EPIC POLICY+INNOVATION COORDINATION GROUP

PUBLIC SAFETY POWER SHUTOFFS WORKSTREAM – MEETING #2

DECEMBER 16, 2020 10:00 AM – 11:30 AM

>> Welcome everybody. We'll be starting shortly. Welcome everybody. Thank you for joining. We'll be starting in just a couple minutes. Welcome everybody. We will get start shortly. Welcome. Everyone. We are to discuss a TOING that are critical to the lives of California. This is the final safety power shut off work stream. Of the policy ordination group. My name is Andrew and the public utility commissions consultant for the policy and innovation coordination group. We are working with the energy division at the public energies commission and the role every seeing the for epic the electricity research and development program that the CPC created back in 012 and extended through 2030. I want to thank the other participants for joining us today including the program administrators, the commission staff and advisors, utilities PG and, E and (Indiscernible) staff. I want to point out Rebecca and [name?] helpful information in the chat which Q and, A box as we go. If you have questions on this process, please reach out to PICG at the accelerate group.COM -- I'm going to share the presentation. The pub California public utilities group launched the for the epic program to gather incite and lessons learned from... (See Screen!)

>>: This is the second and final meeting of the public safety power shut off work stream of the PICG. As part of this work stream, we have been discussing how to minimize the social and economic disruption of public safety power shut off events for the most critical public services and most vulnerable communities... (See Screen!)

>>: Today our discussion is going to focus on projects that can demonstrate how utility its investments... (See Screen!) We have an excellent set of presenters today. We'll be hearing from Nikky with PG&E. Prajwal from SCE. Dr. Ghazal from university of California. Once the presenters have gone and take about five to six minutes each, we will be doing a Q and A session and discussion at the end. If you have questions for the panelists based on their presentations and other topic that is, you feel might be interesting. Please enter in the Q and A box that is in your screen on Webex. If you don't see the Q and A box up and available. You might have to look at the bottom right hand corner of your screen for a section that says Q and A and might be at the far-right hand corner of the screen. If you have any -- any technical difficulties as we go through the presentations with audio or video, reach out to Amanda at the e-mail address provide. Find that in the chat and also in the e-mail you received earlier today. Again, this meeting will be recorded and available online afterwards, hopefully by tomorrow. At WWW dot epic partnership.org. You can find the link in the chat function and a live translation to Spanish. So again, I want to thank you for joining us today. I look forward to our discussions. Please if you have any questions or comments please include them in that its Q and A feature that's there. I want to go with Nikky welcome thank you for joining us today.

>>: Thanks for having me.

>>: Grate so I'm talking about the redwood coast airport microgrid in California (Indiscernible) location specific options for reliability and resiliency upgrades (Indiscernible). So first I want to give a background of my microgrid (Indiscernible) of.

>>: And not rebuild or have over headlines PG&E microgrid as a product to serve the customer with the same service as with (Indiscernible) grid. What we're focusing on today is the second cart GOIR (Indiscernible) you have multiple customers and because we have multiple customers (Indiscernible) and ensuring that it the distribution grid is safe to operate. In the project (Indiscernible). Next slide. So, our project is at Humboldt. It's a rural isolated community in California. (Indiscernible) so some reliability issues. Particularly vulnerable to tsunamis and (Indiscernible) earthquake power shut off events to impact the area. As well as the H-u-m-b-o-l-d-t (Indiscernible) renewable energy. So, with the desire with increased resilience locally and (Indiscernible) who wanted to develop local energy anyway is it came together to build a microgrid to meet the desire for resilience and renewable energy. And partner with PG&E can become (Indiscernible) how this microgrid (Indiscernible) that it becomes easier and (Indiscernible) around the states. So, S-c-h-a-t-z energy research center (Indiscernible) but I'm happy to answer any questions on that. E quick map of our funding. This is an epic funded project and (Indiscernible) PG&E is really great for that opportunity. Next slide. Next slide. So, a few technical details about the microgrid. So, the microgrid is hundreds of percent (Indiscernible) it is going to be the first (Indiscernible) in California. There's a generator that already exists and (Indiscernible) to the microgrid. It is critical to identify what infrastructure needs to stay on in the event of (Indiscernible) catastrophic events. We have the airport and U.S. coast guard (Indiscernible) it's a large microgrid. That is DC coupled. So, 2.2 megawatt and battery storage and we participated in the CAISO wholesale market. There is also a behind matter that is 320 kilo watts, and these are serving (Indiscernible). One of the key lessons in the microgrid (Indiscernible) which means that, you know, most of the customers getting their energy from the (Indiscernible) or grid operator. So, we introduced a new customer or (Indiscernible) simply for the sake of (Indiscernible) what it means to serve both bundled (Indiscernible). (Indiscernible) one of the key things that we have learned in a clear line of responsibility and clear line (Indiscernible) needed to ensure (Indiscernible) -- the switches, the transformers and the master control of the microgrid, these are all owned by the utility and then there's a clear electrical boundary where the resources are owned by the third party (Indiscernible) learn this is a good model for (Indiscernible) microgrids and indicates where you would have, you know, some who already have existing (Indiscernible). (Indiscernible) it's really good for microgrid operations. At PG&E operate the microgrid and that will determine (Indiscernible) and the way we're trying to share this is (Indiscernible) by testing. This is the State of the art for high fidelity test bed in it our facility to understand (Indiscernible) works. Can skip to the last slide. So, I think in conclusion the way they see this its project would be contributing to learning for resiliency is four ways. We're trying to see how advanced testing can really (Indiscernible) integrated to the rest of the distribution around the State. But I think one think that sometimes is undervalued is social innovation. The (Indiscernible) and other community leaders to build partnerships and important role in scanning microgrids. And this project allows us to learn by doing. We're learning to (Indiscernible) so with that I'll stop and happy to take questions.

