, did I hear correctly that you are going to basically build a new substation and eliminate the existing substation?

MR. BECK: Ultimately we will totally eliminate the existing substation, and the new substation will be it. There will be a 138 and a 46kV substation replacing the two existing substations.

MEMBER HAENICHEN: Could you explain a little bit about interruption of service during that procedure. You are going to build the new one first completely and then just switch the wires around, or --

MR. BECK: Well, we are phasing the project. We are working through the details of exactly how to phase it. But the plan is to build major portions of the new substation, and then we will cut individual circuits over time. So it won't be done all at once or overnight.

MEMBER HAENICHEN: Okay. One final question that I have on the placemat. The third item from the bottom says reduces water use on-site by 70 percent. Compared to what? Compared to if you built this the way your existing runs, water cooled?

MR. BECK: You will hear more about that in the testimony, but the bottom line is that ultimately when we get the RICE units in, we will be retiring Sundt Units 1 and 2, the 160 megawatts. So they will be mothballed in place. We won't be using them. And the associated water use that those utilize today is where

we have the 70 percent savings.

MEMBER HAENICHEN: That answers my question beautifully. Thank you.

CHMN. CHENAL: Member Woodall.

MEMBER WOODALL: Mr. Beck, at some point could you explain to us what is the difference between a switchyard and a substation, because I know on occasion there has been some differing interpretations, and during the orderly course of your testimony.

MR. BECK: I could do it during testimony or I could do it right now. I think it is a pretty simple answer.

MEMBER WOODALL: Okay.

MR. BECK: A switchyard does not have any transformation, any transformers in it. A substation does have transformation within that facility. And in this 138kV substation we do have two transformers associated with it, stepping the voltage down to 46kV.

MEMBER WOODALL: This is really asking you to speculate, but why do you think that the siting statutes would cover switchyards but not substations? Is there a rationale that you could consider? And if you're just picking something out of the air, then I won't ask you to do that. I am just curious.

MR. BECK: Member Woodall, I can't speak to why

the statutes were written the way they were. There is an interesting split between ACC, where ACC has jurisdiction over switchyards, and in Pima County, Pima County has taken over jurisdiction over substations. And the reasoning for the two being different, I do not know. I am not sure what the basis of that was. Other than when the transmission lines are being built, typically you always have, almost always have a switchyard associated with them at some point. Substations are more specific to distribution and other reasons for stepping down the voltage.

MEMBER WOODALL: Mr. Beck, thank you so much for that informed speculation.

CHMN. CHENAL: Member Riggins.

MEMBER RIGGINS: Thank you.

Mr. Beck, I just had a quick question. And this might be something that is covered in the testimony, but on the flyover I was noticing, and I didn't hear, is there any discussion or part of the project to move evap ponds or have any evaporative ponds anywhere else on the property, or does this type of cooling system require, like similar to the preexisting generating station, evaporative ponds?

MR. BECK: Member Riggins, the ponds that we are eliminating will be gone. They are not needed anymore.

MEMBER RIGGINS: Okay.

MR. BECK: We will be maintaining, I believe, one pond on the site for runoff water. I believe we have it in the testimony; if not, I know it is in direct testimony, some statements about we signed a deal with the City of Tucson, Pima County on effluent from the site. So we are actually discharging a lot of our wastewater to the county sewage system.

MEMBER RIGGINS: Okay.

MR. BECK: And there is a cost to that. And I believe in our direct testimony we have some values of what those numbers look like.

We will reduce that level of output to the county sewer system, and have a savings associated with that. And we will only have the one pond on-site for basically just on-site drainage issues.

MEMBER RIGGINS: Run off, okay.

MR. BECK: So the ponds that are there are being eliminated --

MEMBER RIGGINS: Okay.

MR. BECK: -- not specifically related to the RICE project, but the RICE project drives the need for the land and we don't need the ponds. So we are removing them.

MEMBER RIGGINS: Okay.

MR. BECK: And also they reached the end of their life as far as the liner system.

MEMBER RIGGINS: Okay. Thank you. And thank you. Renewables was going to be my next question. So thank you.

CHMN. CHENAL: I had a question, Mr. Beck. You mentioned one of the facilities converted to coal from something else as part of your testimony. That caught my attention. What did it convert from? Oil?

MR. BECK: Mr. Chairman, it converted from oil and gas, which was the original plant design for the four units at Irvington. I think it was actually TG&E at the time was ordered, I believe, by the EPA or -- it was a federal requirement. I am not sure which agency ordered us to convert to coal. It was the time when the future of gas was uncertain, and coal looked to be plentiful and cheap.

And so under order we actually converted Unit 4 to burn coal. We actually had plans to convert another unit also to coal. The rules changed and we scrapped those plans. And, in fact, we had some of the materials for that conversion that we didn't have a need for after that. So we had to sell those at rather cheap prices.

CHMN. CHENAL: Okay. Thank you very much. I thought that was very informative.

Any further questions from the Committee?

(No response.)

CHMN. CHENAL: Okay. Mr. Derstine.

MR. DERSTINE: Mr. Chairman, would you like to proceed -- I think we have slated next would either be Mr. Beck's direct testimony, or he can run through the proposed tour. Or would you rather do the tour towards the end? We could slide it now. You have just seen the flyover. He can show you the tour. And then we can proceed with testimony, if that makes sense.

CHMN. CHENAL: Let's do the tour. Let's talk about the tour now, and then we can decide where we are after that.

MR. DERSTINE: All right.

MR. BECK: Shortly we will bring up the verbal description as well as a map of the tour route that we are planning. So our intent is to start at 1:00 p.m. this afternoon from the hotel here. We do have a bus arranged. We would head down Alvernon to our plant site several miles away from here. So starting at Doubletree, we will come down to the Irvington campus.

Patrick, do we have Map 2?

So once we get to the Irvington campus, we will come in our northern gate here. We will travel down to this training center, which is right there. We are

calling it Stop 1. We intend to get out there, go into a conference room. Mr. Spencer will give a little bit of overview of the plant as well as talk about safety issues and maintaining safety on the plant site.

We will then reload onto the bus and head out to our Stop 2, which is the RICE generation location. Mr. Spencer will talk about the generators, more or less what the site will look like. He will explain a little further about some of the facilities that we can see that either have been removed or are in the process of being removed or will be removed on the site, in particular regarding the coal handling equipment facilities out there.

We will also talk about the 138kV substation and just generally where it is located, showing you the triple circuit that will be tapped.

Then we would get back on the bus and proceed from Stop 2 to Stop 3, which Stop 3 will be back where our existing 138kV and 46kV substations are located today. You will see that location. You will see the construction of that substation is old lattice, very old design. So you are going to see how congested from just the amount of steel that's in that facility there is.

And then we would continue from Stop 3 to Stop 4, which is across our campus. It is our TEP

training facility. We thought, well, you are here and you have the opportunity, it would be good just to point out how we train our people and some of the facilities that we have here.

And as we are driving across the campus to get there, we will point out some of the other future modifications on the site. You will hear a little bit in testimony about the planned area development plan that we are working with the city. And that is directly as a result of a lot of the other facilities we are putting on this site. But in preparation for the RICE units we started that process to get the grading permit.

And then we will get back on the bus, head over to Stop 5, which is back near the gate we came in. That is the TEP control center. We will take you into a room adjacent to the control center. It is a viewing room with glass windows, glass walls you can look out. And we will explain what our operators are doing and how we operate the system at a very high level, hopefully give a little of context to what we are talking about. And that would be the end of the tour.

We anticipate approximately two hours, give or take, depending on the level of questions out in the field. I know we want to limit our discussion in the field to some degree. And I guess one question that I

have is on the pieces that are kind of informational and informative, whether or not they go on the record or not just from a court reporter standpoint. She was asking a few questions about that, so...

MEMBER WOODALL: Mr. Chairman, I personally would like everything to be on the record so that the Commissioners have the benefit of everything that we have heard. That's my personal --

CHMN. CHENAL: I think that's a better way to do it. But in deference to Colette, maybe we can give a modified summary, like a summary of the comments on-site when we get back. Mr. Beck, you can give a fuller description, you know, to the extent the members want to hear that.

MR. BECK: Yeah. And I think to the extent things we will be talking about in the testimony, we could say we would like to defer to, to the case.

CHMN. CHENAL: Sure, sure. All right. Very good. That looks like a nice tour. And I think it is going to be interesting to see the control room and get a little context, because we see little bits and pieces of the system, let's say, and it is nice to see kind of the -- get the bigger picture and actually be able to see it and see how it fits together. So I think that's very helpful.

MR. BECK: Mr. Chairman, that was kind of our thought, was that, knowing that your tours are usually out in the field out in the middle of nowhere, we are right there at our facility, it was a great opportunity to show you the control room as well, like I say, the training yard and a few other things we are doing on campus that are additional revenue generators that help offset our cost to customers.

CHMN. CHENAL: Good. I think we look forward to that.

Mr. Derstine, let me ask you a question. I have heard it Derstine and Derstine. I want to get it right because I am getting embarrassed when I am saying your name and getting it wrong.

MR. DERSTINE: No one should get embarrassed saying Derstine. I say Derstine. But I may be wrong.

CHMN. CHENAL: All right. Mr. Derstine, we will go ahead.

MR. DERSTINE: It works if anyone calls.

So it is 11:15. I don't know if you would like to take a short break and start with Mr. Beck, plow forward and use the 45 minutes up to lunch time.

CHMN. CHENAL: Let's take a short break. This will be a nice time for a break take. We will take ten minutes and resume after that. So we will go off the

record.

(A recess ensued from 11:14 a.m. to 11:32 a.m.)

CHMN. CHENAL: Are we ready to resume the morning session?

And Mr. Derstine, we are going to start with Mr. Beck, is that correct?

MR. DERSTINE: Mr. Chairman, that's correct. Ms. DeCorse is going to present the direct testimony of Mr. Beck.

CHMN. CHENAL: Wonderful. Before we begin, for those of us using the iPad, if we want to follow Mr. Beck's presentation, we go to the supplemental exhibit list, is that correct?

MR. DERSTINE: That's right.

CHMN. CHENAL: And then the supplemental Beck hearing presentation, which is Exhibit TEP-4A, is that correct?

MR. DERSTINE: Correct.

CHMN. CHENAL: Okay. Ms. DeCorse, please proceed.

MS. DeCORSE: All right.

EDMOND BECK, RENEE DARLING, and CONRAD SPENCER, called as witnesses on behalf of the applicant, having been previously duly sworn by the Chairman to speak the truth and nothing but the truth, were examined and testified as follows:

DIRECT EXAMINATION

BY MS. DeCORSE:

Q. And Ed, I know you are already sworn in, but can you please state your name again for the record.

A. (BY MR. BECK) Edmond Beck.

Q. And by whom are you employed and in what capacity?

A. (BY MR. BECK) Tucson Electric Power as the director of transmission development.

Q. Have you testified in previous proceedings before the Line Siting Committee?

A. (BY MR. BECK) Yes, I have.

Q. And how many proceedings would you say that you testified in?

A. (BY MR. BECK) I know -- I did list them in my prefiled direct testimony, and I didn't go back and count the number, but it is greater than ten.

Q. Thank you. And before we start with your testimony presentation, let's discuss the exhibits that

you prepared for today's hearing.

So Mr. Beck, do you see an exhibit in front of you marked as TEP-1?

A. (BY MR. BECK) Yes, I do.

Q. Can you please identify that document?

A. (BY MR. BECK) That is the TEP application for certificates of environmental compatibility for both projects.

Q. And was the application prepared by you or under your direction and supervision?

A. (BY MR. BECK) Yes, it was. I wrote certain parts of the application and reviewed the whole application.

Q. To your knowledge, is the application organized and prepared consistent with the Arizona Corporation Commission's rules for applications before the Line Siting Committee?

A. (BY MR. BECK) Yes, it is.

Q. And to your knowledge, does the application contain all of the exhibits that those rules require?

A. (BY MR. BECK) Yes, it does.

Q. And Mr. Beck, you prepared prefiled direct testimony marked as TEP-3. Do you have any changes or corrections to TEP-3?

A. (BY MR. BECK) We have updated it. No, no, for

TEP-3, which is my direct testimony, I do not have any corrections.

Q. Thank you.

So if I asked you the same questions in TEP-3 today would your answers be the same?

A. (BY MR. BECK) Yes, they would.

Q. Is your testimony in TEP-3 true and correct, to the best of your knowledge and belief?

A. (BY MR. BECK) Yes, it is.

Q. And you also prepared a PowerPoint presentation to accompany your prefiled direct testimony. That PowerPoint is marketed as Exhibit TEP-4?

A. (BY MR. BECK) That is correct.

Q. You also prepared a supplemental PowerPoint presentation that is marked as TEP-4A that you will be using today at the hearing. Can you explain the difference between TEP-4 and TEP-4A?

A. (BY MR. BECK) TEP-4A includes some additional information that we felt would be valuable for the case that we identified subsequent to the original filing, as well as some responses to information from the Sierra Club.

Q. Is the information presented in TEP-4 and TEP-4A true and correct to the best of your knowledge, information, and belief?

A. (BY MR. BECK) Yes, it is.
Q. So what we will be presenting on the screen today and what we will be using to support your testimony will be TEP-4A?
A. (BY MR. BECK) That is correct.
Q. And if the Committee wants to follow along using their iPads, which I guess we have already discussed, they should turn to TEP-4A in the iPads, yes?
A. (BY MR. BECK) Yes, that is correct.
Q. All right. So we have loaded for you your presentation. Would you please describe for the Committee your educational and professional background.
A. (BY MR. BECK) Yes. I have 39 years of experience in the utility industry throughout various aspects of the TEP organization. I have a bachelor of science in civil engineering from the University of Arizona, as well as an MBA. I am a registered professional engineer in the state, as a civil. And my recent roles and responsibilities have included siting projects for TEP, substations as well as transmission facilities. And I have supervised the preparation of the application and supporting exhibits for today.
Q. Thank you.
Can you give us an overview of the application and what TEP is requesting?

A. (BY MR. BECK) Yes. The applicant in this case is Tucson Electric Power. As has been indicated I believe in my previous discussion, but to reiterate, we are requesting a certificate for transmission construction associated with relocating our 138kV substation on the Irvington campus. There are multiple lines that will be extended, and in a couple cases shortened, to tie into the new substation.

So as you look on the map of the project, the overall project site, the triple circuits that are along the south side of the property effectively will be shortened. Those lines going to other substations will drop into the new substation, and the other circuits effectively get extended from the old substation site. So that's one certificate that we are requesting.

The other certificate that we are requesting is for the RICE generation itself.

Q. Moving on to Slide 3, would you please give us a high level summary of your testimony that you are going to present today.

A. (BY MR. BECK) Yes. I will be dealing with the application itself, and notice and posting requirements to put that on the record, an overview of the RICE generation and the Irvington transmission line relocation projects, talk about the technical components

of each of those projects, and also identify some various differences that we have between the two certificates. So you will see that there are a couple of conditions in the transmission that we felt didn't apply in the generation, and then some proposed language changes in the one specific condition that is applicable to both certificates.

Q. And you mentioned the notice and posting. If you could please look at the exhibits identified as TEP-11 and TEP-11A in front of you, which are the proof of publication and posting of notice of hearing, can you walk us through those exhibits and explain the purpose or reason for the supplement to the Committee.

A. (BY MR. BECK) Okay. We originally published notice of the project in the Arizona Daily Star in December on the 18th. We have a copy of that that was prefiled, as well as the affidavit of publication.

Subsequent to our original filing, we posted again in the newspaper in December -- I mean, excuse me, in January, and we have a copy of that as well, the affidavit of publication. And that was for, I believe the date was, January 7th.

Q. That is correct. And can you please discuss any photographs of the signs and the posting of those.

A. (BY MR. BECK) Yes. We also included the sign

posting map as well as pictures of the signs that were posted on the site. We originally posted signs on the periphery of the Irvington campus, since that was our property and we had access. We did subsequently post a sign south of the interstate in this Greenway Park. And we had to wait for permission and blue stake to occur before we were able to position the signs, so it didn't make it into the filing.

Q. Great. And were those Exhibits TEP-11 and 11A prepared by you or under your supervision?

A. (BY MR. BECK) Yes, they were.

Q. And then moving on to Slide 4, to put the projects in context, can you give us a general overview of TEP's system and how these projects fit into it?

A. (BY MR. BECK) Yes. Again, as I stated before -- and this is a common drawing or diagram you are going to see throughout. Again, this is specific to the Irvington campus and that's where our projects are.

But to give you a little bit of context, some of you have seen this before, for some it is a review. But these are the remote generation resources that TEP has and uses to serve its load. We try and serve the majority of our load from the remote resources, and/or renewables that are coming on line within the Tucson area. And we limit how much local gen that we actually

operate because it is typically less efficient.

We have got Navajo generation up in the northern part of the state. We have Four Corners and San Juan up in northern New Mexico. Our biggest unit is the Springerville unit. And actually, I take that back, it is no longer the biggest, but it is one of the biggest, Springerville, along the eastern edge of Arizona. We have a portion of the Luna plant in southern New Mexico, and have now purchased the Gila River plant, one unit, and we have a power purchase agreement on another unit there. Those are actually bigger units. But they are split between TEP and UNSE, so it is not 100 percent TEP.

