GOVERNMENT OF PUERTO RICO PUBLIC SERVICE REGULATORY BOARD PUERTO RICO ENERGY BUREAU

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IN RE: REQUEST FOR PROPOSALS FOR
TEMPORARY EMERGENCY
GENERATIONCASE NO. NEPR-AP-2020-0001SUBJECT: MOTION TO SUBMIT
SUPPLEMENTAL FILING

PETITIONERS' MOTION TO SUBMIT SUPPLEMENTAL FILING IN COMPLIANCE WITH MAY 3rd RESOLUTION AND ORDER

TO THE HONORABLE PUERTO RICO ENERGY BUREAU:

COME NOW, Comité Diálogo Ambiental, Inc., El Puente de Williamsburg, Inc. - Enlace Latino de Acción Climática, Comité Yabucoeño Pro-Calidad de Vida, Inc., Alianza Comunitaria Ambientalista del Sureste, Inc., Sierra Club and its Puerto Rico chapter, Mayagüezanos por la Salud y el Ambiente, Inc., Coalición de Organizaciones Anti-Incineración, Inc., Amigos del Río Guaynabo, Inc., Campamento Contra las Cenizas en Peñuelas, Inc., CAMBIO Puerto Rico, and Unión de Trabajadores de la Industria Eléctrica y Riego (collectively, "Petitioners"). Thank you for allowing Petitioners an extension to file additional documents. Attached please find Declarations by UTIER President Angel Figueroa Jaramillo, Myrna Conty, and Dr. Agustin Irizarry attached as <u>Exhibits</u> <u>A</u>, <u>B</u>, and <u>C</u>, respectively.¹ Petitioners respectfully request that the Energy Bureau grant another week's extension to Petitioner's participation in this case, to review and respond to the documents in PREPA's May 7 Motion in Compliance with Bench Order. Petitioners also request that the Energy Bureau issue an order stating that no temporary generation contracts will be approved unless PREPA can demonstrate a need for these units, <u>after</u> it immediately takes the following actions on more cost-effective methods to serve summer peak load:

- Schedule calls or meetings with all large customers to discuss load management options and scheduled use of their approximately 234 MW of self-generation units. Provide a publicly available report on the results of these meetings
- Continue to provide publicly available reports on progress of repairs of all generation units currently offline, especially Costa Sur Unit 5, with thorough explanation for any delays.

¹ Petitioners present these Declarations with Certifications from the declarants. The declarants were not able to have the documents notarized due to the COVID-19 crisis. Once the Governor's lockdown orders have been lifted, Petitioners can provide signed and notarized declarations upon demand.

THE ENERGY BUREAU SHOULD GRANT ADDITIONAL PARTICIPATION RIGHTS TO PETITIONERS AND THE PUBLIC.

President Figueroa Jaramillo, Ms. Conty, and other members of the public were able to listen in on the Thursday, April 30th conference call among the Commissioners, the Bureau's consultant, and PREPA. Petitioners have asked their members and supporters to come forward with public comments to the Energy Bureau, with their thoughts and concerns on the call and the RFP process generally. We attach as <u>Exhibit D</u> an example of one such public comment from Gloria Fontánez, a resident of Candelero. In February, PREPA decided to place temporary fossil fuel generation units in eight locations including Ms. Fontánez's neighborhood, but kept these locations a secret and refused to even notify residents of its plans until the Energy Bureau finally forced PREPA to do so months later, on April 13th. PREPA did not think to solicit these residents' input and participation. The Energy Bureau must allow for participation by these Puerto Ricans before forcing new polluting units into their neighborhoods.

During the April 29th PREPA Governing Board meeting, PREPA consumer representative Tomás Torres made an eloquent argument for increased public scrutiny of PREPA's actions, through Energy Bureau proceedings:

Tomás Torres: I have an overall comment of great concern that I cannot particularly enclose in a particular committee or one particular effort. But I think it is an old thought that needs to be discussed. And it is a matter of transparency. We are going through a crisis. And when we are going through this deep crisis, public participation is a must. And it is a must because it is a two way validation process. You have a legitimization process because you have the people participating and the people give legitimization to, legitimize your decisions. And that is lacking here. That is lacking here. That is a great concern.