>>: Thank you. Welcome Nicki. I appreciate this. When you say quick clarifying question when you say DSO on your slides. You're referencing entity as DSO and not a third party. >>: Yes, as a grid operator.

>>: Excellent. All right. Thank you. We're going to go into our next presentation. To remind you. If you have questions for Nicki or anyone else. Put in the Q and A box on the right-hand side of the screen. If you don't see it behind some buttons on the lowest corner or three buttons might be hiding behind there. And I'm leaving Nikky's e-mail up for any direction direct questions to follow up with her after this. So, I want to turn it over to P-r-a-j-w-a-l who is going to present next for microgrid resiliency.

>>: Thank you can you hear me Andrew.

>>: Yes, thank you.

>>: Thank you once again for the opportunity to speak at epic PICG. Meeting and (Indiscernible) it's to support activity NS microgrids and the systems. Today I'm here to present on two EP pick (Indiscernible) focused on microgrids. The first is protection of microgrids and power plants. (Indiscernible) it's the demonstration build up on the first and is focused on video demonstration. So, in terms of lessons learned and the challenges we have faced with our -- we have focused base basically on these two. As you -- as we all are aware the (Indiscernible) like the electrical out is because of these (Indiscernible) Californian's SCE is OLS also exploring with a microgrid and provide relief by reduce the number of minutes of interrupt answer by using local generations as part of the microgrid. So, these are two EP pick projects are basically built to as a platform to help SCE and to design and implement introgrids and the processors. The successful demonstration of these projects will help build a system design implementation processes and pilot standards to require for future microgrid projects. So, as I said earlier the first project is focusing on the loop microgrid pattern. Like Nikky covered earlier pretty much what a loop and what she's talking about. Here the goal is to control a different type of control scheme, protection SKEEMS. We have tons of issues basically on the projects inside. We'll have to test different cases which I'll talk about in the next slide. So, the demonstration project in this case (Indiscernible) in this case we also demonstrating in front of the microgrid. It will -- it will be a (Indiscernible) microgrid like Nikky presented. It's a (Indiscernible) resiliency to (Indiscernible). We are planning to partner with the city for this project focus on critical facilities in the (Indiscernible) community. So, the project will also utilize advance capabilities and microgrid controller. And we'll also have a third party as part of the microgrid. The third process will also be electric vehicles, (Indiscernible) in this case we are discussing with the stake holders as well as the city to incorporate those DERs as part of the microgrid and control all these DERs as a whole. Lastly, as you can see on the drawing, high level architecture diagram. This microgrid here we are demonstrating the flexibility and stability from our side control tore a partial feeder. So, our projects are basically focused on the partial feeder microgrid whereas we will have (Indiscernible) architecture where we will be handling microgrids working in close coordinates and with front of the oh microgrid owned and operated by the community. Next slide. So, in terms of the use cases. E here you can see six microgrid cases that covers the different states from get connected to (Indiscernible) and these are similar to (Indiscernible) in terms of the technical concepts. We are testing different scenarios. In some cases, it may have been 100

percent (Indiscernible) whereas in some cases it might be a mix of (Indiscernible) as well as like (Indiscernible) as well. So, the test grid should be -- different mix of generations so we can test our different scenarios we'll see in the field. And we'll have to test protection schemes -- protection schemes that will be also tested in our test bed that we'll be developing in our lab. The microgrid controller will be interfaced with grid management system that will allow us to have -- basically in control from operations perspective from our operators so that we'll be able to safely island and [indiscernible] to the main grid during these (Indiscernible) emergency s. And as I said earlier, demonstration will be focused on the nested microgrid and working (Indiscernible) front of the microgrid to create this complex microgrid in terms of ownership and operation. In terms of project execution, we are (Indiscernible) and thumbs up microgrid deployments. So far, we have developed the systems, requirements. We have selected one site and in process of doing an increment with the city for smart demonstration and also in the microgrid system and started working on developing the hardware in this period. The other activity on the right, in the exclusion plan. These are will only begin after the lab testing will be computed. Next slide. Preponderance here are some of the key challenges and lessons learned so far. Like I said earlier. We're not here to talk about the technical challenges that we have in the field. We have not yet demonstrated but in terms of site selection specifically on terms of site selection, we have seen these challenges processed in the EMic (Indiscernible) but also the micro -- pilot that is (Indiscernible) continue (Indiscernible) we have seen similar challenges in what type of (Indiscernible) the site selection is one of the key challenges here in terms of site selection. We have collaborated with our customer (Indiscernible) to define certain (Indiscernible) as well as identifying some potential cities (Indiscernible) so in terms of site selection. We will need to have sites that have existing DERs. Some investment, potential investment from the community or city. And sufficient space for installing the DERs which are mainly a key. And then once we defined the list, we also filtered with the (Indiscernible) community closer to (Indiscernible) risk and fills. So what we have seen is from the site that we selected, it was not exactly on (Indiscernible) but the community was in terms of the benefit, it does make sense to select this particular city where the community as a whole get benefit during the out TAJ because these it critical facilities are on during that duration and we'll be able to safely island because the P (Indiscernible) and not power down. And also, LUKS with land as well. So, we continued with that site. So, the other key challenge we have seen as you know amended DERs and find (Indiscernible) in the microgrid or find other full investment potential. We are lucky in this (Indiscernible) because the city that we selected (Microphone Interference) was already planning to do behind the meter microgrid so installing behind the meter energy service and (Indiscernible) from their microgrid. We were also able to incorporate our SCE energy storage integration program where we'll be installing ago front of the meter advance systems that will be participating as a grid forming in (Indiscernible) during these question periods.