Kind of zooming in you will see basically the TEP service territory shown on this map primarily covers Tucson. We zoom in on that, the black outline you are seeing here on the slide is the TEP service territory. And within that is our 138kV transmission system that delivers power to our distribution substations for delivery to customers. We import power into the 138 system at three locations on the periphery of that 138kV system. And the projects we are talking about are almost in the middle of the system at Irvington located there.

So coming back to the map again of the Irvington

project, we have got, as I said, triple circuit here, and we have multiple circuits that are coming in from the northern direction into our existing substation, as well as connectivity from that substation to the existing Irvington units as well as some gas turbines, two gas turbines that we have just east of the main steam units. All of that connectivity has to get back and become connected to the new substation. So that's the reason for the transmission construction associated with this project.

Within the TEP's service territory, we have to balance our load. And so that's -- we will get into that a little bit more in further slides.

Q. So leading into that --

CHMN. CHENAL: Excuse me. I just have a question, Mr. Beck. You indicated that bringing power in from the other remote sources is more efficient. And I wonder if you could just tell us why that is, given that there is transmission losses associated with bringing it from remote sources. And will that change with the RICE project, the efficiency factor?

MR. BECK: The remote units, while there are losses involved in that, historically they have been our cheapest units to operate. That picture is changing as the costs of coal and associated air requirements to

offset coal come about, and also the issue that some of these coal units will be shutting down.

So one thing I didn't talk about is the San Juan unit. We have actually in December of 2017 shut down one of the units that TEP had rights in. So we did away with 170 megawatts of coal resource at San Juan. We anticipate our other portion of the San Juan unit also going away in 2022.

Navajo is currently operating. There is questions about what its future life looks like. We anticipate Springerville will be one of the last coal units that will ever get shut down because it is one of the most efficient with the best environmental controls that are in place right now.

As far as the efficiency goes, for renewables that are within the Tucson area, yes, renewables are very cheap, so we utilize renewables to the extent we can. As we will talk more about, TEP's goal is to get to 30 percent delivery from renewables by 2030, which is above the current requirement that the ACC has set, which is 25 percent, or, excuse me, 15 percent. So we see a real value in the renewables, especially from a cost standpoint.

But to make the renewables work, which will be more -- we will have more testimony on that, because of

the variability, we need something that's fast, responsive, and we need it placed locally within our system. And we need something that we can rely on 100 percent of the time for voltage support within the Tucson area. And that's where the RICE units come in.

CHMN. CHENAL: Just one more follow-up question. When the units are decommissioned, I forget if you said it was the Four Corners area or Springerville, but what happens to the transmission lines then if those power plants are decommissioned? Is it the intent to remove those transmission lines, or leave them in place not being used?

MR. BECK: At this time we anticipate leaving them all in place. And we anticipate that they will actually get utilized as part of new renewables generation that potentially will come on line throughout the eastern part of New Mexico. There is some very good high quality wind resources in the northern and eastern sections of New Mexico that are looking for outlets to get to the west, likely to -- definitely to Phoenix, and likely -- their interest is to get to California, if they can make that happen.

So these transmission lines, to the extent they can tie to those, if they no longer are committed totally to coal generation or other resources, they

would be available for wind. So we anticipate that's what will replace the use of those lines.

CHMN. CHENAL: Well, this is far afield, but I just throw out for future reference to the Committee that, I mean, we had Southline. We had SunZia who are vying for that as well. I just wonder in the future when we have conditions that we discuss we consider if we should put a condition in as to what should happen to the lines were the lines not to be in use for a particular period of time, you know, long period of time. Just throw that out, but far afield of what we are discussing today.

MR. BECK: Yes, Mr. Chairman.

BY MS. DeCORSE:

Q. And in the context of those questions, could you please speak to the purpose and need for the RICE project?

A. (BY MR. BECK) Yes. So I guess I already mentioned the TEP long-term strategy is to diversify our generation portfolio and serve 30 percent of our retail load with renewable resources by 2030, basically double what the current Commission requirements are.

We also anticipate retiring over 500 megawatts of coal-fired capacity that we would replace with a mix of efficient natural gas-fired capacity as well as

renewable resources.

So I mentioned that we have purchased one unit and we have got a PPA with a purchase option on a second unit at the Gila River plant. Those are very efficient natural gas units. And they were a very reasonable price because of the market conditions. So that is part of our replacement for our future needs.

But we are looking for the renewables to be a large part of our future mix. And you will see the pie charts on the bottom of this chart. 2017, you can see very reliant upon coal generation today. And by 2030, we are down to basically 30 percent coal, 30 percent renewable at that time. But again, we still need local facilities that can support that. And we will talk about, you know, some other options, energy storage and so on, and the reason they are not cost effective at this point.

As far as TEP, we are our own balancing authority. And what a balancing authority must do is maintain balance between our loads and our resources at all times, minute by minute. TEP's loads have historically had very small variability minute to minute. We know what they are and we can accommodate them with the resource mix that we have historically had in place.

But our experience right now, and we are in about 11 percent penetration of renewables on our system, and still ahead of the 15 percent time-wise from what the Commission requires, but just in that 11 percent we are seeing very high variability minute to minute on those resources. And the simplest explanation is to look at solar.

We have solar facilities. And in the monsoon season, a cloud will come over and pass over one of those solar installations, and you can see immediate drop-off in the output of those plants, in some cases almost down to zero. They don't quite get down to zero, but it is a considerable drop in the output of those plants. So that's where we are looking for something that is a very quick start, fast ramping product to offset that variability.

In addition, we need voltage regulation in the service territory. And typically that's by spinning generation that's on line. Historically that's been the case. There may be opportunities in the future for energy storage to play some role in that, but they are not cost effective at this time, which you will see further on.

CHMN. CHENAL: Member Woodall.

MEMBER WOODALL: Mr. Beck, if TEP did not act as

its own balancing authority and, in fact, was part of some larger balancing authority, would some of the problems that you have identified here be alleviated? In other words, would you have more resources you could call upon?

And I am asking this because I have heard other people bring this up as a reason for why you don't need to be so concerned about variable renewable generation.

MR. BECK: While it is true that the larger a balance authority an area is you have call and availability of multiple resources, if you get a lot, over a large geographic area, you have some diversity from the actual renewables themselves.

But a good example would be the California ISO. It is basically a balancing authority for the State of California. They are having real struggles in meeting that variability, and also the ramp rates. The ramp rates are the biggest issue right now for them.

And you probably have all heard of the so-called duck curve. And if you look in the morning or in the evening when their renewable resources are either ramping up, especially the solar facilities over the evening when they are ramping down, it gets pretty close to a vertical line. And we will have a little bit more of some of that in the testimony, but trying to respond

to that is the issue.

So if you get a larger balancing area, arguably there is some benefit to that. But you still have the issue of balancing that load and resource. And if you have a balancing authority that encompasses fixed generation resources that are not renewable, then the entity that has a lot of renewables can call on those to help them out.

And that's exactly what California is trying to do with their EIM, spreading their duck curve issue out across a larger broader area where the renewables have not penetrated yet. In the future when the penetration of renewables kind of gets across a whole system, one whole balancing authority, you get back to the same issue. So it is really a timing issue.

MEMBER WOODALL: Thank you, sir.

MR. BECK: So as part of our process, when we, as we have been looking at how can we meet the 30 percent renewables, looking at what we are experiencing with our level of renewables today, as well as looking outside of our system, what California is addressing, we saw the need for some kind of fast response units. And we said we need to go out and do some study work.

So one of the things we did was hired Burns &

McDonnell, an engineering consulting firm, to prepare an assessment of quick start and fast ramp generation technologies that could help us address our renewables, the renewable variability that TEP was experiencing. That first report concluded that, of course, TEP should do some further study of the technologies of interest to define scope, the project, and what the cost and timeline would look like.

So we went on further. We used the costs of performance data from the Burns & McDonnell study as well as information from Pace Global and other industry experts on cost of and future outlook for fuels and other items. And we used our internal simulation tools to do an economic evaluation.

But based on specific criteria that TEP had, and some of the criteria that we had identified, was we have a minimum gen requirement of approximately 10 megawatts. So we would want to be able to have continuous operation of a unit at no greater than 10 megawatts, start time to full output in five minutes, a very fast ramp time, once it is in operation, how fast can you ramp, take it up to its maximum, and then, overall, a full ramp of up to 200 megawatts in five minutes.

And we were seeing the need for that. And Mr. Spencer will discuss that in his testimony, of what

our outlook is into the future as far as the variability. And that's kind of where that 200 megawatt number comes from. And we also want to have the ability for multiple starts and ramps each day without incurring what we call maintenance penalties.

CHMN. CHENAL: Member Woodall.

MEMBER WOODALL: Mr. Beck, at some point did you factor in water use and its significance as a component of your selection of this technology? And if it is going to be addressed later, I will just wait for that.

MR. BECK: It will be addressed later, but it was a consideration, yes.

MEMBER WOODALL: Thank you. Thank you.

MR. BECK: Regarding the maintenance penalties issue, one technology that people look to is gas turbine technology. There are various issues with that. One for us was the ability to start and ramp quickly, they usually take ten minutes or more to get up to speed. And every time you start and stop one of those units, it affects basically the maintenance life of the unit. It shortens the time to when you have to do maintenance.

One of the benefits we found with the RICE engines, you can start and stop those as many times, as often as you want, with no impact to the actual life of the unit, and the only difference is the running time.

So if you have got X number of hours you would have to do maintenance, once you hit that, you do the maintenance on the RICE units. When you look at the gas turbines, it is a combination of that plus the starts and stops just because of thermal stresses on the units.

CHMN. CHENAL: So is the maintenance on a gas turbine akin to the maintenance on a jet aircraft engine, in terms of, you know, there is certain number of hours that it is slated for?

I mean I have some familiarity with it, the tests that are always being done by computers as the engine operates, the parameters of the engine. But it usually has a TBO of a certain number of hours before it has to be basically replaced in a fixed maintenance schedule.

MR. BECK: It is very similar, because basically they are jet engines tacked onto a generating unit.

MEMBER HAENICHEN: Mr. Chairman.

CHMN. CHENAL: Member Haenichen.

MEMBER HAENICHEN: Mr. Beck, could you give a little more discussion on that. Why is the thermal stresses more critical on a CT, combustion turbine, than on the recip? Just because the former operates at much higher temperature?

MR. BECK: Mr. Spencer can speak to that in much

more detail, but just at a very high level it is the thermal masses involved, the amount of steel in the units, the fast increase in temperatures associated with the jet engine. I believe that impacts that time element. But again, Mr. Spencer can speak to that.

MEMBER HAENICHEN: Thank you.

MR. BECK: Conrad, do you want to?

MR. SPENCER: So as was mentioned, the gas turbine is essentially the same design as an aircraft engine for most cases. And so they have very small rotating blades that have very close tolerances between the stationary blades and the rotating blades.

So as Mr. Beck mentioned, you have this thermal mass issue. So every time you take all of those very tight tolerances through a thermal cycle of start-up and shut-down, you provide the potential for those to contact each other and begin a process of wear. And that's why aircraft engines have a certain number of hours that you have to do inspections to make sure that you haven't touched stationary and rotating blades. It is exactly the same principle on a unit that's strapped to the ground and tied to a generator rather than thrusting an airplane into the air.

The RICE engine, on the other hand, is just like your car. It is a big thermal mass piston with a rod

connecting to the crankshaft, and that crankshaft is ultimately tied to the generator. A gas turbine typically turns at somewhere greater than 3600 RPMs. So you have higher speeds, closer tolerances. The reciprocating engines that we propose as part of this project turn at 512 RPMs, so they are much slower speed. So you have that thermal mass. You don't have to take them up nearly as high a speed.

As you are probably well aware that force in a rotating device is the mass times the square of the speed, so every time you take something faster in speed, the forces are doubled. And so what you do to get 60 hertz electricity is you put a multiple pole generator attached to it.

CHMN. CHENAL: Member Haenichen.

MEMBER HAENICHEN: Following up on that description -- thank you for that, by the way -- why then do people use combustion turbines for peaking at all? Why don't they use this system everywhere?

MR. SPENCER: The magnitude of the reciprocating engine market and the sizing of those engines really was in its infancy upwards of just five or six years ago. The largest engines you could purchase on the market were about 10 megawatts. It is just in the last five years that commercial availability has been given at

units as high as 20 megawatts. And so you had this whole fleet of 10 megawatts and less reciprocating engines applied to a number of different applications, but you didn't have this 20 megawatt availability until just the last five years commercially.

MEMBER HAENICHEN: Okay. Further, is it not true that if water usage was not a concern, which I know that it is, that these RICE type engines would be a lot more efficient if you cooled them by rejecting heat with water as in a cooling tower? Could you elaborate on that discussion a little bit?

MR. SPENCER: In all of our evaluations of the efficiency, you have a twofold nature of the cooling water through the jackets of the crankcase of a reciprocating engine, very similar to your car. One is to heat that crankcase up to a temperature to minimize the thermal stresses created when you start firing natural gas and create substantial heat.

And so you preheat the crankcase, if you will, by putting water through it or warming water through it to get it to temperature so that you can get the quick start response that we want in the application that's shown on Mr. Beck's slide there, this less than five-minute response. And so you want warm water going through certain parts of that crankcase so that that

engine is ready to start when you need it.

Then on the flip side the question is, well, you are also trying to cool that water off once you get it up and firing and you get it hot. And so the sizing of the radiator field that you will see here is such that the dry cooling achieves the same temperatures on the inlet of those crankcases that could be achieved with water.

MEMBER HAENICHEN: But at what expense? You have to move air at a very high velocity, I would think, in order to get the efficiency, or the heat rate, close to the CT, as Mr. Beck said earlier.

MR. SPENCER: Well, just as a point of reference, the particular engines that we are looking at have heat rates in the lower 8,000s at full load. Okay?

MEMBER HAENICHEN: Right.

MR. SPENCER: The best gas turbines, simple cycle mode, is in the 9500 range. So we are talking fairly substantial improvement in heat rate or fuel efficiency between the RICE and a gas turbine.

MEMBER HAENICHEN: Okay. But now let's compare a hypothetical one, which would be the reciprocating engine with using heat of vaporization of water in a cooling tower to the present ones that you are proposing. Wouldn't that be a lot better?

MR. SPENCER: No. And the reason for that is the design of the radiator, as you spread that water over a substantial area, you use variable frequency drives for the fan units.

MEMBER HAENICHEN: Yeah, I understand.

MR. SPENCER: And so under certain ambient conditions the fans don't even run. There is enough cooling area in the surface of the radiator to necessitate very little airflow to cool it off. Just the surface effect of cooling is what cools it. And so you are never wasting water getting to that, cooling that water that occurs in a gas turbine or a steam turbine application.

MEMBER HAENICHEN: Okay. Well, thank you. Maybe you and I can have a little off-line discussion after the hearing. Thanks.

MR. SPENCER: Sure.

CHMN. CHENAL: For the record, Member Jones just arrived.

I note the time is, you know, 12:07. Is this a good time to take a lunch break?

I thought that was a very interesting, you know, explanation, I mean discussion by the panel. And I am sure we are going to have a lot more questions. So Mr. Beck, I am not sure if I were a betting man that we

are going to be finished by tomorrow. But we have an extra day if we need it.

So let's take a break for lunch, and then the tour starts at 1:00.

(A recess ensued from 12:08 p.m. to 1:05 p.m.)

CHMN. CHENAL: This is the time set to begin the tour. So we will just put on the record that we are going to leave the venue and get on the tour bus.

And just a reminder to the members that we cannot talk about the substance of the case while we are on the bus. And when we go to the various stops, we will just take very brief comments from Mr. Beck probably. If there are any questions, keep them to a minimum. And then when we come back, we can have Mr. Beck kind of provide a little more explanation as to what we saw.

So, all right, let's go on the bus.

(TIME NOTED: 1:06 p.m.)

(All Committee members present for the hearing and the applicant proceeded to the bus to begin the tour.)

STOP 1

(TIME NOTED: 1:37 p.m.)

CHMN. CHENAL: All right. So we are all here.

Let's go back on the record. We are at the --

MR. SPENCER: Generation training room.

CHMN. CHENAL: -- generation training room.

So I just had asked if we could keep the discussion and explanation kind of as short as possible for Colette's benefit. Then, when we get back, we can provide some more detail.

MR. SPENCER: Okay. Just so a point of record, all the people that were on the bus, there were three additional Arizona Public Service Company employees that rode on the bus with us.

If you gentlemen wouldn't mind, just introduce yourselves.

MR. DUNCAN: Kevin Duncan.

MR. EICH: I am Stephen Eich.

MR. LARSEN: Brad Larsen.

MR. SPENCER: Okay. The room that you are in is the generation training room where we hold a number of our training sessions for our employees that cover safety issues, technical, and a myriad of other subjects. And this room is used for apprenticeship training. We have a facility directly behind us where there is facilities that have electrical and mechanical and instrumentation training, simulation systems that are used to train the employees, and particularly the

apprentices for their training who are training to take the place of employees as they retire.

Because the nature of generation and transmission and distribution is a very technical field, it requires several years of training to be able for someone to function safely and effectively in the maintenance and operation of the generation systems. So one of the things that we wanted to simulate today is something that is done each time before tasks are performed in the generation facility. And a very similar system is used on the transmission and distribution facility. So prior to any work efforts occurring, a tailboard or prejob briefing is held to describe the tasks that are going to be done and a review and a dialogue with the employees that are going to perform that to ensure that everyone has a clear communication path of what is going to be done, what safety measures are going to be taken so that we achieve a result without injury.