We were forced [interruption omitted] to approve or to consider let's say, a significant source of funding for emergency generation due to the delay of Costa Sur. And before we consider it, we need to know the reasons of those delays. We cannot approve it blindly without knowing the context and reality and without knowing the reasons for that delay. The reasons need to be provided and need to be verified. And the place to do that is the Energy Commission. All the proceedings related to the approval of these emergency generations for the benefit of PREPA itself to avoid court challenges, to avoid appeals to the same Commission. This need to be discussed extensively. And when I say extensively, it is an extensive amount of hours that will save time in court. And that needs to be discussed in the Energy Commission. For example, we can have FEMA people sit and for the record say that yes for the emergency generation will be or will not be paid. In my view, that is not clear yet. And we can hear views of the people, and we can even modify part of the intentions of our decisions if necessary.

If we don't do that, we will be kind of putting the whole of Puerto Rico in a boiling pressure. And that will have consequences. We need to let people in, we need to hear people, we need people to express themselves and maybe we need to amend the decisions of this Board based on this listening. And that is very significant. Doing what the executive director just proposed of not doing that on the Energy Bureau, so doing that separately with the FOMB, and others, will bring more heat, and we will increasingly create more pressure, more challenge to the utility, more challenge to the Fiscal Board, more challenge to the Commission, and that will force the utility, PREPA, cannot work well, cannot work with the expected outcome.

My call for this Board is not only in the proceedings of the emergency generation, but for all the other proceedings that are often in the Energy Commission at his time. This is to open public participation, to let people express themselves, to learn from them, and maybe modify the positions that the Board has taken. This will be for the benefit of consumers, for PREPA itself, and for the benefit of the people of Puerto Rico. Those are my words.²

² AEE Junta de Gobierno, *Reunión Junta de Gobierno AEE - 29 de abril de 2020, 2 de 2*, Youtube (April 30, 2020), <u>https://youtu.be/smDxRXRs0TE?t=2035</u> [hereinafter PREPA April 29 Governing Board Meeting].

Petitioners ask for the opportunity to continue participating in this docket, on terms deemed reasonable by the Energy Bureau. We support the motions for intervention by OIPC and Engineering Services International. We look forward to OIPC's contribution to this docket, to ensure that ratepayers are not harmed by yet another rushed, secretive RFP process to acquire unnecessary fossil fuel resources.

PREPA HAS FAILED TO DEMONSTRATE ANY NEED TO SPEND HUNDREDS OF MILLIONS OF DOLLARS ON TEMPORARY GENERATION.

The Energy Bureau has enough information at this point to reject, or at least suspend, the RFP process. The initial reasons that PREPA claimed it needed this generation are no longer true (if they ever were valid in the first place).

PREPA's initial <u>Urgent</u> Request For Approval of Request For Proposals For Temporary Emergency Generation claimed that Costa Sur Units 5 and 6 would not be repaired until February 2021; we now know that Costa Sur 5 could be back online in at most three months.³ PREPA initially claimed that these units were urgently needed for May and June peak demand; we now know that these units could not be online until mid-July at the earliest.

PREPA's February 25th Supplement included a Load Forecast v. Generation Availability chart. With this chart, PREPA claimed that temporary

³ See PREPA, Notification and Urgent Request for Approval of Request for Proposals For Temporary Emergency Generation at 2, Dkt. No. NEPR-AP-2020-0001 (Feb. 12, 2020), <u>https://energia.pr.gov/wp-content/uploads/2020/04/2020-02-12-AP20200001A1-Notification-and-Urgent-Request-for-Approval-of-Request-for-Proposals-for-Temporary-Emergency-Generation.pdf</u>. See also Declaration by Ángel Figueroa Jaramillo.

generation was necessary not to serve load, but rather to provide an adequate reserve margin.⁴ The chart is now obsolete: since February 25th, to UTIER's credit, UTIER workers have managed to bring several offline generation units back into service, as well as significantly shortening the timelines for repair of Costa Sur Unit 5.