>>: Okay. You have to wrap it -- it up, okay.

>>: Sure (Indiscernible) like how the microgrid look like in terms of hardware. So that we saw in one of the projects on the microgrid and other projects. Without having a vendor on board so very hard to visualize with clear DRAUGS. But like we are developing those right now but that is one of the key challenges that came again and again in terms of aesthetics thank you.

>>: Thank you. It. Prajwal, if you are able. If you can put your contact information in the contact (Multiple people speaking) that would be great. I want to move ahead here to Dr. Ghazal from the university of California vine. Our first two presentations were a little bit more on microgrids and utility community microgrid relationship. Now we have Dr. Ghazal what's the role of specifically to PSPS and what they've done here. Welcome Dr. Razeghi.

>>: Thank you, good morning, everyone. I'm G-h-a-z-a-l and -- energy at universities vine. I'll be briefly talking about microgrids and PSPS events by talking about several of our existing and previous projects. We'll focus on epic projects. Next please. So, the goal of this epic station automation and opt my SAGS of distribution circuit operation. It's to establish control -- that opt myself MIEZ the dispatch of energy resources. This is facilitating of noble resource and actually maximizing renewable penetration without any infrastructure upgrades and upgrading (Indiscernible) and feed their microgrids through the controller as well as their distribution system management and taking advantage of the smart waive technology. In this project we did a fuel cell and upload generation why the system is islanded. Next. Indecent exposure please. Okay. So, to achieve the goals of the project we modeled two (Indiscernible) and territory. The models are validated collected during a previous project led by California (Indiscernible). Then we developed and assimilate add controller at the substation which microgrid controller or GMC sub --. They were developed by advanced power and energy program during DOE projects with Edison as a partner. In that project developed this for a microgrid controller and implemented for microgrid. Developed a KROERL tested it and hard wired a loop as mentioned previously and then deployed a controller on UCI microgrid and see the results of that demonstration. I think what interest of this group can be is the significant in out TAJ duration time which is a district result of the islanding capability with this particular microgrid controller. Next please? Now back to that epic project. This shows the system that we modeled, two circuits, one of the circuit SS mostly residential. The other is mix of residential and commercial customers and simulated with high penetration and compared residential behind the matter residential energy storage with front of the matter community energy storage serve a block of homes or several customers at a time. Next please? So, this table shows briefly the optimization without any upgrades without violating any system constraints. And as we can see both mind the mead meter and front of the meter, the storage can increase the renewable penetration in this system. Next please. So, with the PV, the maximum PV penetration and the energy storage configuration result FRTS previous steps, they were added to the model and included a battery energy storage and the fuel cell at the substation and -- several models including out TAJ distribution block time SXS form a microgrid if necessary and on average across these cases saw a 60 percent of our TAJ duration for the lows in the system. Where's where for one for or provide all the lows where for longer O-u-t-a-g-e-s balance low and generation while the system was islanded.

>>: Really quick can you explain what the different colored lines are.

>>: Sure. Sorry about that. One the red line is the total load on the system. And the blue one is the load you see at the substation which is all the DERs especially behind the meter in the system. The purple one is the battery at the substation. It's sort of oh all -- main purpose is to help plan session the fuel cell from grid connector to island it and the yellow one is like the fuel cell operation. X All right next slide. So, this project in addition to greenhouse gas emission reduction and as well as other reduction. Benefits listed here and most important one is lower in

cost to improve energy efficiency as well as avoiding Outages forming through the microgrid. Before I conclude I want to touch upon a follow up project that we did. Which was funded by SNOOU institute of transportation studies. Under SD 1. We used the same system but modified the models to -- and look at the electric vehicles and vehicle to home. Similar to V to G. Similar to home energy storage while the home is islanded. And we saw a significant reduction in energy time SXS in addition to back up generators. Additionally, we saw all the DERs in the system and plug in to help facilitate grid to (Indiscernible) utility asset SXS critical facilities while on -- there's a great out TAJ. All of which increase the reliability and resiliency of the system and how avoid or at least mitigate the negative impact of PSPS E vents. For that I will conclude.