The nature of the business is there are high voltages, high temperatures, high pressures that can seriously injure, if not kill, someone if things are not done right the first time. And so as a culture, this is one of the things that we do repetitively to have these kind of prejob or tailboard conferences prior to work

efforts. Because we are going to go onto the campus today, and we are not going to go up close to anything that could hurt anyone, but we wanted you to understand how important safety is to us and the consideration that we take for it.

The Sundt plant employees, as a team, have now worked almost 24 months without a reportable injury. And one of the reasons that they have been able to achieve that is a culture that is grounded in some fundamental principles. And so we would like to share with each of you -- if you will pass those down.

If you will take out the coin, I will explain the coin and explain what the coin means and how we use it as part of our safety culture. On the back of the coin you see Tucson Power Production, Tucson Electric Power Company. It has an image of the steam units that you can see graphically in the coin. Okay?

If you flip the coin over, you will see a representation of safety for life. And you see that the root structure and the words that really describe the foundation of our safety culture is awareness, communication, teamwork, commitment, and attitude. And so that's the roots of the things that are critical for us to work as a team to achieve safe results each time that we perform a task. Then you see that, as the tree

goes up above the grade surface, the trunk is the heart of the tree and then all of the limbs and leaves, all of the beautiful part of the structure, why we work safely every day, family, friends, children, spouse, partner, co-worker, parents, whatever that might be.

And so this coin represents the culture that we want to achieve. And what we do is we ask each of our employees to have this in their pocket at all times. And so, as they go about their daily tasks, they put their hand in their pocket, we want this to be a constant reminder of the culture, the communication, the attitude, all of those expectations and the whys. We want you to go home every day the same way you came, hopefully just a little tireder.

So it is a simple reminder that is very visual and very physical. Because safety is all about transferring knowledge to their hands, their eyes, the steps that they take, where they put their hands, where they put their body so that it can be protected with the protective equipment that they wear. But more than anything else, it is all about keeping our heads in the game.

So this is just a simple tool that is used to remind us of the culture and the expectation that we have. So we share that with you. Feel free to put it

in your pocket as a reminder as you go about your daily tasks of what it means to do things safely, not only in a job setting, but all settings, because we encourage our employees to apply these same principles not just at work but at home and in everything that they do. Okay?

So that's kind of an example of a prejob brief or a tailboard that we would have. We would go into details. And so I am going to talk about some of the details of what we are going to do now.

Mr. Beck, on the record earlier today, talked about the tour stops. We are going to go to those tour stops. The first stop, we are going to get back on the bus and we are going to go out into the dirt area where the reciprocating engines and the 138kV substation are going to be built. We will get off the bus. We will stay close to the bus because there is a lot of construction activity going on around that area with removal of coal equipment, removal of all power cabling that's no longer necessary so that you can see the actual site. And we will point out a few things at that point in time that Mr. Beck put on the record this morning and that I will put on the record tomorrow morning. Okay?

We will get back on the bus and then drive back to the existing 138 yard. Once again, we will get off

the bus and look back at the units so you can get a real good feel of what it all looks like in person.

CHMN. CHENAL: Questions?

(No response.)

CHMN. CHENAL: All right, good. Let's get on the bus. We will go off the record.

(TIME NOTED: 1:45 p.m.)

(The Committee and applicant proceeded to Stop 2.)

STOP 2

(TIME NOTED: 1:52 p.m.)

CHMN. CHENAL: Back on the record, first stop.

MR. SPENCER: At the first stop we are located on the area where the proposed RICE generation facility will be built. So it will literally be, where we are standing will be the buildings that house the RICE engines. As we look to the east, we will see where the 138kV substation will be built. As you look to the south, you will see the triple circuit 138kV transmission line that Mr. Beck testified to this morning.

Ed, do you want -- where did Ed go?

MR. BECK: I am right here.

MR. SPENCER: Ed will give a description.

MR. BECK: We will remove the existing structure there. We will replace it with two structures to turn three lines coming in from each direction. They will all come into -- this is the substation today. Those are lines connecting to the substation, 138s that are, in this case, out east of our system here, east of Irvington.

MR. SPENCER: Just as a point of reference, the concentrated solar steam array is located just to the north of us. There is a whole set of mirrors at the ground level. Water is taken from Unit 4 at the Sundt station, brought out, taken up. The mirrors track the sun. The sun turns the water into steam. The steam is taken back and put into the normal steam cycle to replace having to burn natural gas by using the sun. It is a very small quantity. It is about five megawatts on a unit that produces 155 megawatts. And you can see that it takes a lot of acreage to turn water into steam for that purpose. But it is literally a bridge technology that allows an old fossil based plant to use the sun to offset the burning of some of the natural gas.

CHMN. CHENAL: Any questions?

(No response.)

CHMN. CHENAL: All right. Thank you. And then

let's --

MR. SPENCER: Let me make one more point.

CHMN. CHENAL: Sure.

MR. SPENCER: As you look back to the west, you see Unit 4 and then Unit 3's cooling tower, which are part of the wet cooling systems associated with the existing steam units.

MEMBER JONES: Are there plans to augment that or enhance this type of facility or is there a lack of space? You said this was kind of a bridge technology or new. Are there any plans to increase the use of steam from solar?

MR. SPENCER: From solar application? No. This was a onetime shot.

MR. JONES: Okay.

MR. BECK: You may point out the coal handling stuff that's coming out.

MR. SPENCER: Right. So, as you can see, the coal conveyor belts are that big arching brown with the red line at the bottom of it. All of that used to extend to the side of those red barricades all the way back to what we call T-3. They have removed all of that in the last few days as part of potential preparation for this site.

CHMN. CHENAL: All right. Thank you very much.

Let's get back on the bus and we will go to the next stop.

(TIME NOTED: 1:56 p.m.)

(The Committee and applicant proceeded to Stop 3.)

STOP 3

(TIME NOTED: 2:00 p.m.)

CHMN. CHENAL: Everyone, folks, we are just going to stay on the bus.

All right. So now we are at the next stop. Take it away.

MR. SPENCER: I wanted to make one additional comment. We pointed out on the other side of the plant that we used a slip stream of water out to the concentrated solar steam generator to produce steam for Unit 4. As another note, about 17 years ago there was an agreement reached, and Los Ales Landfill -- Los Reales Landfill, which is approximately five miles to the southeast of us, there was a system developed to capture methane from that facility, pipe it to this facility. And we burned that methane in Unit 4. It is a fairly small quantity. It is not real high quality. But it burns just fine and produces approximately five megawatts equivalent from that source rather than

pipeline natural gas.

MR. BECK: Okay. So we are adjacent to the existing 138kV yard, which is to your right from where you are sitting. This is what will end up getting replaced and go away with the new substation that will be over by the RICE units.

The ring bus annex that I talked about is back and to the left. It is a little bit harder to see, but it is right kind of behind us. That also will end up going away. So you can see there are a lot of lines coming in and connecting into the 138 yard today as well as then connections to the plant units on the other side of the substation. All of that connectivity has to get extended or moved over to the new substation. So that's the purpose of all of the transmission associated with this project.

Any questions?

MS. DARLING: 46.

MR. BECK: So our 46kV yard is right over here. It is a little bit lower in height. That also is getting replaced or removed as part of this project. There will be an adjacent 46 next to the 138 yard. The two large lattice structures in front of us, those are the ones I mentioned earlier, will be going away also. We have multiple 46 circuits coming in on those

structures and they will get replaced with monopoles as part of this whole redesign.

CHMN. CHENAL: And one final question. The unit, the Sundt Unit 4 --

MR. BECK: Correct.

CHMN. CHENAL: -- is that decommissioned or will be decommissioned?

MR. BECK: No. That unit will stay in place. It has just been changed. It will not, does not burn coal, will not burn coal anymore. It will continue to be used on natural gas as well as the supplemental solar and landfill gas.

CHMN. CHENAL: And it is units -- which units are we looking at?

MR. BECK: 1 and 2, which are the northernmost units, the far two units.

CHMN. CHENAL: All right. Thank you.

MR. BECK: As we turn up here, we are going to go -- if you look to the right behind these units, you will see two gas turbines. You may or may not recognize them but those are the gas turbines that we also have on-site already for peaking needs. Those are long term and they are also, they provide black start dislocation, should we be totally severed from the grid.

CHMN. CHENAL: All right. Thank you. We will

go to the next stop.

(TIME NOTED: 2:04 p.m.)

(The Committee and applicant proceeded to Stop 4.)

STOP 4.

(TIME NOTED: 2:08 p.m.)

CHMN. CHENAL: Let's get back on the record then, Stop 4.

MR. SPENCER: So the big steel looking tanks, shiny aluminum insulation on them, when we drove past, those originally were part of the fuel oil supply system for the Units 1 through 4 steam boilers. They have been converted since we no longer burn fuel oil to an asphalt storage facility. So TEP leases those tanks to generate revenue to offset rates for the ratepayers. And Western Refinery is the company that has that lease. And they rail asphalt in. They warm it up with steam from the plant. They put it in those tanks. Then they have a transfer facility that takes it out in trucks to batch plants for road construction projects and other asphalt paving operations.

MEMBER JONES: Those are heated tanks?

MR. SPENCER: Those are steam heated tanks.

MEMBER JONES: Okay.

MR. SPENCER: Okay?

Any questions on anything you saw as we got to this stop?

(No response.)

MR. SPENCER: Mr. Beck is getting the manager of training for TEP, Roger Hall.

MR. BECK: We have Roger Hall, who is kind of in charge of our training yard. So I thought we would have him just give a brief overview of what we do here. He can identify all the facilities and what they are.

CHMN. CHENAL: Mr. Hall, we are going to need to swear you in first.

(Whereupon Roger Hall was duly sworn by the Certified Reporter.)

MR. HALL: Again, my name is Roger Hall. Nice to meet all of you. I am the manager of safety and training and standards here. And this is our Ken Saville Training Center. And this yard we use for a lot of different purposes. One of them is training.

We have ten apprenticeship programs that we do here. And what we do is, it is typically a three or four-year program depending on the craft. We have journeymen teaching apprentices how to do their tasks. They have to complete four years, three to four years of on-the-job training. And then they come and they do two

hours two times a week until they get to 160 hours per class. And they do that on their own time after hours.

So what we do here, and it is -- I am going to try and point as best I can. I don't know how good you will be able to see. There are several sections in this yard. The first section, the substation section, that's relatively new. And we use that for substation training. We don't energize that at substation voltages. And we are still in the process of completing it. We are going to energize it at lower voltages so we can run controls and switches and things like that. That's in the process of being completed.

Right next to it you see the yellow stairwell there. That is a substation transformer. What we have done is we have put doors on that. If we ever do changing of bushings or something like that, what we have to do is we have to go in that transformer. We drain the oil. We have to go in -- what we do is we bring the fire department here and we practice our rescue. Because if we have an employee get trapped, they might slip in this or they might have a heart attack, whatever it my might be, we don't want the first time the fire department comes to rescue to be the first time seeing this kind of equipment. So we practice that with the different rescue cases and with our substation

groups so we are all trained on that.

Continuing on in the yard, it is really hard to see but you are going to see three yellow gates out there kind of far with the blue TEP signs on. That's a little underground portion of our test yard. What we do is we do underground testing there. An example of that is right now we are looking at putting a new automatic throw-over switch in one of the downtown buildings. And what we don't want to do is experiment on a building of that size. We want to do our experiment in this yard right here, prove that everything works well before we get it out into the real system, and we are going to work all those bugs out here. So right now that's what we have in there. But there is a plug-and-play area where you can remove that and put whatever you may need in that area.

Going way out there, it is a little hard to see, but you have lattice towers way out there. We are required to do annual rescue training for our transmission group. So we do ropes and rescue training there that they will actually repel off of the tower and learn how to do rescues. And they have to practice that on an annual basis. That's an OSHA requirement.

Coming into the yard a little more, you are going to see a bunch of wood poles in the middle of our

overhead portion of the yard. And what we do in that portion of the yard is -- we are required to meet the National Electric Safety Code height requirements out in our real world. In our training yard, we bring that down a little bit, so we aren't at our proper clearance. And the reason we do that is we are going to be training guys and we want to be able to communicate with them. So they are going in a little lower than they typically are and we are going to be able to talk to them and do that kind of training.

Something else we do in that section, anywhere where you see gravel, we can energize that portion of this yard. Anywhere you see dirt, we can't energy that portion of the yard, with the exception of that substation transformer right here. So in those sections that we energize, we can also do trial units there.

An example of that is we have a reclosure on a pole over here. It is a called an Intelirupter made by S&C Company. We have actually been doing some trial work with that out there. So that's an example. Anything new comes up, we can plug it in there. We can get everybody in there. In this case it was a troubleman. So we bring in all our troublemen doing switching on that. We are going to train them right here. We get them real comfortable before it gets out

in the field, and we have to do those kind of trainings out there. Plus it is a lot easier to get everybody around a switch out here than out in the field where we might have the public watching.

If you go really far to the east, you are going to notice some really big -- I am going to step down here -- you are going to notice some really big weathering steel structures. Those structures are 500kV structures. And in the real world out in our system, those would be over 150 foot tall. Those are about 60 foot tall. What we do is we cut the top portion of those towers off. And the idea there is we are going to do the same thing we talked about in the distribution area. We are going to do all our training lower, and we are going to do all that training where we can communicate with the people doing it and have a little control in the yard. That is not -- we never energize that. That's just for changing out bells, things like that. By bells I mean the insulators you can see on the wire.

Straight here you are going to notice some poles that are really low. And that might seem odd to you. Kind -- I don't know if you guys can see that in the back, but those particular poles, we do that to -- we have -- they are not energized. What we do is we talk

about transformer connections and we talk about things that a lineman would stay up at the top of the pole for.

Some utilities have training centers where they will have poles at the full height. They will build a scaffold around it and bring everybody up. They are going to train at the height of the poles. We brought the poles down. We got great weather here. We don't do it indoors. So it is more practical for us.

Going to your right, right behind the building there, or going to my right, right behind the building there, you are going to see some bare poles. That bare pole area is where we do pole climbing. What we will do is we will actually -- as an example of that, next week we are hiring some preapprerentices. And we are going to actually have them -- we have them climb under part of their interview section, because we want to make sure that when we hire them they don't have a fear of heights. So they will sign a waiver. They go through some knockouts. And if they are successful getting that far, they will actually climb.

So we use it for, we also use it for pole climbing training. So we are going to send the apprentices up. We typically give them a football or something, or have them throw the football around to get them real comfortable being on that, climbing. And

probably most in here have not had the opportunity to climb, but it is a really tough job. It is a lot harder than it looks when they do it. So it is just getting them familiar with it.

Something else we use that area for is just like the other towers that I talked about. We have to do annual pole top rescue. So what we do is we have a dummy that we have to go -- he is, he is the hurt man. So we go up and we demonstrate that we can rescue that guy and bring him down from a pole. And we do that because in the real world, if somebody does get injured, we want every lineman out there to be able to get that person off the pole. And, again, this is an OSHA requirement that we do that also.

Talk a little bit about what we are doing this year. We are getting ready to, right here behind me, these two parking spots, we are going to be taking those two parking spots away. We are going to put a gate in right here. And we are actually going to have a meter farm here where we are going be able to test and do trials on meters. And we are going to be able to buy 80 meters as an item in our budget, and hoping to complete that within the first quarter of our year.

Other than that, that's mostly what we do, is training and trial type stuff here. Does anybody have

any questions?

(No response.)

MR. HALL: All right. I know I covered that really quick. I only had ten minutes. So, all right, thank you.

CHMN. CHENAL: Thank you.

MR. BECK: Okay. Just a couple more items to add.

I know Conrad talked about the asphalt. Part of our, the PAD that we are working with with the city for the campus redevelopment includes some new buildings that we plan for the future. We planned directly south of us now a fleet services operations. I am not sure what the correct title -- shops, buildings. I mean the name changes once in awhile. But that will be where all of our crews and equipment is taken care of.

We also have planned for an office building directly south of the training yard, just a little bit to the east of where we are at but south of us. And that would be a new operating headquarters, engineering center, where ultimately we plan to move the control room that you are going to see into that building, as well as, I believe, our engineering group from downtown, land department, and some other functions that are kind of scattered across the campus right now as well as in

our downtown office.

Another thing I will point out in the training yard, directly to the north of us there is that lattice structure that is a dark, pretty dark gray. If you look further to the east, to your right, and you will see it is a different type of mast, but, again, it is lattice but it is looking pretty white. Both of those started out as dulled galvanized steel. That used to be the way we built our 345 system. Rather than just pure galvanized, we would dull it so it wouldn't have been as reflective and shiny. But, as you can see, over time even the dulling starts to chalk and turn to white.

I know we have had lots of discussions with the Committee before about paint color and pole color and whether we paint or don't paint. There is an example of even galvanizing not holding up in our sun. So the Corten or the weathering steel as our current TEP standard is reflected in those 500kV structures that are directly ahead of us, or to the east of us, just to give you an idea.

Yes.

MEMBER HAENICHEN: Is all of the training system-wide down here, like for Springerville and all of that, or do you have other sites?

MR. BECK: Well, Springerville, there is not a

lot of line type training that we have here. It is available to the Springerville personnel. But for the most part, I believe they have their own training program on-site, because they are generation strictly. I believe we brought down some of our crews out of UNS Electric out of Mohave to come down here, and of course the Santa Cruz crews come up here and train.