PREPA's updated chart, provided last night, shows that in the most likely Scenario (with Aguirre 2 online in a matter of weeks, and Costa Sur 5 online in mid-August), PREPA would be operating with reserve margins exceeding 27% at all times when temporary generation would actually be available.⁵ This demonstrates no need at all to spend hundreds of millions of dollars on temporary generation units. Just at first glance, PREPA's calculations also include several unexplained machinations that appear designed to lower PREPA's supply. For example, PREPA does not appear to include capacity or energy from its utilityscale renewable generation resources.⁶ PREPA also decided to apply an unexplained, arbitrary, oversimplistic 88% usage rate to the maximum capacity of generation resources across all units, of all ages and all technology types.⁷ Again

⁴ PREPA, Supplement to Notification and Urgent Request for Approval of Request for Proposals For Temporary Emergency Generation at PDF p. 10, Dkt. No. NEPR-AP-2020-0001 (Feb. 25, 2020), <u>https://energia.pr.gov/wp-content/uploads/2020/04/2020-02-25-Supplement-to-Notificationand-Urgent-Request-for-Approval-of-Request-for-Proposals-for-Temporary-Emergency-Generation-NEPR-AP-2020-0001.pdf [PREPA February 25 Supplement]. PREPA did not provide the actual data underlying this chart until months later.</u>

 $^{^5}$ 20200505r1 Generation Outage Schedule Analysis Temporary Generation RFP PREPA PREB, tab Chart Ag2 May CS5 Aug.

⁶ *Id.* at rows 40, 41, 42.

⁷ Id.

Petitioners respectfully request that the Bureau grant an extension of time for Petitioners to fully review and respond to these documents.

In addition, PREPA has failed acknowledge several factors that significantly reduce summer peak load. One, obviously, is the COVID-19 crisis. PREPA's charts show that since the start of the crisis, PREPA's real observed load has been significantly lower than forecasted load for almost every week.⁸Another factor lowering summer peak demand is the ability of large customers to use their own self-generation units, totaling about 234 MW, at peak times. Finally, PREPA has repeatedly been directed to ask large customers about load management options to reduce summer peak demand, aside from and separate from use of selfgeneration units.

Petitioners' <u>Exhibit E</u> shows that with these additional supply resources online, and accounting for reductions in summer peak demand just from use of large customers' self-generation, the temporary generation units are no longer necessary.

Since February 2020, PREPA has backed off from its hyperbolic insistence on 500 MW of generation. PREPA's Governing Board now acknowledges that the need is far lower and far more uncertain: "Chairman: We are still not clear exactly how much we are going to need. It might be 100 [megawatts], it might be 250, might be 150."⁹

⁸ Id.

⁹ PREPA April 29 Governing Board Meeting, at <u>https://youtu.be/smDxRXRs0TE?t=2035</u>.

The problem is that as currently structured, PREPA's RFP is not flexible enough to accommodate such uncertainty. Under PREPA's proposed contracts, PREPA will be locked into paying "fixed, non-variable prices that will not change during the 12-month agreements."¹⁰ If PREPA signs a contract for 250 MW, PREPA will be forced to pay for 250 MW even if it needs less: or even if it needs none at all.

PREPA will be spending unknown hundreds of millions, if not billions, of dollars to rent these units. PREPA refuses to disclose these costs to ratepayers. Indeed, up until May 3, the exact cost was a secret even to PREPA's Governing Board:

Chairman: Fernando, when can the Board have a report on those costs? I mean, even though is not public, we would like to have a preliminary report on the proponents that were selected, [can we] use their names, make clear what we have?

Fernando Padilla: Yes, Mr. Chairman, yes. No later than this Saturday. . . . Everything will be in detail there.¹¹

PREPA claims, but has not yet proven, that FEMA and insurance companies will pay some part of these rental costs. During the April 30th conference call, PREPA representatives assured the Commissioners that they had received a letter from FEMA stating that temporary generation would be eligible for FEMA funds. It turns out that is false. FEMA's April 15, 2020 letter actually states:

¹⁰ PREPA February 25th Supplement, at II, Para. B. *See also* Statement in Support of the Joint Regulation, Section 4.2(ii).

¹¹ PREPA April 29 Governing Board Meeting, at <u>https://youtu.be/smDxRXRs0TE?t=2187</u>.