>>: I have one quick burning question I got. What was the total PV capacity compared to the load on the feeder you modeled? Percentage or ballpark estimate.

>>: I think I included the percentages in that table. So, the penetration is maximum was 37 something percent. And renewable penetration based on energy across.

>>: Energy. Okay. Excellent. I'll have some more questions I received when we get to Q and A. Thank you very much gone as a reminder if you have questions to post to panelists. Use the box on the lower right-hand corner. I'm getting from lots of places in the chat. So please put in the Q and A so they see the questions come in before I ask them. One more. We have a last presentation here from welcome Nisha from FDG and E around their work and wild fire safety and how epic haslet led to their research project. Welcome back.

>>: Thank you. This is Nisha and Robert. I'm from the wild fair mitt GAILGS investigation team. And from gas and electric. Thank you for having us here. So here is the agenda in the topics to cover in the presentation. We want to cover the topics. Cover a couple of topics in the epic two projects. Talk about the (Indiscernible) and how we're planning to improve it and then wrap it up with our future vision.

>>: Hi everybody. First, we'll start off with our PSPS journey. This began in 2010 when we knew we wanted to proactively shut off circuits in high wind events but didn't have proof to support our decision. In order to support that, we first installed many whether stations in the back country. This is one of the first projects I worked on. And many things went into placing these weather station its. Now in addition with the weather stations this improved data analytics and many of the indexes we use for our -- decision such as FPI [name?] and most recently the circuit risk [indiscernible] and that gives us a health score of health and risk. So, it's really exciting to be a part of this it entire journey please. It started back in 2017. For epic two we built the data signs platform and to do this we first built a day at the lake on the [indiscernable] platform and we decided to bring in a machine learn our analytics. It's the first time we did that (Microphone Interference) and focus primarily on reliability and the leading indicators at that time were, you know, (Microphone Interference) failure. Fast forward to 2020 the asset management program was spawned, and this learned from epic two which is research and development and we built a data lake on (Indiscernible) primarily on asset failure, asset risk failure and the used cases we've done so far are holes, overhead conductor failure, and most recently another T failure model. Now this is all culminated with the circuit risk index. And what this has allowed us to do is take an analysis project that was produced in a business group and really build it in a reproducible

fashion on our EAMP platform. It's really fascinating. Next slide please. Now our data analytics maturity. Now to a large degree we still document never leave that right? Subject matter experts use that to base decision on. For past couple decades served the experts with analysis and other data type data reports and the platforms that support them. Now we are moving toward a predictive model and such -- as such with the machine learning model that is we produce. And really working with the business groups to help them learn how to it use those predictive models. That's a major component. It's one thing to produce it but use it and understand what they mean, what the failure scores mean for instance and how to apply that to proactive decisions. Next slide. And these are the decision-making factors that go into our PSPS, you know, shut off decisions. And as you can see many of them are driven by weather. It it's primarily weather. But there it is other factor that is go into it such as whether we have temporary construction on a circuit. And how much hardening have we done on a particular circuit. That's why (Microphone Interference) is so important because now we have a score to tell us how risky this circuit is. How risky a portion of a circuit is, and we can aggregate on different levels of the circuit. So, it's very flexible in that way. So, I'll pass it off to Nisha.

>>: Thanks Robert. There are a variety of factors considered and look at during a (Indiscernible). This is the current state of analytic SXS what metrics used. If you look at the bottom right, we have the dashboard and that shows the key met tricks such as the FPIs fire protection -- along with some other visual and other situational awareness tools. So, we're always looking to improve and explore more data. That in the process as Robert mentioned developing the new circuit risk index. Which is a health index combined with the risk score. This is still in development. We have early scoring but looking and refining it. The goal is to provide a single metrics for many asset related data sets. It's more of an index and not PRI predictive. What I mean by that. It will tell us this segment or circuit is much riskier with some data behind it -- it. But we are doing some -- you know, we're conducting more analysis and doing more studies to see if there's correlation to help the model be more predictive for the future. CRI can be integrated with all the other tools that Robert mentioned and showed in the PSPS decision-making. It can help us kind of inform us how we do work in the field because we have all this its asset information. It can help strategic investments which is the wild fire generation system and other cases, we're thinking it through because right now in development and refining it. This slide is an illustrative for the dashboard we have built. It gives us an assessment of the map. For example, in old pole it's more high risk than the new green poles. This can also show us the help of an asset by segment or circuit. You know, there's a lot of good things you can see in here. You see the number of poles, the average age, the material, so it's still being developed and improving it to gather more data and refining it, so it can be better used. Lastly, with analytics in mind. This is really our future vision as we look into technology that will minimize the impact of PSPS and mitigate the risks of a fire. So, we have a proof of concept for (Indiscernible) next generation system. Which is a risk-based tool that helps us with making investment division and also long-term planning. So, what we want to do with that is leverage that model and a Realtime decision make tool. Call it wings off the operational tool. And what we want this to do is consume all of these its data points into one comprehensive view to look at the fire risk and the -- compare it to the PSPS impact. So, the idea is really -- instead of having eight to ten different indices. You have this one assessment that would look -- take into account -- all the key from these indices. Again, this is real early in the stages. This ideal state. Very preliminary and conceptual, this is the vision we're heading towards. And with that, I would like to say thank you.