We also use this yard for outside contractors. We let them utilize the yard for training purposes also. At one time we actually thought about opening this up as a regional training school. We tried to get some traction in the industry. And that just really never took off. So it is pretty limited to the region and primarily TEP.

MEMBER HAENICHEN: Thank you.

MR. BECK: I think that's -- oh.

MS. DARLING: So, Marc Jerden suggested you talk about the agreement we have with Civano Nursery in the southeast corner.

MR. BECK: This is something we can point out on maybe the overhead slide when we are back in the meeting room, but on the southeast corner of our property, we have a corner designated for basically collecting all of the tree trimming and other material that come off of tree trimming that we do as well as others. It gets

collected there, gets turned into compost. And then Civano Nursery, which is a group that works with handicapped people, they actually grow plants. And they have a sales yard. It is like a nursery. So that compost stuff is used by the Civano group in their process.

So we try and expand and do as much as we can for the environment and renewables and just all the environment issues.

CHMN. CHENAL: All right.

MR. BECK: If no questions, we will head over to the control.

CHMN. CHENAL: Thank you.

(TIME NOTED: 2:23 p.m.)

(The Committee and applicant proceeded to Stop 5.)

STOP 5

(TIME NOTED: 2:29 p.m.)

CHMN. CHENAL: Let's go on the record. And then we are going to swear a witness in for our record.

So, Colette, you can swear him, if you would like.

(Whereupon Sam Rugel was duly sworn by the Certified Reporter.)

CHMN. CHENAL: Would you please state your name.

MR. RUGEL: My name is Sam Rugel. I am director of system control and reliability. And I am going to describe our operation here.

I want to mention about the sign-in --

MR. BECK: Just make sure the court reporter can follow you, too.

MR. RUGEL: The sign-in book, we have a couple of standards that we have to adhere to. The CIP, which Conrad I think mentioned you are familiar with, cyber infrastructure protection, but standards of conduct is a universal procedure that we utilities follow. We do not share transmission information with our marketing group so that we don't have any favoritism because of what we know about the transmission system in a competitive way. So that's what that book is. We have access because of the screens to transmission information. So just to set that premise about this room.

And this control area, the operation -- if we can, let's turn out the lights so that we can see a little bit better into the control room. Is that okay with everybody, with you? I am going to walk us around the room here.

We are a fully integrated operation center. We have generation dispatch, transmission operations, and

distribution operations. And not all utilities operate necessarily in that manner. We still are integrated that way.

Generation dispatch, they are the ones that are going to be the primary beneficiaries of these recips. They are very excited about this asset. Their responsibilities are to maintain the balance between load and resources. And as the testimony probably is indicating, with all of the renewables that we are integrating into our system, it is becoming more and more of a challenge to respond to the fluctuations of renewables. And assets like the recips give us more capability for that response. So that is the prime, keeping the balance is the primary responsibility of the generation desk. And I will go into that in a little bit more detail.

Right behind the generation desk is the scheduling desk. So any energy that our marketing group purchases or sells must come into or out of our system through transmission that's both ours and our neighbors. We keep track at this desk of all the transmission transactions, and we control to what is coming in. So they roll up all of the transactions and produce a number for the generation desk as a resource that they control to and part of maintaining that balance.

Over to the far left, the front desk and the back desk, the back desk is the backup desk. That is the transmission operation. Transmission operation is responsible for maintaining voltage, power flow on the system, all switching aspects, and they control the system. If there is to be maintenance or if there is damage to equipment, repair and replacement, if there is storm and restoration activities, all of that is controlled from the transmission desk. Substations, lines, anything that interfaces with the power plant is controlled at that desk.

And, similarly, distribution, which is now everything over here, here on the left of this glass wall, is, again, service to the customer. And they maintain voltage and they control all the switching aspects of the distribution system, the lines, the underground equipment. They dispatch troublemen to go out and, you know, respond to calls that come into the call center.

Are you going to visit the call center? No? Okay.

So all of that information comes in and is controlled in this room. The glass wall is a divider between distribution and supply. This side of the control area is the bulk electric system, the supply

that the distribution depends on.

So any questions? If I were to go into, just go a little more --

How am I doing on time?

CHMN. CHENAL: I think you are fine.

MR. RUGEL: If I were going to go into more detail on what the generation control is about, we follow FERC and NERC standards. They are the standards established, but they are also good operating practice. We have been following these before they became standards. It is the basis, it is the foundation of reliability that has made our electric system what it is today. And from a generation perspective, there are three control performance measures that we adhere to.

The first one is that balance that I talked about between resources and load. Our measure is over, over a year. And we have to show that over a year we have averaged a perfect balance or better to have a good score with the standards. And what that means is we have supplied all of our load with resources and we are not deficient or leaning on the interconnection more than we supplied and gave back to the interconnection, if that makes sense.

Number two is, whenever we lose a resource, any generator, we have 15 minutes to replace it. It is our

responsibility as a balancing authority to replace that energy within 15 minutes.

And then third is the frequency response. Frequency response is whenever somebody does, anybody in the interconnection or ourselves loses a generator, frequency immediately begins to fall, and you have to stop that immediately. And all generators on the interconnection, everybody in the western grid, their generators, the governors put out just a little bit more energy to arrest, to stop that frequency decline. It is, some people call it, a socialized system. Everybody helps to respond to the frequency decline. The second one, to replace that energy in 15 minutes, that's your responsibility.

And so the way that those three measures are achieved is through reserves. All units that carry -- we have them, we have our reserves spread out. So what that means is a generator that is on line and running, if we don't run it to the top, we have a little bit of margin on that unit. And it is that margin that we use to respond to all three of those measures.

Now, where the recips come into play is they are, they do carry reserves, frequency responsive, and they also, because they are fast starting, we can use them for like the 15-minute response. They don't have

to be on. We can just start them up and in 10 minutes they will be fully loaded, enabling us to meet the requirements without even having them on. So it is one of the beautiful things about the recips that we are excited about.

Conrad, anything else?

CHMN. CHENAL: Member Haenichen has a question.

MEMBER HAENICHEN: Can you talk a little bit about voltage support?

MR. RUGEL: Yeah. So voltage support in the local load pocket comes from -- the generators provide a substantial portion of the voltage support. They provide VARs, another term, another characteristic of a generator, that we want them on line to immediately respond to when the voltage falls. They have an automatic voltage regulator that senses that and can respond with VARs immediately.

We have, all of our local generation has that capability. And we have a certain amount of generation that has to be on at all times to respond to the voltage dips.

MEMBER HAENICHEN: What about renewable generation and VARs?

MR. RUGEL: Well, it is being discussed and explored. The renewables definitely have capability

with their inverters. The way to achieve that, though, is you have to back off the amount of renewables, renewable production, in order to draw upon them when you need them. So there is some, there is some possibilities there.

There is also, there have been some incidents in California during some of the fires when they lost transmission and the inverter-based renewables dropped out and didn't come back for a period of time. The California utilities and the regulators, NERC, have been working with the manufacturers to prevent that from happening, so for a faster recovery. So you lose the line, you lose the voltage, but as soon as it is cleared, those inverters immediately begin production again so you don't have that, that loss.

MEMBER JONES: I am curious. Does TEP have access to Hoover Dam and the Dynamic Signal as a balancing authority or do they get it elsewhere?

MR. RUGEL: To Hoover Dam, we do have customers that have Hoover allotment. TEP itself does not.

MEMBER JONES: I didn't recall seeing that.

MR. RUGEL: No. But some of our customers have asked if, you know, can we use that signal to control to. And in all cases, it hasn't been economical to control to the signal. But they still get the credit

for the energy produced.

MR. BECK: Sam, you might just touch on the conversion, the distribution management system.

MR. RUGEL: Ah, another great aspect in our future.

Distribution has the potential for a lot of automation. Right now we have -- we are at the point, if something is out, we depend on the customer to pick up the phone and call us and say, hey, I am out of power. We have a little bit of telemetry. If a substation breaker opens, we know that, and everybody on that feeder is out. But downstream from the breaker, if a fuse blows, we don't know that. There is no telemetry on a fuse or -- and so we are dependent on the phone calls.

With the automation, with the metering replacements, those meters will let us know through telemetry that certain customers are out of power. And all of that can be programmed into the systems for immediate indication and response and dispatch.

CHMN. CHENAL: I had a question. Two of the six big screens you have got in there are two different weather channels, TV stations to weather channels. How do you use that information? Why is that so important?

MR. BECK: Let me start why we even have access

to those to start with. We didn't used to have those in the control room. We didn't have outside TV. So the guys had their monitors; they watched our system only. And our president of the company got a call from somebody, I believe in California, saying, hey, we had an outage, whatever, we had some problem. He called system control to say what is going on. Our operators had no clue. It was out of our state; it wasn't in our system. So I believe within a week we had access to, I don't know, CNN I think it was.

So that was the impetus to at least get cable into the facility. And then you guys then saw the opportunity to kind of watch the weather.

MR. RUGEL: Right. Generally -- I am surprised there is two weather. There is usually a news and a weather, and depending which operator it is, it is either CNN or Fox. But --

MEMBER JONES: They don't eat together, do they?

MR. RUGEL: But, Ed is right. There have been times when during the California earthquakes we -- this desk watches the frequency, has seen the effects of the earthquake on the grid. And yes, it is nice to know what is going on because there is an immediate connection to the world through that.

MEMBER JONES: That brings up a question. When

they had that switch failure in Wellton that basically shut down all of southern California and most of Baja north, would your folks have seen that as part of that grid or would there have been something you saw, or not?

MR. RUGEL: Yes, we always see the effects through the frequency. They don't always know what is going on right away. Again, hence the news. And one of the things all balancing authorities and transmission operators do, we have an internet connection or a dedicated channel for all reliability entities. And we post immediately what, you know, what the disturbance was or what is going on in the region. And so we can, through that, we can provide assistance or at least be informed that, you know, this event took place.

CHMN. CHENAL: Any further questions?

MR. BECK: Maybe, Sam, can you touch on the U of A and the weather and solar stuff that we have been working on?

MR. RUGEL: Another fascinating...

Okay. So with all of the renewable projects, and we have them scattered throughout the system, utility scale, and predicting this stuff, you know, clear day, everyone's prediction is pretty good. But the monsoon season, it is really hard to tell. And so what the University came up with was a three-tiered

approach.

They have, for kind of a long-term view, they have their algorithm that all weather forecasters use, meteorologic modeling. And then for a little more short term, they use some satellite imaging, tracking clouds. And then with, for the short term, like interhour, they use these irradiant sensors. It is just measuring the sunlight. And we have these scattered throughout our system, at our substations and at our solar facilities. And we are watching, they are watching the sunlight and tracking cloud movement.

In addition to those models, they have the output of our solar facilities. And so they calibrate their prediction with our actual output. So they roll all of that together and produce a next hour to, you know, several days out forecast for our marketers. And this desk here is so that we can kind of see where things are going and we respond accordingly.

So when we see that, you know, there is going to be a short -- first of all, if marketing knows the day ahead, they plan and purchase resources or allocate so that we can use our reserves to respond. And if we have missed those forecasts and we see it coming, then we can, again, marketing can go out into the market and buy energy as it is available.

So those types of efforts with the University have been great.

MEMBER WOODALL: Assuming that there is a lot of adoption of storage for residential use, does the utility need to know how much of that storage exists and where it is for operational purposes? And I am assuming it is nonexporting.

MR. RUGEL: Well, yes, we do need to know. We need to know everything that a customer with a renewable -- or any type of a generator, we need to know for safety reasons. So there is that aspect.

But with the storage, there is a lot of capability of partnering with our customers. If we and the customer, if there could be a mutually agreeable arrangement where they could charge, you know, at convenient times and we could dispatch out of that for system response, yeah, I think there is some potential there. So the couple of things we could do --

MEMBER WOODALL: I am, at this point I am talking about nonexporting systems.

MR. RUGEL: Nonexporting, I guess we would probably only need to know from a safety standpoint. Well, if it -- I don't know how it could be nonexporting if it is connected to the grid.

MEMBER WOODALL: I am cheating because that

topic is going to come up in our interconnection rules. You don't need to respond any further.

MR. RUGEL: Yeah.

MEMBER WOODALL: Thank you. I appreciate your answer.

MR. RUGEL: Okay.

MEMBER HAENICHEN: Well, thank you very much.

CHMN. CHENAL: Thank you very much, very interesting.

MEMBER HAENICHEN: I mean we have never done this before.

MR. RUGEL: Right, right. I appreciate the interest.

MEMBER HAENICHEN: It is real world.

MR. SPENCER: This is the ultimate real-time system, because when I flip that switch, generators have to pick up to carry that load instantaneous. That's ultimate real-time.

CHMN. CHENAL: Member Haenichen would like to know if he could control any of it from the control panel.

MEMBER HAENICHEN: My fingers are trembling.

MR. BECK: As you leave the room, if you get a chance just to look out into the map room, you will see we have the old school wall map boards, where a lot of

companies are going to strictly digital. We probably will in the future, but we still have them.

MR. RUGEL: That's our backup system. It is a system of maps with pins for opens.

CHMN. CHENAL: We are off.

(TIME NOTED: 2:49 p.m.)

(The Committee and applicant proceeded to the hearing room, arriving at 2:59 p.m.)

(The Committee and applicant assembled in the hearing room.)

(TIME NOTED: 3:18 p.m.)

CHMN. CHENAL: All right. This is the time for the afternoon portion of the hearing back at the hearing venue after a very interesting tour. And I think we all compliment the applicant and counsel and staff for putting that together. It was very informative, not something we have normally done, where we have actually gone into a control center and, you know, seen the inside workings. So we thank you for that.

I guess we are ready to start with the panel and the afternoon, Ms. DeCorse.

MS. DeCORSE: Do you want Ed to do a recap of anything we talked about? I think we maybe mentioned that.

CHMN. CHENAL: That's an excellent suggestion.

Let's do that and see if anyone has any questions. I know I have one question, but maybe, Mr. Beck, we can do a recap and open up questions before we get into testimony.

MR. BECK: Yes, Mr. Chairman. We went on our tour, and our first stop was at the training center at the Irvington campus, where Mr. Spencer talked about safety, and how important safety is to our organization, and in particular to our power production group.

We went from the training center on over to the location of the RICE engines, as well as the transmission substation, the new 138kV substation, pointed out the existing triple circuit and some of the facilities that have been or will be removed as part of the overall project, and just the general location of where the new projects would be built.

We then went from there to the site of our existing 138kV substation, where I pointed out the substation, both 138kV, the 46kV, and our satellite 138 yard, all of which will ultimately be removed when this project is completed.

Pointed out the generating units as we went by those, Sundt Units 1 and 2 that will be removed. Talked a little bit about Sundt Unit 4, the fact that it has supplemental input from solar as well as landfill gas.

To be clear on the record, Unit 4 will continue to operate into the future just on natural gas. We just eliminated the coal-burning option.

Then we proceeded from that substation to the TEP training yard, where Mr. Hall talked about what those facilities are and what we use them for. I also pointed out at that location some of the future buildings we are planning on putting on the campus, as well as pointed to the structures to raise the issue of galvanized versus Corten or weathering steel.

We proceeded from the training yard back over to the TEP control center, where Mr. Rugel gave an overview of the control center, what we do in there and asked for any questions.

CHMN. CHENAL: All right. A couple follow-up questions. I forget which unit it was where the coal conveyor system has been partially dismantled. Was that No. 4 or was that 1 or 2?

MR. BECK: It is all for Unit 4.

CHMN. CHENAL: Okay. So Unit 4 will continue to operate using natural gas, is that correct?

MR. BECK: Correct.

CHMN. CHENAL: And Units 1 and 2 were coal-fired, but now they are running on natural gas or --

MR. BECK: They have always been either natural gas or fuel oil.

CHMN. CHENAL: Or fuel oil. And those are operating as we speak?

MR. BECK: They are capable of operation, yeah. Just 4 was on today.

CHMN. CHENAL: Okay.

MR. BECK: 1, 2, and 3 are available for use as needed.

CHMN. CHENAL: Okay. And 1 and 2 are intended to be decommissioned as a result of the RICE units?

MR. BECK: Correct.

CHMN. CHENAL: And Unit 3, what will happen to Unit 3?

MR. BECK: It will continue to be operational. With the RICE units, our need to call on that unit will be considerably reduced.

CHMN. CHENAL: And Unit 3 is gas operated?

MR. BECK: Correct.

CHMN. CHENAL: Okay. I had a technical question. There was a discussion when we were in the control center about frequency. And I just would like a little clarification on what that is and how that's regulated by the utilities, including TEP.

MR. BECK: Frequency can be considered a measure

of the balance between load and resources. So when we are in balance, we have got the frequency right at the 60 hertz mark. That is the target value. If we lose generation, we will see the frequency decrease. It is an indicator that we are short on generation somewhere within the overall grid; it may not necessarily be in the TEP system. So that can be across the whole region.

And as Mr. Rugel indicated in some of the major events in California, there is enough frequency deviation across the whole grid that it is noticeable to us at TEP. Smaller perturbations elsewhere on this system may not show up too well at the TEP system if they are far enough removed, so definitely a measure of what our local units are doing, but on a big enough contingency, even outside of the region, it could impact our frequency.

CHMN. CHENAL: And when it is impacted, do the utilities draw on reserves or some other way to get that frequency back in synch, if that's the right terminology?

MR. BECK: Well, the immediate result of a frequency deviation is that all utilities typically have some units on automatic generation control, and they will respond to that frequency dip immediately and start bringing the frequency back up.

And then as Mr. Rugel indicated, the utility that's actually causing the problem has 15 minutes to fix their problem or replace the generation they are missing to restore everybody else to their natural position of precontingency position.

CHMN. CHENAL: So the frequency is caused by more demand than supply on the grid, and it is corrected by the utilities drawing on resources and bringing that supply in synch with the demand, is that correct, essentially correct?

MR. BECK: It can either be increases in the load or a drop of generation. So if you lose some generation or a line, it can cause that frequency drop, and then the response to that is to increase generation on those units that are still available or are online.

CHMN. CHENAL: Thank you very much.

Yes, Member Haenichen.

MEMBER HAENICHEN: Mr. Beck, why don't you explain to the Committee why it is important to keep the frequency at a certain level.

MR. BECK: Well, a very, very basic issue with the frequency is, at least it used to be, that with analog clocks that was what set your time. I mean your time, if your frequency deviated, your time would either go slower or faster on a clock. With digital it is not

as much of an issue. But that would be the immediate view that an individual would have, is the time error on their clocks.

One of the things that Mr. Rugel didn't point out is we have time error on our board in the control room. There are two clock numbers up there. One is Greenwich mean time, I believe, and the other is our actual system time. So we can see as those deviate, it is the result of frequency issues.

And so you want to try and keep that frequency right at that balance. I mean timing, the time is just one indicator, but it has impacts on all of our equipment that's connected to the system. Motor loads, motors don't respond well as the frequency starts varying too much.

CHMN. CHENAL: Member Haenichen.

MEMBER HAENICHEN: In these events why don't you give us a back of the envelope feel for how much the frequency deviates. Is it one hertz, or would that be a lot?

MR. BECK: One hertz would be quite a bit. Our band is between, from 60 we try and stay 59, I think it is, .4 to 60.4. That's the bandwidth we are supposed to be operating in. And occasionally we have had deviations a little bit beyond that, but not much. If

you went one megahertz beyond, that's a major.

MEMBER HAENICHEN: One hertz.

MR. BECK: One hertz. I'm sorry. One hertz.

MEMBER HAENICHEN: Megawatts, that would really be bad.

MR. BECK: Megahertz would be really bad.

CHMN. CHENAL: Member Riggins.

MEMBER RIGGINS: I had a question. And it is kind of a general question. But I guess, in terms of maintaining the balance, and earlier, Mr. Beck, you had talked about California using renewables to kind of maintain a balance, is there any comparable projects for like the RICE units that are going to be or would be proposed, is there anything in TEP's systems or is there any other projects that are similar to this using RICE for this type of generation?

MR. BECK: I think we are one of the early adopters at the utility level for using RICE. I am not aware of any others.

MR. SPENCER: Portland General Electric has a similar facility along the Columbia River. It was installed two years ago for a very similar purpose for renewables and for grid balancing. Pacific Gas & Electric has a facility with smaller reciprocating engines in the northern California coastal area for the

same reason.

Those are the only two reciprocating engine facilities that are owned by utilities in the western grid that I am aware of today. Now, there are others that are potentially on the books and being considered in Montana and other locations for all the same reason.

MEMBER RIGGINS: Okay. Thank you.

MR. BECK: Mr. Chairman, just to add to the previous question regarding the frequency, one thing that utilities have in place for frequency deviation is an under-frequency load-shedding program. And all the utilities, at least in the western U.S., coordinate and have identified the amount of load they would have to drop for various levels of frequency. As we start to drop below that 60 hertz, if it gets to that cutoff point, we will actually drop load. And we have got preprogrammed systems in place to drop that load. And it is called under-frequency load-shed program. And all utilities, at least in the WECC, are signed up to that program.

CHMN. CHENAL: Thanks for the clarification.

Any further questions from the Committee?

(No response.)

CHMN. CHENAL: Then I guess we can proceed, Ms. DeCorse, with the testimony.

BY MS. DeCORSE:

Q. All right. I first want to direct you to the left screen that's labeled Planning to Meet Future Operational Requirements for the hearing at Exhibit TEP-16. Ed, can you explain what this is, Planning to Meet Future Operational Requirements, give some background?

A. (BY MR. BECK) Yes. This is a slide that came out of a presentation that TEP presented to a workshop for the integrated resource planning process. This comes from 2016, and I thought this just gave kind of a good view of what we have been discussing as far as some of the steps we have been working on.

Q. Okay. And I just wanted to let everyone know that you have that in front of you also as a paper copy.

But I believe you were talking about the purpose and need for the RICE project and the studies that we did. Do you want to continue on that?

A. (BY MR. BECK) Yes, that's correct.

So I think we were on Slide 10. We would introduce this slide on the left as, I guess, a 10A, ten and a half.

MS. DeCORSE: So we are doing it as a separate exhibit, TEP-16. And we can formally call it TEP resource planning process.

MR. BECK: Okay. This seems to fit right into this part of the slide presentation.

So basically what I am trying to point out here is that in 2014 we were looking at what our future needs would be. And at that time we were at 80 percent coal and only 4 percent renewables. We were looking at operational requirements that included the regional haze compliance issues, the renewable portfolio standard that was out there from the Commission, and an energy efficiency standard that was out from the Commission. We looked at some of the solutions as being coal plant retirements, additional natural gas units, and additional renewables on our system.

Subsequent to that we actually made the decision as a company that we wanted to get to the 30 percent renewable level. And that drove us to then purchase the one unit at the Gila River plant to add gas-fired generation to our portfolio. So that was part of our portfolio diversification strategy.

We also identified energy storage technologies as another thing we should be working on and looking at. And we, in fact, did put in battery storage last year, two installations totaling 20 megawatts. Those batteries are good for 15 minutes. So it is not a very long-term solution to anything, but it is really a

trial. And they were coupled with some of the solar projects we had in place.

We also are looking out for next year or the year after to put a 30-megawatt battery system in place with another solar project that we have coming on line. And those batteries will be good for four hours. So at least it gives us some extended range.

And the batteries, what we are -- what Mr. Rugel is actually working on is how he can implement those batteries to help with the frequency response issue on a very short-term minute-by-minute basis.

We were also at the time looking at -- at that time, in 2014, the Clean Power Plan was on the horizon. And, of course, that situation has changed. But we were also looking out at the duck curve issue that California has, and if we were going to 30 percent renewables, we would be replicating that similar problem.

And, regionally, transmission development, if some of the larger lines that are proposed get developed, they will have a large impact on renewables and our use of existing generation. Two of those are the Southline and the SunZia project, which have not broken ground yet.

And some of the natural gas infrastructure development that has been ongoing identified possible

other future opportunities to use gas-fired generation.

But that was all considered as we were doing our IRP process and all of our analysis and studies, some of which I have already talked about, some of the criteria that I talked about on Slide 10.

BY MS. DeCORSE:

Q. Ed, could you explain what the duck curve is?

A. (BY MR. BECK) It is the issue in California for the most part; there are other places starting to experience it, but it became an issue in California. And it is the ramp of the renewables, in particular solar.

In the morning as the sun comes up and the solar comes on line, there is a very steep increase in output of generation from all the solar plants. So your generation numbers are going up dramatically, your load is staying the same. So you have got to deal with it by reducing your fossil-fired generation for the most part. And then, likewise, in the afternoon, as the sun starts to go down, you have the reverse effect, where you are losing incredible amounts of generation over a very short time period. And so you have a very steep curve.

And someone took a look at those curves when they were put on a chart and identified that they looked like a duck. And so they have got the name the duck

curve. And it has stuck very well to the -- within the industry.

Q. Thank you.

And the ramping needs analysis, did that go into TEP's consideration?

A. (BY MR. BECK) Yes. So looking out for future ramping needs, one of the things we looked at was how -- for us, we are primarily depending upon solar generation. There is not a lot of wind in our region. We have to look to basically New Mexico for a good wind resource. So we are really banking to a large degree on solar within our territory.

We took a look at should we concentrate the solar in one location at a utility scale, what if we had it geographically dispersed across a region, or the base case, which is kind of status quo, where we have got some spread around our system, but we didn't do a very detailed analysis as those projects developed to make sure they were geographically dispersed.

And so you can see on this chart it is just an indicator of the number of days in the future where we would have net ramps that are greater than 200 megawatts. And you can see that in the geographically dispersed we identified potentially three days with those high ramp rates. And if we stay status

quo, the way we have been building out, we would have 28 days where we have those high ramps. And if we really concentrated the solar into one location, we could have 118 days out of the year where we have real high ramp rates. So it just identified to us the need to geographically disperse our renewable resources.

Further, we identified in here that in 2019 we would have that 30 megawatts of battery storage, and that was part of our consideration as we were looking at those ramp rates. These on the right-hand side is just an indicator of which of our units could help respond to the ramp rate and at what level.

And you can see we have got 48 megawatts in here identified as future natural gas, as well as then another chunk here, which is our Gila River unit, which we already have in place. So a portion of that 48 would be from the RICE units in the future.

CHMN. CHENAL: Member Haenichen.

MEMBER HAENICHEN: Mr. Beck, I need you to help me understand something. When you refer to a battery bank or a battery storage facility, and you say it is 20 megawatts, don't you really mean 20 megawatt hours? It stores energy, right?

MR. BECK: Well, the peak is 20 megawatts and it is available for 15 minutes.

MEMBER HAENICHEN: So it is a force of 20 megawatts?

MR. BECK: Right, correct.

MEMBER HAENICHEN: Thank you.

MR. BECK: Yeah. When you look at a megawatt hour, it would be five megawatt hours.

So continuing on with the purpose and need, our analysis determined the RICE technology is TEP's best resource for allowing the additional renewables that we want to utilize, provides the benefits of it is capable of operating at low output without a significant heat rate degradation. So we could have that 20 megawatt unit operating 10 megawatts, might be our minimum, and really have no economic impact to the project.

The modular capacity allows us to use only one unit for that 10 megawatts, or we could spread it over two. And then we would have potentially either eight or nine as remaining backup units to that one or two, depending on how we were operating. And a single 20-megawatt unit operating in that lower level of operation will meet all of our minimum run requirements, but it still leaves that 10 to 14 megawatts of ramping capability that's on line ready to go.

CHMN. CHENAL: Mr. Beck, I had a question. Going forward, do you anticipate, maybe this is a

question for Mr. Spencer, but do you anticipate that in the future TEP will go to the RICE technology versus gas turbines?

MR. BECK: Well, we are definitely at the point where this 200 megawatts we have identified as our next resource and the right resource at this time. It will take future analysis to determine what the situation looks like. If battery storage has incredible breakthroughs or there are large breakthroughs on using renewables to provide some of the ancillary services we are looking for, renewables could be an answer in the longer term.

It is just at this time, the RICE units are the right fit for what we need, as well as what is available and what is economic. And so I don't think we can say at this point that in five years the next set of units we would put in are RICE; although, at this time RICE looks very good for us.

CHMN. CHENAL: What is the relative cost between a megawatt hour of energy produced with the RICE unit versus a gas turbine? I don't need the cost, I am just -- is one cheaper than the other?

MR. SPENCER: Yes. So when you look at the levelized cost of gas turbines over a 20-year life versus RICE -- and we have that analysis and we will

show you that in testimony -- the RICE is a cheaper resource.

CHMN. CHENAL: Okay. You will have testimony on that later?

MR. SPENCER: That is correct.

CHMN. CHENAL: Okay. Member Woodall.

MEMBER WOODALL: Can you tell me if there is any other utility that's using this technology currently in Arizona?

MR. BECK: I don't believe so in Arizona, but there were the two in the northwest Mr. Spencer indicated.

MEMBER WOODALL: Was this technology discussed in one of Commissioner Burns' technology workshops, do you recall?

MR. BECK: I am not aware.

MEMBER WOODALL: Okay, thank you.

BY MS. DeCORSE:

Q. Mr. Beck, can you please explain the technical components of the RICE project?

A. (BY MR. BECK) Yes. So you have seen this picture at least once and you will see it again. But this is a similar type project in Texas.

Now, one difference, and Mr. Spencer may talk about this a little bit more, and I had already

indicated instead of a single building like this, we plan to have three buildings or three structures. We will have one structure around five units, another structure around the other five units, and then in between there is a smaller structure for some associated equipment, electrical equipment in there.

Q. And now we are moving on to the transmission project. Can you speak to the purpose and need for that?

A. (BY MR. BECK) Yes. So for the transmission, we currently, as I mentioned, we have a main and transfer substation, for the most part, with a satellite that is a ring bus, all of which are a little less flexible. It is not so much the reliable aspect as flexibility for switching and, should a contingency occur, how you can respond to that contingency.

And we have been getting issues raised by the peak RC, which is the reliability coordinator for the region, when we try and do maintenance on any of our facilities that are not breaker and a half. They basically say you can't do that maintenance, which is not a good thing from a system perspective.

So the one way that we have of responding is to convert to breaker and a half to allow that flexibility. Basically instead of a single breaker protecting a line,

you are relying on one and a half breakers to protect a line. So if you have a problem with one of those breakers and you need to do maintenance, you can take that one out of service and the other breaker provides 100 percent protection. You are only paying for that other half, but you actually get the use of the whole thing if and when needed.

So from a reliability perspective, we need to convert to breaker and a half. We can't do it within the configuration or the space that we have available. And therefore we had identified that we wanted to build a new substation on our campus and relocate everything.

It has been in our plans for awhile, and it was, I believe, a couple years out in our actual budget when the RICE program came up. And to help accommodate the RICE project, we have accelerated the substation work by a couple of years. The existing substations will not allow any future interconnections. And so it is problematic to try and bring other RICE units and connect them into the existing substations. And since we need to do the reliability fix anyway, it just made sense to do them together. And then the addition of the new substation will further allow several more future lines to interconnect, if and when needed at that substation.

The actual transmission line relocation project consists of the new substation, which we have had the discussion that it is technically not part of the CEC. We will have 2.26 miles of double-circuit 138kV transmission line, two-tenths of a mile of single-circuit that will be converted to double-circuit, and two-tenths of a mile modification to the triple-circuit structures that you saw today.

Just some examples of the poles, and you have more examples on the placemat of what the monopoles will look like, they are indicated on this slide. We are planning to use tubular steel monopoles, ranging in height from 55 to 199 feet. The likelihood that we will actually have 199 feet is not too large. Our engineering group just wanted some flexibility should they run into some particular clearance issues.

Span lengths will typically be between 600 and 800 feet across the site, and we are anticipating 41 structures are needed for the design.

Again, there will be no right-of-way involved in this because we are totally on our existing property. And again, the total length is 2.2 miles of new and four-tenths of a mile of repurposed lines.

Q. Mr. Beck, can you please explain any potential impact the projects may have on communication signals

and discuss any mitigation measures TEP will undertake.

A. (BY MR. BECK) Yes. As far as the impacts on communication signals, we see no impacts on radio, television, or communication signals from either project. Our transmission hardware on the lines are designed to minimize gap and corona discharge which are typically a cause of noise. So any radiofrequency noise should be nearly nonexistent.

As far as mitigation measures that we typically use at TEP, if there are areas that have good reception prior to the project that have problems after, we will inspect and repair any loose or damaged hardware in our line. If interference from corona discharge from an AM station within a good reception area prior to the project is identified, we will make appropriate modification of the receiving antenna systems to the extent needed. If there are issues with two-way mobile radio, typically by moving less than 50 feet so that you are basically out of the shadow of a structure, there no longer is an issue. So we don't see that as being an issue.

And we will work with any tower operators to resolve issues directly related to the project, so towers being any communication towers. I was pretty specific regarding radio, television, or communication

signals where they are over-the-air signals. We are working with the UPRR to look at any possible impacts to their communication signals along the tracks. And that's something that is in process, been in contact with them and we will work out mitigation plans with them to the extent needed.

CHMN. CHENAL: Member Haenichen.

MEMBER HAENICHEN: Mr. Beck, what about cell phones?

MR. BECK: Our history has been we have had no complaints or no complaints of cell phone reception due to transmission lines.

MEMBER HAENICHEN: Thank you.

BY MS. DeCORSE:

Q. What is the estimated cost of the projects? Oh, sorry, I will let you finish.

A. (BY MR. BECK) We have also had extensive experience with the transmission line construction and development as well as generation development. We regularly develop transmission lines supported by monopole structures similar to what we are intending to use. And we have constructed generation projects ranging from 25 megawatt simple-cycle turbines up to 400 megawatt coal plants.

BY MS. DeCORSE:

Q. Now, Mr. Beck, can you please speak to the estimated cost of each project?

A. (BY MR. BECK) Yes. Regarding the cost, we are estimating that the cost for the transmission line work will be about approximately $7.4 million, the 138kV substation relocation will be $30.4 million, and the RICE generation itself is estimated at $160 million.

Q. As part of the cost for the projects did TEP analyze the estimated cost of RICE units against other types of generation?

A. (BY MR. BECK) Yes, we did. And we also just recently looked at some new studies by Lazard, who is an industry expert on energy costs. And they have identified -- they compared lithium ion battery storage against natural gas reciprocating engines. And as you can see on this chart, the levelized cost of batteries is generally up in that $257 per megawatt hour range versus RICE units at 130, so not quite twice the cost for battery storage.