>>: Thank you. Thank you everybody for participating today. I have a kind of quick burning question for you. So, you may want to start off some of the question there. And Nisha what you presented on wings and the circuit risk index. When we think about planning and long-term asset planning, what have you found so far in terms of -- even the early stages here of asset risk around the PSPS risk and wild fire risk. How do those work today? I know you want this to work well in the future and be able to optimize where the risk meets. But what have you found so far in this early analysis or is there any overlap? Maybe speak to that a little bit.

>>: No response.

>>: Okay. You are on mute.

>>: Okay. Can you hear me now?

>>: Yes.

>>: Even with wings. It's a proof of concept. We're in the second version of the model. So really, it's -- wings is looking -- the fire risk is looking at different components than the PSPS where fires looking at the mission data it a three speak where PSPS looking at the red flag warning days the probability of PSPS and that's really knew. So what we're seeing is -- we're trying to see where, you know, back in the -- that we need to do -- and doing some of the -- we're doing correlation studies can out TAJ SXS seeing where the impact of even the winds are in which area and then kind of running through the model ask seeing what's the best way to kind defendant or what kind of mitigations we want to apply with the results we're getting.

>>: So, one of the questions we have here, a quick follow up, are the model in real-time or do they get date that online and E VOL wait risk? So –

>>: (Multiple people speaking).

>>: Go ahead Robert.

>>: You go ahead, and I'll follow up.

>>: Well, it depends T for wings, we are working with external vendors and working with -- circuit risk index and parties with consulting. And take subject matter expertise with outset and within the company to come up with these models.

>>: And.

>>: (Multiple people speaking).

>>: As a follow, up.

>>: (Multiple people speaking).

>>: Sorry, you know, for our model it that is we're developing for failure, these are primarily not taking like any kind of real-time data or historic data. But subsequent models will take into act power quality data sources. It's rang Ling these sources and fitting into a model that we're going to work on over the next couple years here.

>>: That's it excellent. And start working back to it the questions around microgrids but starting here and hearing you talk about kind of what the inputs are and what the data is. And we did have a question here. Right. My question -- okay. Lots of questions coming in. Thank you all for submitting questions in the Q and A box. So, there's a variety of -- take account customer impact or impacted circuits from deenergization itself and how is that quantified.

>>: Sorry Andrew can you repeat that question.

>>: So, the question was dot indexes take into account the impact from deenergization itself. >>: Yes. So, when we're coming up with these indices we are looking at historical out TAJs. Past events take that into account. Wind speed. So yes.

>>: Excellent. So, I want to transition to some of those its customer impact questions. We have -- I had several things come in and I want to start with some of the context around the multicustomer microgrid that was discussed on the role of utilities and that there are party SXS places with penetration and might be able to be leveraged was described as well. I think there's a lot of questions around the role of the microgrid controller and some of these situations of lots of policy questions on where -- what is the relationship between party SXS microgrid and operator SXS utility land, and I think there's different perspective on their it. Put that to the side on a second and go to a technical question. What are some of the needs of microgrid control development? What have you experience around the key technical challenges when you get from a lab setting and can control everything to a real world setting where there's a lot more factors and everything is in the perfect ready state. What are some of the things of the technical things you're running around in microgrid controllers to be widely deployed. Nicki do you want to start on that, yeah that's a very good question can you hear me clearly.

>>: Loud is good.

>>: So, I think it's a very good question and currently going through that in our project. Basically, the past year working on our controller configuration. It's being led by the controller engineering lab and, you know, I think so it's one of the most significant efforts of the whole microgrid project because you have to think about every single situation and create a control logic for the controller to respond. And I think you can think about controller configuration in two categories. One is, what is it doing to the generation resources. How is it -- it is participating in market and what is the logic there. Mostly from PGI r and E perspective. It's the logic we care ability. What sense (Indiscernible) what is the speed of that signal closer. Is there a backup? So, I think they're very significant questions and they're very detailed and I think one of the major challenges is time and expertise. Need an engineer who really understands what needs to go into this control logic and I want to kind of give props to the [name?] energy resource center and working on the project there, reading this project's controller configuration. And on PG&E after

they have configured this controller we take that and test it. So instead of doing the control logic ourselves, we're creating themselves and putting that microgrid controller in real-time situation. It's not a model and put in the microgrid with a smaller version of the DER. We have a smaller version of PV. And smaller version of the battery. In a hard wire loop with the controller and put in scenarios we think will happen in real life and I've seen how it responds. And that's high fidelity. It's hard wire loop and real-time simulation as a way of validating what configuration. That they can figure, and they value dates. So, I think that's one of the most important and consistent effort in the microgrid project.