Further, when we were looking at our project, we looked at the Lazard levelized costs of energy, and you can see on this table that for RICE engines, their numbers were 650 to $1100. Burns & Mac and the Energy Information Association showed a range of 1,060 to $1,342, whereas, if you look down in the lower part of

the table, you will see that the actual RFP results for TEP came in on the $800 per kilowatt, or the $160 million cost for RICE units.

Looking back at the battery storage option, Lazard numbers ranged from 1388 to 1700, whereas the Energy Storage Association identified 1315 to 1549. Proposals received by TEP for similar type projects were actually $1500 per kilowatt, or a total project of 300 million, so pretty close to being double the cost of what the RICE units would be.

Q. So would you say that the RICE units are the lowest cost option from looking at these RFPs?

A. (BY MR. BECK) Definitely, yes.

Q. Aside from being the lowest cost generating resource, are there other additional benefits associated with these projects?

A. (BY MR. BECK) Yes, there are. And specifically we did interconnection studies for the RICE project itself. Even though it is connecting to the TEP system, we ran the transmission planning study as an interconnection study. We identified that there would be a more robust electric grid as a result of the project, actually both projects. The projects would improve TEP's ability to respond to the fluctuations in renewable generation, which was one of our goals, and it

would help to eliminate the issues that we face today regarding reliability standards, in particular the outage issue and maintenance issue.

And finally, in the ACC Staff response to the Chairman, which we, I believe, we have got as an exhibit, Staff stated that Staff believes the proposed projects will improve the reliability, resilience, and safety of the grid, as well as the delivery of power in Arizona. They will also add to clean energy resources by compensating for the intermittence of renewables, and facilitating an increased capacity of renewable generation resources in the State of Arizona.

Q. So --

CHMN. CHENAL: Member Woodall. Excuse me.

MEMBER WOODALL: Mr. Beck, do you know who the engineer was that worked on this response?

MR. BECK: Nonso.

MEMBER WOODALL: Dr. Chukwu Nonso Emordi, Chidebell-Emordi?

MR. BECK: That would be the one.

MEMBER WOODALL: That would be the one. Thank you.

MS. DeCORSE: For clarification, we marked that as Exhibit TEP-14.

MR. BECK: Yes, we did.

MEMBER WOODALL: Thank you.

BY MS. DeCORSE:

Q. Now, Mr. Beck, can you please briefly describe the proposed CECs and conditions, and highlight any differences between the two?

A. (BY MR. BECK) Yes. Regarding the transmission CEC, we have identified in the CEC that we have drafted a request for a 500-foot corridor for routes for each transmission line as part of the project, with 250 feet on either side of the route centerline as shown on what would be the attached exhibit in the CEC.

This case is different than the majority of cases, in that everything is on TEP land, and we are not sure whether even requesting a corridor is something that is required. But we started with the draft of 500 feet, so you will see that when we talk about CECs.

Regarding the generation CEC, we are requesting a certificate for construction of the 200 megawatts of reciprocating internal combustion generation on the TEP Irvington campus.

The two proposed CECs are similar, but for several of the conditions actually within the CECs. And just to highlight those two differences before we get to actual deliberations later, in the transmission CEC there are two conditions that we didn't feel applied to

the generation. One dealt with the use of nonspecular conductor, and the other was regarding participating in regional transmission studies. We didn't feel those should be in the generation side.

And then in both CECs there is a condition regarding cathodic studies for pipelines. And we will be proposing some specific language changes relative to the use of the word studies versus measurements. It is a concept that we had this discussion in the Nogales case regarding the fact that we are not going to trip a line, go out in the field and try and measure the impact. We are going to study it without actually having the contingency occur.

CHMN. CHENAL: Do you remember, Mr. Beck, if the proposed CEC condition that was, well, proposed by ACC Staff, which word they used in that?

MR. BECK: They did use the word measurements. And we have subsequently had communications with Staff suggesting the use of the word studies, and they came back and said that they were set, they were okay with that.

MS. DeCORSE: We have copies of that if you would like it as an exhibit; if not, we were going just to mention it at the time of the CEC discussion.

CHMN. CHENAL: I think we can wait. We will

accept that as an avowal.

MS. DeCORSE: Okay.

BY MS. DeCORSE:

Q. Sierra Club was mentioned earlier, and their comments that they filed last week on January 12th, 2018. Have you had a chance to review those comments, Mr. Beck?

A. (BY MR. BECK) Yes, I have.

Q. And those are in front of you as well marked Exhibit TEP-15?

A. (BY MR. BECK) Yes, they are.

Q. Would you care to comment on any of their assertions?

CHMN. CHENAL: Let me interrupt for just a moment. I would hope, Mr. Beck, that you would summarize the concerns that were raised by the Sierra Club, I think for the record and for the benefit of the Committee, as part of your comments in response. Because I think without having a clear explanation of what their concerns are, the response won't make as much sense.

MR. BECK: I can do that. Just for your information, the way we kind of split it was effectively two comments from the Sierra Club. And I kind of identified dealing with question or comment number 1,

and Mr. Spencer was going to deal with number 1.

CHMN. CHENAL: That's fine.

MR. BECK: Is that satisfactory?

MS. DeCORSE: And on the slide it actually has their number 2 in quotes. So that was their second concern, which, the second heading, which Mr. Beck will be speaking to, and then Conrad will speak to the first.

MR. BECK: Yes. So their point number 1 was TEP should be pursuing an efficient renewable solution to its power needs rather than building a new gas plant. They also said that costs of renewable projects are decreasing. We fully agree that the renewable projects have been decreasing. We think they are starting to hit a low point. I am not sure they will continue in their drastic decreases that they have had.

But as we pointed out, and as Mr. Spencer will point out further in his testimony, our ability to manage the variability caused by the actual renewables themselves is the problem. And any response using renewable generation to respond to that is in its infancy, and the cost related to trying to use those renewables in that fashion is still very high.

The Sierra Club mentioned the First Solar project. They indicated it was in Arizona. It was actually an installation within the California ISO in

California, but it was managed out of an office in the Phoenix area; it was just their control center. And it was a test to show the ability to regulate with solar, and at a very high level it showed success within that study. The study was partially funded by the NREL through the DOE. And so they did their study work.

The problem or the piece that's remaining to that whole process is how do entities that are providing those services get compensated. There is no mechanism today for paying for or charging for those ancillary components that you would be providing. And if you have a solar facility that you curtail in order to provide certain services, you are going to expect somebody to pay for that. And that is something that has not been worked out. So as I mentioned earlier, longer term renewables may be an option, but today they are not an economic option that we can really rely upon.

And within the Lazard study that I mentioned earlier, Lazard came out with a conclusion. And their statement in their report was:

Although alternative energy is increasingly cost competitive and storage technology holds great promise, alternative energy systems alone will not be capable of meeting the base-load generation needs of a developed economy for the foreseeable future. Therefore, the

optimal solution for many regions of the world is to use complementary conventional and alternative energy resources in a diversified generation fleet.

And that is exactly what TEP is proposing in this case. The RICE units that we are proposing are just one component of an overall portfolio we are putting together with our ultimate target of getting to that 30 percent by 2030.

CHMN. CHENAL: All right. May I -- are you finished with your discussion of that point, Mr. Beck?

MR. BECK: I actually have one more slide regarding Sierra Club.

They further recognized in their comments that any significant increase in costs represents a potential increase in the cost of energy to customers. Well, just based on the proposals received by TEP in 2017, if we were to look to energy storage, it would be double the cost of the RICE project, with all of this cost ultimately being borne by TEP customers. So we don't see these other options at this time as being economical or justified for our customers.

CHMN. CHENAL: Okay. Just a couple points. In the Sierra Club letter, which is TEP-15, on page 2, the third paragraph, there is a statement that says a First Solar project in Tempe, Arizona demonstrated that

utility scale solar plants can provide the same grid balancing reliability services that have historically been provided by fast ramping gas plants. Then there is a Footnote 8 to a California Independent Systems Operator, you know, article or -- article I would say.

I would just like you to comment on that, because I think we should make the record, you know, that this has been raised. And we heard your testimony and what you have cited, but this has not been specifically addressed. And then on the next page there is one more I will toss to you.

MR. BECK: Okay. Mr. Chairman, relative to that particular issue, again, it goes back to the first point I raised. The study that was done was actually units in California in the Cal ISO. They were controlled out of a control room within Tempe, and so they indicated it was an Arizona project. It wasn't.

That project specifically showed that in the stand-alone situation, a renewable project could provide ancillary services that potentially helped deal with the variability issue. But the surrounding issue with that, there is no mechanisms in place to price, charge, or actually provide that service from any of these renewable project developers to users such as us, TEP, as a utility. And we likewise don't have in place the

mechanisms or tariffs that would allow us to likewise develop such a project and identify the costs and how those should be recovered.

So in the longer term, there very well may be optionality to use renewables to provide these services, but at the present time the cost and the capabilities to do that have not been finalized or determined.

CHMN. CHENAL: Okay. I appreciate that. I am sorry. You were probably answering my question before I asked it, but I was -- I just wanted to make that clear on the record.

And secondly, and you may have already addressed this, but there is a reference in the second to last paragraph of the letter, just last week an energy solicitation in Colorado yielded bids for solar plus storage projects that were far lower, with an average bid of $36 a megawatt hour, which they say is 20 percent lower than TEP's contract.

MR. BECK: That is the quote that they gave, and I have seen some headline quotes similar to that. The devil is in the details, as we all know, as to what do they mean by that average cost, and what does that actually include. And even in the TEP numbers, we had very low numbers back when we entered the contract we had. But just looking at that number doesn't give the

full picture of what you are getting for the project and what the true costs are.

So I mean it is a sensational headline to say that costs have gone down 20 percent. But you would have to dig into the real details of the underlying data and the actual proposals that were received. And at least the little bit of research I was able to do since we got this letter, I couldn't find those numbers. They weren't available.

CHMN. CHENAL: And thank you. Again, my purpose in asking these questions is more to make the record complete than it is to cross-examine you on the points you raised previously.

Member Woodall.

MEMBER WOODALL: Just for clarity, these were bids. There is no RFP, is that correct? Or do you even know?

MR. BECK: I am not even sure. I would suggest they are probably a result of an RFP.

MEMBER WOODALL: Yeah, yeah. But I mean these weren't a contract. These were just bids that they received, and there is no contract for this amount, as far as you know?

MR. BECK: Not that I am aware of.

MEMBER WOODALL: Okay, thank you.

BY MS. DeCORSE:

Q. And Mr. Beck, to Member Woodall's question, did TEP put an RFP out for battery storage?

A. (BY MR. BECK) Yes. So in fact the numbers that are on the chart on the screen at this point, those were the results of the RFP.

Q. So can you please elaborate, if you haven't already, anything else you would like to add to battery storage and its limitation as a fast ramping generation resource?

A. (BY MR. BECK) Well, again, as I mentioned, that technology is kind of in its infancy for application in the variability of renewables. And there are some big names in the battery arena that are trying to figure that out and work it out, Tesla being one major entity, as well as Samsung, and there is at least three others.

But the technology of the batteries is still continuing to be developed. The safety and ability to use the batteries, you look at cell phone batteries and how some of those have exploded or burnt, it is because you are trying to compress that energy into a small area. And as you try and do that at a utility scale, one of the things you are looking at is, well, where do you put them and how do you put them.

A large component of battery storage is cooling.

And if you are not aware, a lot of these battery projects utilize cargo container type structures where they just load them up with batteries and they plop them down on your site. And TEP does have some of those at our facilities. There is large cooling AC units stuck on the back end of those to keep those batteries cool. And you have to have redundancy in the cooling systems, because if you have failure, you can have real heat problems.

And so all of those things we are still working through, how good are we at managing all of that stuff, and as an industry, not just TEP, but as an industry. And so over time I think that the battery technology is going to continue to improve, and there will be opportunities to utilize it for things such as the variability of renewable resources. As I said, TEP is looking at a 30 megawatt battery installation tagged onto a 100 megawatt solar project that we have signed a PPA for. So we are planning to do that.

What a lot of the battery companies are doing is, because the PPAs are usually two to three years out in the future, they are banking on great technology improvements in the batteries and offering low prices. And we have got purchased power agreements that have clauses in there that we feel at least cover us from our

side. But what happens if those battery entities get to the point where the project goes in service and that technology hasn't improved to the extent to meet their budgets? We haven't seen what happens yet with that.

Q. Thank you. I know we are at the end of your presentation. Do you have any concluding remarks?

A. (BY MR. BECK) Yes. So TEP must respond to the NERC planning standards. And that's the issue. The breaker and a half substation conversion is to allow us to do maintenance and cover contingency issues that have been coming up recently in our operational realm.

We must enhance our ability to respond to fluctuation in our growing renewable portfolio, and we feel these projects balance our ability to construct and maintain the facilities, while minimizing the impact to the environment, which will be more fully explained in detail in Ms. Darling's testimony.

We don't have a cost of acquiring right-of-way in this project because we are on our site. And the cost of upgrading structures is relatively small relative to the RICE project. The costs of the transmission are needed for reliability, so they are going to be there regardless of the RICE program.

We don't see the project significantly impacting any communication signals; although, I did mention UPRR

is one we are still working with. We have extensive familiarity with the equipment to be used. The projects are technically feasible and they provide the most economic means for TEP to respond to reliability requirements as well as the variability of renewable resources.

MS. DeCORSE: Thank you.

CHMN. CHENAL: Member Woodall.

MEMBER WOODALL: So how is it that you are familiar with the equipment to be used if this is the first project in Arizona?

MR. BECK: I will let Mr. Spencer respond to that.

MEMBER WOODALL: Oh, clever.

MR. SPENCER: The use of reciprocating engines is not new to the generation division. We have small versions of these used in emergency backup applications at our facilities. So the reciprocating engine, from the standpoint of pistons and piston rings and crankshafts and things of that nature, is not new. The size will be new. So instead of four-inch diameter pistons, these will be 24-inch diameter pistons.

MEMBER WOODALL: Thank you, sir.

MS. DeCORSE: That concludes Mr. Beck's hearing presentation. Mr. Chairman, with that, we would like to

offer Exhibits TEP-1, TEP-3, TEP-4, TEP-4A, TEP-11, and TEP-11A into evidence.

CHMN. CHENAL: Can you give me the numbers again, Ms. DeCorse. Would you give me the numbers again, please.

MS. DeCORSE: It is 1, 3, 4, 4A, 11, and 11A.

CHMN. CHENAL: Okay. Applicant has offered TEP Exhibits 1, 3, 4, 4A, 11, and 11A. Any objections?

(No response.)

CHMN. CHENAL: Okay. Those exhibits are admitted into evidence.

(Exhibits TEP-1, TEP-3, TEP-4, TEP-4A, TEP-11, and TEP-11A were admitted into evidence.)

MS. DeCORSE: And I missed -- I am sorry. We added TEP-14, 15, and 16, which are Staff's letter, Sierra Club's written comments, and the slide Mr. Beck showed of the TEP resource planning process.

CHMN. CHENAL: Could you put up Exhibit 16 again. It has been marked as Exhibit TEP-16. Ah, yes, okay. All right.

TEP, in addition to the ones previously admitted, applicant has offered TEP-14, 15, and 16. Any objection?

(No response.)

CHMN. CHENAL: Okay. TEP-14, 15 and 16 are

admitted as well.

(Exhibits TEP-14, TEP-15, and TEP-16 were admitted into evidence.)

MR. DERSTINE: Mr. Chairman, I am looking at my watch. So it is 4:20. I know we have a scheduled break at 5:00, or we could run past that, with public comment at 5:30. If I could ask for maybe a short break, we will decide on which witness best fits our remaining time for today and fits into this window, and we will be ready to proceed.

CHMN. CHENAL: Okay. Let's take a break until 4:30 then.

(A recess ensued from 4:19 p.m. to 4:36 p.m.)

CHMN. CHENAL: All right. Ask everyone to take their seats, and we will begin the afternoon session after the afternoon break.

So any questions by any of the members before we turn it back to counsel for the applicant?

(No response.)

CHMN. CHENAL: Okay. I guess Mr. Derstine or Ms. DeCorse.

MR. DERSTINE: It is Mr. Derstine. We stopped --

CHMN. CHENAL: Isn't it Mr. Derstine?

MR. DERSTINE: I want to say it the way you say

it.

We were going to go and proceed with Ms. Darling's coverage of all the 360.06 environmental factors, but in light of the time window we have, we are going to move forward with Mr. Spencer. And so that's what we will do.

CHMN. CHENAL: Please proceed.

DIRECT EXAMINATION

BY MR. DERSTINE:

Q. Mr. Spencer, you were sworn; you are still under oath. But for clarity of the record, why don't you state your name again.

A. (BY MR. SPENCER) Conrad Spencer.

Q. All right. And Mr. Spencer, we identified you as the director of Tucson power generation and the project director for the RICE project, is that right?

A. (BY MR. SPENCER) That is correct.

Q. Okay. How long have you been with Tucson Electric Power and in those capacities?

A. (BY MR. SPENCER) Just short of five years.

Q. And before that what did you do?

A. (BY MR. SPENCER) I spent 31 years with Arizona Public Service Company, APS.

Q. What did you do at APS generally?

A. (BY MR. SPENCER) 28 of those years with APS were managing the Cholla facility and other positions leading up to that in northern Arizona, which is a coal-fired power plant, and then three years in Phoenix at the corporate office as the director of project management generation engineering.

Q. All right. Returning to your role as the project director for the RICE project, you prepared some set of slide or hearing presentations to assist us with your testimony here in this hearing. Let's talk about those for a minute.

Let me direct your attention to TEP-8 and TEP-8A. Do you have those in front of you?

A. (BY MR. SPENCER) I do.

Q. Okay. And have you had a chance to review TEP-8 and TEP-8A?

A. (BY MR. SPENCER) I have.

Q. Do you have any corrections or changes to those two presentations?

A. (BY MR. SPENCER) I do. There is an incorrect number of gallons of water usage currently and projected in both of those slide decks.

Q. Okay. And can we make that correction when we move on to that slide?

A. (BY MR. SPENCER) Yes.

Q. Okay. Other than the correction that you are going to make in your testimony when we get to the appropriate slide in those presentations, any other changes or corrections?

A. (BY MR. SPENCER) No.

Q. All right. The information, other than the correction you are going to make to gallons of water used by the RICE project in comparison to the existing steam generators, other than that, is the information in TEP-8 and TEP-8A true and correct, to the best of your knowledge and information?

A. (BY MR. SPENCER) Yes.

Q. All right. What is the difference between your presentations 8 and 8A?

A. (BY MR. SPENCER) 8A addresses comments made in the written letter of the Sierra Club.

Q. I think we have covered your role and responsibilities to some degree. Well, go ahead and cover your responsibilities as project director for the RICE project, just to give some general background for the Committee.

A. (BY MR. SPENCER) I have overall responsibility for the RICE project, for establishing the budget and managing the budget, for obtaining all the permits necessary to allow for construction and start-up and

commissioning the project, all the procurement activities, the bidding processes that are occurring, the engineering and the construction, and the ultimate commissioning and start-up.

Q. Mr. Beck testified at some length about some of the analysis that was done by TEP with regard to finding the right generation resource to meet the various needs that he has described in his testimony. Were you involved in some of that analysis work, or was that presented to you as kind of a decision, here, go forward with it?

A. (BY MR. SPENCER) I was involved in the majority of the analysis work, interacting with many other departments within TEP, and the execution of contracts with outside entities to develop the tools necessary to make the decisions that we have made.

Q. All right. So with that, why don't you start and give the Committee a little more background on the RICE units. Mr. Beck has covered some of that. I don't want to be overly duplicative, but from your perspective as the project director, tell us what you think the Committee needs to know about this project.

A. (BY MR. SPENCER) As was stated by Mr. Beck, the company had planned to file the integrated resource plan of 2017. In preparation for that, for approximately a

year and a half prior to that, we began to evaluate the fundamental goals associated with that integrated resource plan. The fundamental goal that was going to be new that would be stated in that integrated resource plan was this goal to achieve 30 percent renewable sales by 2030. That caused us to step back and say, you know, what have we got to do to achieve that.

Q. Okay. So you know we were in the control room and we heard some discussion about, I think the term was used, challenges for TEP as it is a balancing authority on the system and the challenges that renewables provide. Can you give us a little more discussion about what sort of -- what are the challenges for TEP in achieving its goal of 30 percent renewables by 2030.

A. (BY MR. SPENCER) Absolutely. Several departments corroborated to take an historical perspective of actual load fluctuations, and then evaluating on top of that what fluctuations we were seeing in the existing portfolio of renewables.

And so Chart 4 that is shown there takes the 2016 load profile for the entire year of 2016 and breaks it into 10-minute segments. And you can see that as people turn their lights on and off, as air conditioners turn on and off, there is this normal fluctuation that was portrayed by Mr. Rugel's testimony in the system

operation control center today that we literally real-time chase the load, if you will. And so there is this constant fluctuation. And so as you can see from this slide, the magnitude of the majority of the load swings are within plus or minus 50 megawatts.

We then superimposed on that the existing portfolio of renewable resources that existed in 2016, which was approximately 275 megawatts of utility scale photovoltaics or wind, mostly photovoltaics, and about 50 megawatts of distributed generation, which is primarily rooftop solar. So that's a total of 325 megawatts of renewables that existed in 2016.

We did the same analysis where we laid on top of each hour of the year from January through December in 10-minute increments the magnitude of the variability of that 325 megawatts of resources. And you can see that the magnitude was in the range of plus or minus 100 megawatts. So the native load shifts around about 50 megawatts. The resource that we are trying to capture and use to cover that swings around, in this level in 2016 of about 325 megawatts of renewables, about 100 megawatts.

CHMN. CHENAL: One quick question. So the chart on the right, make sure I understand, the chart on the right is not showing generation, renewable generation?

MR. SPENCER: That is correct, sir.

CHMN. CHENAL: So it is not -- well, load, but load -- I look at load as demand. That's not -- I am not in your industry, but load is demand and you have got generation to meet the load. So the right screen is basically showing the generation and variability of renewable generation throughout the course of the year?

MR. SPENCER: That is correct.

MR. BECK: That is correct.

CHMN. CHENAL: Okay.

MR. SPENCER: So as you look at this number -- and I will show some slides in a minute or two that put this in relative magnitude of the TEP system -- we said let's lay out the plan for achieving 30 percent renewables of our retail load over an entire year from renewables, what does that profile look like in 2024.

And so once again, on the left is the 2016 load profile, okay, still showing the same magnitude, because we don't believe that's going to radically change. But in 2024, at the current rate of integration of renewables, which pushes us up to 800 megawatts of total renewables, you see that the magnitude of those swings is upwards of 200 megawatts of variability.

BY MR. DERSTINE:

Q. So maybe this goes to the Chairman's question

and shows my lack of understanding, but the comparison between the native load on the left and what you are showing on the right is, with the renewables on the system in 2024, we are having spikes of generation, renewable generation, that far exceed what the native load is for Tucson, or our service territory, and TEP is forced to deal with that excess generation within increments of an hour or ten minutes?

A. (BY MR. SPENCER) That's correct. So just to clarify, that's the sum of all the generation, all the renewable generation, how much it fluctuates every ten minutes. That's the projection.

CHMN. CHENAL: Excuse me. That's more than the load, though. So to Mr. Derstine's question, you have to unload that generation some way into the system?

MR. SPENCER: We have to back the generation off.

CHMN. CHENAL: Yes, Member Haenichen.

MEMBER HAENICHEN: I am still a little bit confused. Is the right-hand graph there only renewables, or does that also have the traditional generation superimposed on it?

MR. SPENCER: Yeah, I think it is just the renewable variability, plus --

MEMBER HAENICHEN: Forget variability. Is it

just the renewable actual generation? Does it have the standard stuff that you now have added to it?

MR. SPENCER: This particular graph is the load. So it is this superimposed with the variability of that quantity of renewable generation.

MEMBER HAENICHEN: Okay, thank you.

MR. SPENCER: Does that help?

MEMBER HAENICHEN: Yep.

MR. SPENCER: Okay. So faced with that level of magnitude, we did some additional evaluation of what have we seen in 2017, are we seeing what we think we are going to see. And this chart does a beautiful job of showing August 8th of 2017.

Now, there is a lot of squiggly lines on here. And let me take just a minute to kind of give you a point of reference of what those squiggly lines mean. The blue line at the top of the chart is reference to this scale on the right, which the center is zero. And that is ACE, area control error. Mr. Sam Rugel in the system operation and control center testified what ACE is, that his mission as an operational center is to keep that zero, or keep that line going back and forth across zero. Because what that says is we are balancing the load and the generation. If it is at zero, it means there is a complete balance.

The green line is the sum of all of the renewables in the system on August 8th of last year. The other lines are essentially components of that green line. I will point out that Macho Springs, this yellow, is wind. The green is the sum of photovoltaics and wind.

So here is a typical August day, and here is the variability that we actually experienced on the system. So here we are at 14:25 in the afternoon, so 2:25 in the afternoon. And we see a 48 megawatt drop in total renewables over about a five-minute period of time. And that was primarily due to monsoon cloud cover. And immediately, a minute later, it returns. And so our area control error drops and then recovers.

A couple hours later we have renewables continuing to increase, and then at 16:24 we have a 145 megawatt drop or 137 megawatt drop in renewables over about an eight-minute period of time. And then we have a slight recovery, but we never get full recovery. So literally we have to increase generation resources from somewhere else to get ACE back above zero to compensate for this dramatic drop in renewables that occurred in a very short period of time to try to get back to this zero mark with our area control error.

So this validates this whole concept that we

showed in both 2016 and that we project in 2024, that this is real-time events because of the nature of the intermittency of those resources.

I would point out that on that August 8th day, as the wind picks up, it helped us because the total photovoltaics were going down. But when the photovoltaics are tailing off, guess what the wind did? It went away. And so it just -- those impacts don't help each other. They compound each other in this particular afternoon. And that's not unique, and those charts pretty well demonstrate that.

CHMN. CHENAL: Member Woodall.

MEMBER WOODALL: I know that APS has looked into the EIM market, and I don't remember where TEP was in examining that possibility. Are you still scratching your head about it, or have you rejected it or -- I meant your corporate head.

MR. BECK: Mr. Chairman, Member Woodall, we are continuing to research both EIM and the SPP market as potential avenues that we might look -- that we might move to. The APS did in fact join the EIM and, consistent with the Cal ISO and all others joined, showing huge benefits each year in their EIM process. Again, that's a matter of how you measure those and are they real numbers. It is hard to say. But they are

seeing some benefit.

The biggest concern from TEP's perspective is we are not well connected to the California ISO. So we showed some slight improvements in an economic analysis, but we questioned some of the inputs. And if you change those inputs, we don't have a benefit. So that's why we didn't jump on the EIM at this time. But we are continuing to look at that, as well as the SPP option. And SPP is the one that's working with the Rocky Mountain region to create a regional market up in the midwest or mid --

MEMBER WOODALL: Would you explain what the acronym SPP is.

MR. BECK: Southwest Power Pool. You can look at it as a competitor to the California ISO. So they are primarily west of the western part of Texas and -- I should say the east of Texas. And they are trying to reach out and expand.

What SPP has is a lot of wind and excess of wind. They are trying to find markets and ways to move it out of their system. And they see expanding their market as a big benefit for them, so that's why they are working with Rocky Mountain and why we are having discussions.

MEMBER WOODALL: And how long do we expect these

discussions to continue? Are we talking about years long? And if it is, you know, competitive, proprietary information, then feel free not to answer.

MR. BECK: Right. I believe that we will probably have kind of a decision in the next six months or so which direction we are headed. And to a large degree it depends on how flexible SPP is with that Rocky Mountain region. And if there is enough flexibility there that extends onto our region, that may be an option.

MEMBER WOODALL: Thank you, Mr. Beck.

CHMN. CHENAL: Member Haenichen.

MEMBER HAENICHEN: Mr. Spencer, would you agree with me that the charts that you presented just scream out for energy storage?

MR. SPENCER: Or recips.

MEMBER HAENICHEN: Well, okay. But are you satisfied with the progress that's being made nationally, or internationally really, in energy storage schemes? I am not.

MR. SPENCER: I think as you see the total perspective of what we are going to present, we believe that battery storage is a very viable potential assistance in this challenge that I have presented here. It isn't developed at the level that makes it a viable

source today to go to.

MEMBER HAENICHEN: Too expensive. It is too expensive. Is that what you mean?

MR. SPENCER: It is too expensive and it is unproven. As Mr. Beck previously testified, TEP has installed 20 megawatts of battery storage technology which have the capability of 20 megawatts over 15 minutes. As you see the magnitude of our challenge, it is substantially more than 20 megawatts.

We have announced and have entered into a contract with Next Era Corporation for 30 megawatts of battery that will be installed and operational in 2020. It has the capability of 30 megawatts for four hours. You see that those are steps in the right direction, but they don't achieve the magnitude of variability that we are faced with.

MEMBER HAENICHEN: Thank you.

CHMN. CHENAL: I am sorry. Member Jones.

MEMBER JONES: Thank you, Mr. Chairman.

I was looking at your projection, looking at that 40, 40 megawatts in 3032 -- 2032, excuse me, as being based on storage technology that is not as yet developed. Is that correct? In an earlier chart that Mr. Beck was showing was the continuum of your -- out to 2032. And your other chart shows 2024 where you get to

the point where you have a -- that width of, set of 50 or 200, which is long before 2032.

And when the technology is either hoped for or assumed would come on board, what I am leading to, if the technology accelerates prior to that, are you so wedded in to do reciprocals, the RICE as your solution? Because this is just one plant, certainly not going to take care of all of your needs because you are still looking at the fossil based fuel for most of your production for the near to midterm.

And so do you have any plans as an organization looking at alternatives in the event -- at what point does the cost/benefit on the storage get to a point to where it becomes your option, as opposed to right now it is just kind of an experiment? You are doing it to appease a lot of folks, probably to make a good faith effort at increasing your storage capabilities for short terms. But as the long term, if renewables are going to be the long-term solution for baseline energy, are there any projections where that's going to happen? Because it appears to me that after, when you get to 2024 and after, there is some serious issues with managing the variation in power output and what you do with it.

MR. SPENCER: Fundamentally, as Mr. Beck has testified and as I have shown on the slides, this is a

moving target. And so we believe there is this immediate need to use proven technology to address the situation, continue to install energy storage types of devices. And then, as we get this progression of integration of renewables, we believe that battery storage technology potentially will improve and the costs will come down.

And so really the timeline, and I will show a slide at the very end of my presentation that shows that mid 2024, '25 time frame we have to install additional capacity to address the integration to get us to 2030.

MEMBER JONES: Okay. Thank you.

CHMN. CHENAL: Member Woodall.

MEMBER WOODALL: So you indicated that one of your charts, I think it was Exhibit 16, came from your IRP plan, if I am not mistaken. But what I wanted to ask you was: How frequently is TEP doing integrated resource planning?

MR. BECK: Mr. Chairman, Member Woodall, TEP is constantly looking at its resource plan. And so while we have certain requirements from the Commission for when we have to file that, it is an ongoing process. We have a whole department that that is their function in life, to look at our resource plan and can you continue to refine it, look for new opportunities and identify we

have old opportunities that should be going away. And this is kind of an indication of that, identified a way to get rid of two units and get better producing, less polluting units on line.

MEMBER WOODALL: And to the extent you are constantly examining your need for resource planning, you would be monitoring and following the development of battery storage as a cost effective and safe technology, is that correct?

MR. BECK: That's correct. And in fact, it goes beyond just the integrated resource plan. We have a whole department that's looking at renewables and how to integrate those renewables, including other technologies such as battery storage.

MEMBER WOODALL: Okay. Thank you very much, Mr. Beck.

MR. SPENCER: So to continue this progression of the challenges that we face with the integration of renewables, when you take this out in time to 2030, a typical load profile for a winter day like today, today is a perfect example, that the total TEP load at that point in time on a day like today will start out at about 800 megawatts, will rise up to just over a thousand megawatts, versus in the middle of the summer, when our peak is 2300 megawatts. And by 2030 it is

projected to be up in the, between 2500 and 3,000 megawatts. So this exemplifies this huge challenge that we face as we continue to march down this path.

So the black line is our load profile on a day like today, and would be very similar to what the load profile would look like in 2030. So in 2030, to achieve 30 percent renewables, we will have need to have purchased and integrated in 1200 megawatts of renewable resources. Okay? On a load that that day was only that level, which means that when the sun comes up we have got to get all of the resources that are nonrenewable out of the way to make room for the renewable resources, this shows that, even doing that, that we are in an overgeneration situation for renewables. But as that sun angle goes down, all of a sudden you have got this humongous ramp that you have got to make up all of those resources with something other than renewables.

So this is what is driving us today to say this doesn't get better without fast, flexible generation resources, and putting the recips in now allows us to face this reality that is coming at us by 2030.

And this duck curve, this is the TEP version of the duck curve that we are faced with today, to integrate the resources to get us to that chart I showed you back here for 2024. So in 2024, we are going to

have 800 megawatts. And so to be able to achieve that level of integration, we have got to put the reciprocating engines in service to help this fluctuation and have that up and running in 2019 so that in 2020, when another 100 megawatts of photovoltaics come on, and then we have just announced another 100 to 150 megawatts of wind in 2021, so it just keeps marching forward, so we are trying to get ahead of the curve with a proven technology that can help us with the intermittency and with the steep afternoon load ramps and these morning shutdowns.

CHMN. CHENAL: Member Haenichen.

MEMBER HAENICHEN: Now, the 200 megawatts that you are proposing for this particular hearing clearly would not be enough when you get to 2030. So am I too bold to assume that each time your overall system increases in size that you will consider both more RICE or a mixture of RICE and storage, should the technology be cost effective?

MR. SPENCER: Yes.

MEMBER HAENICHEN: Thank you.

BY MR. DERSTINE:

Q. So Mr. Spencer, if I have got it right, that series of slides, 4, 5, 6, and 7, those are the challenges that face TEP from the renewables on its

system today and moving into the future. And those challenges, I think as you have identified them, are really three. It is the intermittency, steep load ramp, as well as the overgeneration during the middle of the day. Is that about right?

A. (BY MR. SPENCER) That is correct. The additional thing that we are faced with and one of the requirements that the RICE is an excellent fit for is this minimum generation requirement inside the 138kV system of Tucson.

Q. Okay. Well, given those challenges, can you then talk about what TEP has done in order to analyze those problems and how best to address them?