>>: And to go -- I want to push this question over to you doctor around incorporating large penetration of renewables. I think one of the questions that has been raised in previous questions here in order to island and be able to it provide a significant amount of islanding with energy for most of the TIECHLT have large quantity SXS 37 percent or higher of PV on a distribution it circuit. What -- you know, a question was raised in the Q and A that came in was what happens in your simulations around back feed if the amount of renewable general TRAGS capacity exceeds the load at any time. Is that covered by the fuel cell. And where -- how can you best plan for the future for more renewable dominated feeders and microgrids that need to be developed for islanding PROCHLTS I know there's three questions there, but it goes to some of your work, doctor and then Prajwal after that.

>>: So, on the excess PV, so we sort of assume each home on (Indiscernible) and explore while grid connect. The grid is still there so you can export. Doing islanding, with the systems islanded, I think the main image or objective is to store as much of the excess PV we can and energy storage. I show some of the results. We actually scaled up that energy storage at the substation. I think showed 500 hours and went up to five hours and otherwise it's curtailed and signaled the home management system to curtail because we have nowhere to put this. So, in terms of how we can increase more renewable penetration in the system, I think one thing that we wanted to look at in this project was to not do any from structure. So, we adjust the -- with infrastructure upgrades you can upgrade more re renewable, we can -- if you introduce more technologies to enable more demand in the homes in the simulations as I mentioned. We did similar load settings. As some point if your island is balanced but did response during grid connective and go down to specific loads to build responses. Those are not necessarily existing. Now they do exist in this particular circuit that we modeled. As we said its part of thorvine demonstration project at California Edison. So, the homes do have smart appliances and demand response but not the entirety of the grid. So, I think there is still room to integrate more and more renewable. And if you scale -- you have Maine more renewables in the system as well.

>>: And P-r-a-j-w-a-l you were showing with the battery STOERJS or other solutions as well.

>>: Yes, for this demonstration as I said we would have behind the matter microgrids owned and operated by these particular facilities but the front of the meter we form a front of the meter microgrid. Once the grid is active then the behind the MEERTD energy resources will start as a grid falling asset instead of grid form. Start at grid forming and transfer to grid falling. Any formation we will have can be stored in the battery as Dr. Mentioned and if we can't and the battery and energy storage -- like instead of storage exceeding it -- it would have to curtail and opposite (Indiscernible). One thing I want to point here is behind the matter microgrids that -- the

customer is developing will be only providing power to some portion of the (Indiscernible). Once the front of the meter microgrid is (Indiscernible) developing will be active and able to provide load meeting. And able to supply two buildings. We don't have to do demand response at that point. So, it will be taking more at that point. And this will be fully 100 percent enable microgrid. Other challenges we'll see is start substituting's specifically for the protection schemes. We'll have to update like settings on the projects and devices in the field. Because the (Indiscernible) in the field. Let's say able to take -- resources able to meet the load and demand and if we know that there will be excess generation then we may be able to include one more facility which is not currently in the plan but work with the city to incorporate any other technical facility as well.

>>: On that question, I want to go into a line -- a decision discussion around the value of resiliency which a hot topic is these days. And we have a question from row san and it's (more the microgrid projects. Are you setting up a system to -- disruption metrics prevent into microgrid resiliency value and what are those metrics you look like?

>>: I believe one of her concerns had created (Indiscernible) resiliency specifically (Indiscernible) in terms of minute of interruption because of the PSPS events lasting up to a day. I don't think we'll be able to share that number. It's still in implementing. But still have numbers to evaluate and calculate the value of service, we are calling it value of service. Based on the minutes of interruption due to -- to PSPS events. When looking at these specifically for the PSP S1s. We are not only looking at the benefit that is will get participating in market but estimate the value of service we can get during these Outages.

>>: (Multiple people speaking) -- share the number right now.

>>: And also, it's a requirement -- so we have epic PUND funding -- energy center and coming from the (Indiscernible) requirement of their funding to collect data for three years. I'm not exactly where reliability metrics they're using and but that's goal of the data correction. And PG&E of course, we have integration into our center and be able to see exactly how the microgrid is operating and still same (Indiscernible) but don't have the metrics decided yet.

>>: We had a similar question from jack Lynn and specifically directed from SDG and E, how do they quantify and people who endure PSPS events? Do you have metric or working on any other analysis there?

>>: So, for PSPS it's been a little tricky we can look at our TAJs and we can -- we have the out TAJ data but something so new it's difficult to quantify of the outage. We have Tommest MATS but don't no know the number of incidents to get hurt from PSPS. And that's something we're working through right now and finding the different way to quantify it.

>>: And we -- I think there was a comment on here Judith, you're coming onto ask a question. I'll push it over to you.

>>: So, I get this whole discussion it begs the question of do we have data on PSPS outages and the past predictive of the future? So, I think some of the assumptions in the generic microgrid

controller seem a little bit far from how long some of the PSPS events are. So, I kind of like comments on the very basic building block on do we have data on PSPS outages and the other question that I had is in the Edison slide that some of the use cases were black start and grid leasing synchronization so I'm wondering in the role of my KR grids and that particular area is if that one is a viable one. Thank you.

>>: Okay.

>>: (Multiple people speaking).

>>: Go ahead.