A. (BY MR. SPENCER) Absolutely. So as Mr. Beck previously mentioned, we went to Burns & McDonnell Engineering and had them look at all of the alternatives that were available in 2017, early 2017, and say do a cost comparison of all of the types of resources, large frame, gas turbines, aeroderivative gas turbines, combined cycles, reciprocating engines, wind, solar, batteries.

And as we looked at that, and as Mr. Beck has testified, the economics of each one of those was evaluated. And the large frame gas turbine was the lowest capital cost, but it did not meet all of the

specifications that we have talked about, the start times, quick response, being able to push the button and get it on line. All of the gas turbines that we looked at, and are available in the marketplace, have a 10-minute start time. The reciprocating have a five-minute start time. As you saw in that chart of April 8th, 2017, we have short-term needs that are much less than 10 minutes. And so that was one of the reasons that the gas turbines didn't meet the criteria. That was one of the reasons.

We also then have this issue of meeting this minimum generation requirement inside of the 138kV transmission system. And the large frame gas turbines and the aeroderivatives don't have turndown capability of 10 megawatts. They are up in the 20, 30 megawatts as their minimum loads for the lowest capital cost.

So when we took all of those considerations and built a matrix to say what is the lowest cost option that meets all of our needs, the reciprocating engines were the lowest cost option for TEP.

Q. So, you know, maybe it goes without saying, but it occurs to me that someone might think Conrad Spencer is an old fossil guy and he just wants to use fossil generation. But what I heard you saying is the company took a pretty extensive assessment of all available

technologies, and notwithstanding the fact that you are familiar with reciprocating engines and this form of generation, there was a good analysis of all different types of generation resources, including battery storage, and the RICE units came out of that process as the best solution to the challenges that you have identified?

A. (BY MR. SPENCER) That is correct.

MR. DERSTINE: Okay. Question.

CHMN. CHENAL: Yes, Member Haenichen.

MEMBER HAENICHEN: Well, I wouldn't call Mr. Spencer an old fossil, but I am an old fossil. The genesis of the need for all this is the sort of philosophical decision by the company to go into renewables. Would that be a fair statement? If you didn't, this wouldn't be an issue.

MR. SPENCER: That's correct. I mean the largest issue is that, yeah, that is correct.

MEMBER HAENICHEN: Yeah. So I get that. And I think that's a good thing. And I think choosing the lowest cost option now to do it is smart. But I would hope that, as time progresses and these storage technologies improve, you would keep an eye on it and, as you do these increments, maybe someday it will be storage.

MR. SPENCER: Absolutely.

BY MR. DERSTINE:

Q. Why don't you then move on and tell us more about the RICE engines and what makes them the right fit for this issue.

A. (BY MR. SPENCER) Okay. As was previously shown, this is what one looks like. From a size comparison, to give you some relative feel, the bus that we went on the tour with, if you took two of those buses and put them side by side, that's about the length, height, and width of one of the recips, the 20 megawatt version. Okay? It is a V-18, 18 pistons, 24-inch piston, 24-inch stroke. They can produce 25,000 horsepower. That's a four-stroke clean burning natural gas-fired engine.

The generator, which is coupled on this end of the engine as I previously mentioned, turns at 514 RPMs, so it is slow speed, which reduces all of the forces associated with the starts and stops and the necessary time to ramp up the relative generator to the speed necessary to begin to produce 60 hertz energy. So that's what one looks like. And as you can see, it is inside of a building, as has been previously shown.

Q. This morning Member Woodall asked the question about why we are installing 10 of these 20 megawatt

units as opposed to a single 100 megawatt, or doing some other configuration. Why don't you address that question.

A. (BY MR. SPENCER) Sure. Let me go back to that slide. The largest reciprocating engines that are commercially available in the marketplace are this 20 megawatt class. One of the reasons for that is that engine and generator combined weigh 400 tons. They have to be separated into four components to be put on any kind of rail system in the United States to get them anywhere.

So the next step up in size is bigger than the transport systems that are available in the United States to get them in any reasonable cost, economic way to different places. You can move things much larger than that with very specialized equipment, but it costs a fortune to do that. And you can't get any kind of permits across any U.S. interstate system or rail system to get it anywhere. So the recip market is kind of topped out at this 20 megawatt class size for getting them economically to a site.

As you can see from the previous charts, this 200 megawatt was kind of a sweet spot in all of our evaluations of how many megawatts we needed for response capability. And our evaluation of the options was why

maintain 20 ten megawatt units, because that's just more equipment to maintain, why not maintain ten 20 megawatt units, fewer pieces of equipment to maintain long term. So those were the fundamental factors that went into the decision to buy 20 megawatt units and ten of them.

CHMN. CHENAL: Member Woodall.

MEMBER WOODALL: This is just idle curiosity, but where are they coming from?

MR. SPENCER: The supplier that we believe is the most competitive, based on competitive bidding, is a supplier called Wärtsilä, and their headquarters are in Vaasa, Finland, a nice warm spot.

All of the engine components for this size engine are brought together from a different group of international manufacturing consortiums, and they all come to a spot in northeast Italy called Trieste. And that's the facility that actually assembles the engine, tests it, breaks it into four pieces, and puts it on a ship and ships it to the port of Houston. And then it comes from the port of Houston to Tucson.

The generators, this component, are manufactured in Helsinki, Finland, and put on a ship and brought to the port of Houston.

MEMBER WOODALL: Thank you very much, sir.

CHMN. CHENAL: Maybe you mentioned this, but are

there larger units than 20 megawatt?

MR. SPENCER: Commercially there are not, but there are announcements that some of the big engine manufacturers are going to produce some bigger ones. I don't know what size those will be and how they plan to get them anywhere. This was kind of the sweet spot in the market.

MR. DERSTINE: I think we are about 5:20. I think public comment was to start at 5:30. We may even have folks here. I don't know if you want us to take a short break.

CHMN. CHENAL: Let's take a 10-minute break and we will resume at 5:30 or 5:35 with public comment. And then we will resume tomorrow morning at 9:00 a.m.

MR. DERSTINE: Thank you.

CHMN. CHENAL: So this will close for the day the case in chief. And we will resume tomorrow at 9:00 a.m. Thank you.

(A recess ensued from 5:20 p.m. to 5:38 p.m.)

(The public comment session commenced at 5:38 p.m. with Committee members present and the applicant.)

CHMN. CHENAL: Welcome, everybody. This is the time for public comment for the application of TEP for the applications for two certificates of environmental compatibility. We appreciate that there are some people here that want to give public comment. That's very important to our Committee.

My name is Tom Chenal. I chair the Power Plant and Transmission Line Siting Committee.

Let's go over a couple of the rules of the road tonight. We want to hear what you have to say. We would ask you to try and keep your comments to three to five minutes, you know, but, again, we want to hear what you have to say. So I am not going to cut you off mid sentence; don't worry about that.

But what we can't do is really have a back and forth conversation. So we really need to hear what your comments are. We will take what you give us and we will ask questions then of the applicant when the hearing resumes tomorrow morning at 9:00 a.m. You are free to attend.

If there are people that want to make public

comment, say, tomorrow, if they weren't able to get here tonight, I make allowances. You know, after the beginning of the hearing, or if they come up to me and say they would like to make a public comment, we will make that available to them.

So with that, if you would make sure when you come up to the microphone that you give your name, and if you would be certain to please make sure your contact information is -- that you give the contact information on the sheet that's on the table near the microphone in case the applicant needs to get ahold of you in the future for reasons that I have outlined in the procedural order that was issued earlier in the case.

Member Woodall.

MEMBER WOODALL: Chairman Chenal, I am just wondering. If any of the public commenters have kind of specific questions about this project, perhaps they could confer with a representative of the applicant. And I am wondering if someone from the applicant would raise their hand and indicate that they are available for such consultation, if you can see them, so if you have specific questions about it, you could probably talk to them right after the public comment session.

Thank you.

CHMN. CHENAL: Thank you. That's a very good

comment.

So also, if a number of people want to make the same point, you can speak for others. We will let you do that, and you can indicate that there are other people that have the same opinion and we can get their names and make sure their contact information is provided.

But with that, why don't we proceed and we will just take you as you come up. So if the first person would come up and state your name, and we are anxious to hear what you have to say.

MR. MEDINA: Good afternoon. My name is Oscar Medina. I am a father and educator, and a member of the executive committee for the Grand Canyon Sierra Club Chapter. I am here to express my concern and opposition to TEP's proposal of ten new reciprocating internal combustion engine natural gas units at the Sundance plant location.

I live less than two miles away from the TEP Sundance plant. I have three children, one who attends the Tucson Gymnastics Center located near the intersection of Irvington and Alvernon Way. We drive by the Sundance center, the Sundance plant at least three times a week on our way to practice. The facility does not appear to look the healthiest. With all that smoke

and fumes coming from the large combustion burners, even a seven-year-old questions the toxic practices that are happening on your facility.

My daughter's school is located just one mile from the intersection of Drexel and Alvernon. This is only a few hundred feet away from the location of those proposed RICE units.

I find TEP to be malicious by calling and holding a neighborhood meeting for their proposed development while this public comment hearing is taking place. The neighborhood meeting taking place at 6:00 p.m. today at the Mulcahy YMCA Kino Community Center caused the community to come learn about the TEP campus modernization project. Framing this project as a campus modernization project is deceiving to the community.

I would like to advise TEP to take advantage of the renewable energy options that our environment has to offer. I believe that it is time that TEP stop investing in unstable polluting energy options, and consider investing in more environmentally sustainable energy options like solar.

Thank you.

CHMN. CHENAL: Thank you, Mr. Medina.

MS. BAHR: Mr. Chairman, members of the

Committee, my name is Sandy Bahr. I am the chapter director for Sierra Club's Grand Canyon Chapter. That's the Arizona chapter. And we have more than 60,000 members and supporters in Arizona, many of whom live in the Tucson area as well as specifically in the area affected by this proposal.

I did want to second Mr. Medina's comment about I think it is really disingenuous that Tucson Electric Power decided to have a community meeting at 6:00 p.m. tonight, basically overlapping with this public comment session. It was very confusing to me. I can only imagine how confusing it is to people who live in the neighborhood. So I think that the company has some work to do on its interface with the community.

Sierra Club asks that the Committee review the application in light of factors listed in the Arizona Revised Statute 40-360.06, and we urge the Committee to scrutinize the environmental impacts of the project on the local communities, and also look at the availability of cleaner, cost effective alternatives.

Arizona's energy future should be renewable, efficient, healthy, safe, affordable, and equitable, and this project doesn't advance any of those goals. If it is constructed it will have negative impacts on people living and working within the vicinity of the project.

We note that TEP basically says that, well, this project will have fewer emissions than what is there now. And, you know, I think that misses the point that the people in the area have suffered from too much air pollution for far too long. Yes, it was coal generation and then it was natural gas generation, and now they are talking about reciprocating internal combustion engines. But we are still talking about a lot of pollution in a community that has already suffered greatly from it.

I would point out, too, that this facility barely is under the major threshold for nitrogen oxide emissions. It is 39.4 tons per year, and that's just shy of the 40 tons per year which would make it a major source. So the pollution emitted by the facility is significant, and nitrogen oxides do have impact on our health, aggravating asthma, causing coughing, wheezing, and difficulty breathing.

As you have heard, there are schools in the area, the two fairly close by and another nine within three miles. So we ask you to take a hard look at the environmental impacts of this and look at the fact that it really is unacceptable in light of the fact that there are much more efficient renewable resources available, also cost effective renewable resources that could meet the needs of TEP and help it to reach its

renewable energy goals of 30 percent by 2030.

Thank you.

CHMN. CHENAL: Thank you, Ms. Bahr.

And thank you, Mr. Medina. I apologize for getting your name wrong before.

Anybody else that would like to speak? Don't be bashful.

MR. BIERMAN: My name is Dennis Kenneth Bierman, B-I-E-R-M-A-N.

I am here -- basically I know you have heard this before, but I figure you can't hear it too many times. I am a very, very strong supporter of renewables. I am perfectly happy to pay even more in my electric bills to support renewables. I want my electric company to be not just a leader nationally, but internationally in renewables, and particularly solar. I mean we have the sun, more than -- I mean, my goodness.

And so I really want to encourage you to move even more aggressively in that direction. I know you have been doing it. There was a nice article in the paper this morning about wind. But just, as I say, I know you heard it, but I figure you can't hear it too many times.

Thank you.

CHMN. CHENAL: Thank you, Mr. Bierman.

MR. EDIGER: Good evening. My name is Duane Ediger. I am a solar installer here in town. And I happen to have the good fortune of being the first owner of a Tesla Powerwall battery in the City of Tucson that was installed about ten days ago.

A new gas plant at this time, when we are seeing the results of climate change locally, nationally, internationally, and we are aware through climate science that our time in terms of a few, maybe two, maybe three decades to not just reduce carbon fossil fuel use but to eliminate it, makes plants like this financially unadvisable. They need to operate longer than we can afford to operate them in order to make financial sense.

The solar, the costs of solar and storage which could meet the same needs would be greater at the outset. And if that's what is inhibiting the turn to increasing renewables, then just pay attention to the methane from fracking that is going up into the atmosphere at no cost to the producers or to any of us except to our health and the health of our rivers, lands, and skies.

If our utility is serving the people first, who it is meant to serve before the shareholders, then these

considerations will take precedence over a short-term financial benefit from the low price of natural gas currently.

I seriously hope that you will listen to climate science. We have excellent resources in this city. One of the professors at U of A, a climate science professor, I happen to have installed solar at his house today. We want this. Our city wants this. We know that you know that we want it because you advertise on -- you publicized your wind today. I heard it on the radio today as I was driving home. I did not hear any stories inviting people to come to comment or even be aware that a new gas plant was to be built. It is understandable. It is bad PR. It is also bad business.

Thank you.

CHMN. CHENAL: Thank you, Mr. Ediger.

Is there anyone else that would like to speak? I see there are some people that have come this evening.

Sir, come on up and please state your name. We want to hear your comments.

MR. STORER: My name is Tim Storer. I am a TEP customer as well as long-time resident here. Over the years, since I have been here since 1990, I'm just so aware -- first of all, I am very aware of climate change and what we could be doing about it and what we are not

doing about it.

I just returned from two or three trips from Germany. They totally outstrip us in terms of their solar energy there with about half the number of days or less of sun than what we have.

It is just a moral thing anymore. And I want all of us to really stop and reflect on our children, our families, and where this is leading with one more gas plant, all that's released of fracking with methane.

You know more than I do in terms of the technicalities for that. And TEP, I believe, has the expertise the technical expertise to solarize the city. And yet I have watched over years as you have argued with the ACC against this kind of thing through rate charging, homeowner rates going up and all that.

But I just want to say it is either -- in the end it is going to be for our country. It is going to be either community or shareholders. And the community are the real shareholders. And we and all our kids are the shareholders. That's the bottom line for us. And yet from the Pope on down, they are begging us to get onboard and unify to take care of this crisis that's before us. It is not going to last; our civilization can't last this way.

And I applaud whatever you are doing on the

wind. I saw that. But we are about sun here. And we should be leading the world in everything solar. And I just ask you when you go home tonight to your families to really think about what the near future is going to be, because we don't have much of it left.

Thank you.

CHMN. CHENAL: Thank you, Mr. Storer.

Is there anybody else? We want to hear your comments.

Member Woodall.

MEMBER WOODALL: This is for the applicant. There has been several topics that have been brought up here tonight, and I plan on asking them questions tomorrow. So I am sure you have been taking good notes.

Thank you.

CHMN. CHENAL: Okay. I am going to ask one more time if anyone wants to speak. It is approximately five until 6:00, and this was scheduled to begin at 5:30. We started a little late to make sure, if people wanted to show up, we would give them plenty of time to get here. But if there is no one else that wants to speak, going once, going twice. Done.

That closes the public comment session this evening. And I want to thank you for showing up and providing the comments. I can assure you that we are

interested in your comments and we will follow up with the applicant.

I will tell you that the letter that we received from the Sierra Club will be an exhibit. Well, it has already been entered into the record. And we will be asking, we have asked and we will continue to ask questions of the applicant regarding matters that were set forth in that statement.

And so unless the members have any further questions or matters to discuss this evening, we will start tomorrow morning, resume the hearing at 9:00 a.m. And again, if people show up for public comment, we will accommodate them and listen to what they have to say.

So if there is nothing further, we will adjourn for this evening. Thank you again for coming. And we will resume tomorrow morning at 9:00 a.m.

(The hearing recessed at 5:55 p.m.)

STATE OF ARIZONA)
COUNTY OF MARICOPA)

BE IT KNOWN that the foregoing proceedings were taken before me; that the foregoing pages are a full, true, and accurate record of the proceedings all done to the best of my skill and ability; that the proceedings were taken down by me in shorthand and thereafter reduced to print under my direction.

I CERTIFY that I am in no way related to any of the parties hereto nor am I in any way interested in the outcome hereof.

I CERTIFY that I have complied with the ethical obligations set forth in ACJA 7-206(F)(3) and ACJA 7-206 (J)(1)(g)(1) and (2). Dated at Phoenix, Arizona, this 21st day of January, 2018.

_____
COLETTE E. ROSS
Certified Reporter
Certificate No. 50658

I CERTIFY that Coash & Coash, Inc., has complied with the ethical obligations set forth in ACJA 7-206 (J)(1)(g)(1) through (6).

_____
COASH & COASH, INC.
Registered Reporting Firm
Arizona RRF No. R1036