>>: So how we calculated the outage reduction and avoided talking about it because I think there's a metrics in academia we use but doesn't necessarily translate to real life. But for the outage reduction, the actual historical outage date for ten to 15 years for UCI campus and not subjected to PSPS. If we include the outages, the reduction would be more significant because -- you know, and we are served by a 66 KB and specifically so less outages on 12 KB license. That's how we looked at it. And looked at how successful a microgrid is seem [indiscernible] island. If you can seamlessly island and not any load setting and serve enough generation on site on the campus. If we can't dot aisle land and the load generation in balance at the time of islanding will go dark and have the -- we need to back start it and take some time. So, brings back our central plan in the outage duration as well. And that is the thing for each microgrid. We did other calculations for the epic project. Those are inverted base resources. So that's different from -- so yeah, I think that the challenges -- for each system you need to do some simulations at least or back of the envelope to estimate your outage reduction. And the topic of resiliency is more -- more of reliability we have metrics that everyone agrees with and everyone understands and that's not the case for resiliency and it's it very difficult especially if you want to monetize them and put a value on it. So that's why I avoid talk about that it. But we have. We harvest the outage cost based on the research and samples and we have some surgery unit SXS things like that. And that can be done for commercial customers and industrial customers as well.

>>: I don't know if Robert you wanted to follow up on that TFRMGS yeah. Sure. And then there's the (Microphone Interference) data when you have PSPS data and we share our PSPS -- process to do that now which is advancement. As far as the past form in the FUCHLT we still have a lot of work to do but we do have studies to correlate with the PSPS outages and not directly involved with that but doing the analysis (Microphone Interference) because the past inform the future. So, we are working on that.

>>: These impact -- to follow onto Judith's question we look at my KR grid designs of four to ATHSD -- bring your design for and raised in the questions and that Judith brought up actual PSPS events can be 36, hours long. Does that change the technology type and approach to a project?

>>: I guess I can answer in terms of the design of the microgrid. The duration of the outage relates to design the atrocity of the battery and for our camp, we, you know -- the DERs. I should clarify that our -- in a high district but it is CHOOU showing the model of how each microgrid.

The DER on the scheduling is strictly in the hands of the (Indiscernible) but the way they have done that is to guarantee 75 percent state of charge that is always available battery -- participate in the wholesale market. It's oversized and about four times the size of the load and it is -- you have 75 percent state of charge at all times and it's the hope that the PV will replenish the battery if the outage is multiple days and the charge goes down beyond 25 percent. The so that's the model that we can use and the principle the length of the outage is critical in designing your battery in PV management.

>>: Yeah, I can add to that. We did a lot of studies with specifically with different types of emergency, battery PV, fuel cells, so what I found that batteries definitely like if we are being 100 percent -- battery is a must. Large battery is a must. You can rely on PV but what happens if your PV supply is not there. Like the solar -- if it is (Indiscernible) to support the PV [indiscernible] if we are developing PSPS for three days or four days and it is a day where there's no solar how do they commute it to that. So, when we did the study, we did include PV at different capability levels, 100 percent than 50 percent, and 25 percent. So how -- like the size of PV will explode -- sorry the battery will explode to supply power for that -- like long duration and also for the inward microgrids. When we're talking about inward microgrids, in fact, is that always a good choice. We have to see that. And when we systematically or during the year like what we have seen is (Indiscernible) naturally -- with a mix of battery decent size battery (Indiscernible) in the [indiscernible] the battery will be able to supply to eight hours of resiliency whether for other generation sources, so we can ride throughout long duration outages without increasing didn't cost exponents really.

>>: I want to add this question, because obviously today we're talking a lot about PSPS and wild fire outage SXS risk outages but in the past and future we can also be talking about or a question from [name?] around high heat or other high heat event that is we saw this summer, floods, Earth quacks, cyber threats, do we take those into account as well. This is a certain risk for question and also how we think about resolving those questions?

>>: So, for circuit risk index that is more on the focus. That's the full -- poll loading how load the poll is. In terms of when right now the focus is wild fire. That's the Number 1 risk in our enterprise risk industry. For that analysis being done. But I know for now and my, wings are focusing on the wild fire risk. Hopefully that answered the question.

>>: And I can add in terms of cyber security, that is the work stream for this project. The TRC with the consultant that was added onto the project good cyber security plan not only for how -- but thinking of the cyber security of in the future and how it replicated and that's also a deliver rabble in the project in about a year.

>>: Excellent. I do have several questions in just about general wild fire technology and approaches. We covered a lot of this around our mitigation work stream. I'm not trying to imply these are not important but if you go the Web site to wild fires there's a lot of answer TOS some of those questions and it would be helpful there. I do it wanted to go back and talk broadly about risks and decision around PSPS. We had some questions come in here about calling PSPS events during non-red flag days. Is that anyone else like to answer about data, hard decision, do you have any comment you'd like to make on that?

>>: So, in past years, you know, in recent years no, I can't remember an instance where we activated the EOC and shut off circuit WS out of flag warning. Usually a red flag warning triggers an EOC activation and then the shutoff is conducted from there. It, you know, going back, you know, maybe five years or older, I do believe we did this when the rooms around shut off for a little bit more vague but in recent years we have not done that. Interestingly though, to go back to 2017, January 2017, by had a storm at PG&E also from the west. It was a known El Nino storm it was not a PSPS situation because a winter weather type of storm. So, it was pretty interesting, so I do think but nothing has been done on that recently I think it's still being evaluated.

>>: Sorry I mute myself and started speaking I have a question on the benefit questions this goes back around saying and what is the possible improvement and possibly to LE ranch distributed such as PV and other asset TOS support black store relying on more traditional methods.

>>: It's specific to your system and microgrid. I want to talk about the outage duration it depends on the usage you have as long as we have natural gas we can juggle oh emission as well as cost and load management. Right? So that is important so what by looked at here is a couple of things a couple of assimilations we simulate add microgrid exporting power and help a transformer to fire back up process so that helps. I think I included some numbers depending on the resources that you have. Using a PV, it's a little bit trickier because you have many resources your inverters need to operate in trig form you need to and close situation from random loads in between. But if you can achieve those there was I think 30 percent reduction in outage duration. I think I included an average there, but I don't want to simplify this it and say this is readily available and just do it. In are infrastructure upgrades that need to be done. And also, communication and you need to [indiscernable] communicate with behind the meter and energy systems they have. Communication with vehicles if you want to use them to do -- oh so a significant amount of upgrades to have and it is a resource that is sitting there. If you have figured out, we can tap into them, black star.

>>: Did you have a comment as well?

>>: For the black star, yeah. So, it depends on type of islanding that we have to do or at the time. We have some time for this case we know the previous day maybe even happening. We have enough time to transfer that. So, we may be able to do seem less or do black start or black start won't take much time because now, we already prepared, you just have to go from grid forming to grid form mode and able to island that fix and run it. But for on time, it's a little bit different because you don't know what the issues are unless we isolate those issues not able to do microgrid. Once identify that it's -- the fault is not external power to the microgrid that make time some time or check it and maybe some manual process that needs to be done. In terms of the microgrid what we're envisioning is between the data management system for reason TOS island and rethere. So still some manual operations. And in some manual processes but eventually, once the system is proven we may be able to do a that automatically as well.

>>: And as we said that handshake and coordination at the going and it poses a lot of challenges going forward with a setting and real-world setting.

>>: Exactly.

>>: I want to conclude here to ask a question around customer journey we did this in our last PSPS meeting when we reviewed a lot of community-based solution and energy community projects. How should people start? This is obviously more utility focused around projects for those. Those are R that are listening today, significant duration SXS want to look solutions, where do they start? Partners for utilities today?

>>: I can didn't last part of my slide I didn't have a lot of time to talk about PG&E launching and the program allowing communities to partner and decide what level of resiliency and develop what microgrid to develop. And the model across the State. I think that's one of the ways in which really customers who are experiencing low reliability and most (Indiscernible) need to come together with city planners and with community my KR grid would be a solution.

>>: I'd like to just chime in there, too. So, we have all our analytics, the more data the more informed we have and able to impact the PSPS for customers outside the analytic SXS microgrid and happy to program and want to provide generators and microgrids while providing resiliency during PSPS and we're looking at actually fewer generator programs. So how -- where the customer doesn't even feel the outage and previous and first generative program even for the kind of medical baseline and such. You know, we're trying to work through our community and making sure the minimal impact in them.

>>: (Indiscernible).

>>: Sorry I lost my -- these two projects epic projects are focused on treatment microgrid, at some point we get into the third party microgrid party and that's coming through (Indiscernible) as we know. We also have some customer programs through customer service -- pilots through customer service as well like one of the -- there was one question in the list but (Indiscernible) it as well. We have done one pilot act to high school where the school already had some type of BHIEN the matter PV and energy storage -- the energy storage as well -- like the current hardware and foam ware to support the functions to -- or STE work with the school to upgrade those systems and provide resiliency and that was a section of the high school I think gym was converted into a (Indiscernible) crossing as well.

>>: Excellent. Well, these are some of the questions I think and we look at all the policy and innovation coordination group work stream discussion we've had to date and learn in the equity work stream about the importance of engaging communities now ahead of time and engaging local leaders and looked about how do you integrate more in the home or behind the meter and in larger facilities that can help with resiliency and great management. We hear about PSPS risk and manage. How can you implement a term for long-term? What is the length and duration really require for a PSPS event and what does it require? What should we be planning for. The value to create that resiliency level. That is improved for today for customers that experiencing these out answers. These are all question that is are highly integrated and I appreciate the panelists for participating today. I really appreciate the folk that is have stuck through 11 of these work stream meetings and these types of connected dots and coordinated answer SXS policy

question that is we are facing that we'll be discussing on February 18th at the policy forum that you all hope to take the time to it attend. You'll get more information on that in the coming weeks include asks, agendas, invitations and registration. Mark your calendars for February 18 around 10 a.m. to in the afternoon. I know what I'm doing that day. Hopefully you join me for that. Really appreciate those who participated that. Again, the panel, the CC staff that's here. PGE and E and really appreciate everyone who was has it joined us so far and hopefully the rest of 2020 treats you kindly. Thank you everybody. Have a good day.