FEMA will not be considering the provision of temporary generation via Direct Federal Assistance. Nevertheless, FEMA is approving the temporary relocation of essential services, generated by the Costa Sur power plant, through its Public Assistance Program.¹²

During the April 29th PREPA Governing Board meeting, all parties agreed

that "temporary relocation of essential services" may not include rental of include

temporary generation at all:

Chairman: We are not clear still if we are going to get the money, so we need to be very very very cautious. We need to make sure everything is in compliance with FEMA requirements. So, can you tell anything on that, Fernando?

Fernando Padilla: Absolutely Mr. Chairman. We did received a letter from FEMA declaring eligibility on the project. ... And again we are dependent of FEMA and the federal funding for these projects. ... And we are hopeful that we will have the infrastructure and the funding to cover for this infrastructure.¹³

Tomas Torres: ... Now, regarding the FEMA letter. I just want to make sure that we are all on the same page. <u>The FEMA</u> <u>letter basically says that they are approving basically, temporary</u> <u>relocation of essential services. That's what they are saying. They</u> <u>are not approving temporary generation. So, we need to make sure,</u> <u>before taking this giant step that the proper interpretation is been</u> <u>given to this letter.</u>

Fernando Padilla: That is correct.

Tomas Torres: <u>So Mr. Chairman, my recommendation is, my</u> <u>recommendation will be that our attorney, Ms. Astrid Rodriguez,</u> <u>immediately contact FEMA and clarify what FEMA will ultimately</u> <u>pay, because we are making a lot of assumptions.</u> And this is a big step, it is a big decision. ... this is a big step, so my recommendation would be to clarify this letter immediately before taking this step.

Chairman: Tomas, concerning your point, we are on the same page.¹⁴

 ¹² PREPA, Motion in Compliance With Bench Order Entered on April 30, 2020, at PDF pp. 145-46, Dkt. No. NEPR-AP-2020-0001 (May 7, 2020). [hereinafter PREPA May 7 Motion].
 ¹³ Id.

¹⁰ Ia

¹⁴ *Id.* (emphasis added).

Moreover, FEMA's April 15th letter placed strict limits on funding:

However, all costs associated with operating and maintaining the temporary facility will not be considered eligible for PA funding. Once temporary generation initiates, the use of the "Peaking Units"... will not be eligible for PA funding.¹⁵

Finally, FEMA further stated that no funding at all would be provided until PREPA provided a "cost analysis to demonstrate the most cost-effective and practical option" to meet summer peak demand.¹⁶ As detailed in Petitioners' submissions, PREPA has a variety of more cost-effective options: self-generation and load management by large customers, focused efforts to repair existing units without delay, quickstart energy efficiency and demand response programs, and recognition of the biggest untapped virtual power plant resource in the world: the distributed solar and storage already in place on the island.

At this point, without any certainty of FEMA funding, PREPA cannot know how many hundreds of millions of dollars ratepayers will have to pay to rent temporary generation. This violates Regulation 8815 Section 4.7(e), which requires that PREPA's financial plan "disclose the full extent of any expected public sector financing." PREPA's reckless pursuit of unnecessary fossil fuel generation through secret, rushed processes, with no guarantees of any quick reimbursement by FEMA or insurance, is exactly the type of behavior that landed PREPA in bankruptcy proceedings in the first place. Commissioners, the Bureau's consultant, Petitioners, the public, and PREPA's own CEO have identified far

¹⁵ *Id.* at 146.

 $^{^{16}}$ Id.

more cost-effective ways to fill a need for summer capacity, energy, or ancillary services: if PREPA ever proves that any unmet need even exists.

Regulation 8815 Section 7.1(d) prohibits the Energy Bureau from approving any contract resulting from this RFP, if it conflicts with the Integrated Resource Plan or would result in unreasonable profit margins. As detailed above, PREPA's RFP will interfere with the Integrated Resource Plan by forcing ratepayers into rental contracts for short-term fossil fuel units that PREPA does not even need. Those contracts will pay unconscionable profits for fossil fuel units that will barely ever be turned on. PREB should issue an order stating that no temporary generation contracts will be approved unless PREPA can demonstrate a need for these units, <u>after</u> it immediately takes action on more cost-effective methods to serve summer peak load:

- Schedule calls or meetings with all large customers to discuss load management options and scheduled use of their approximately 234 MW of self-generation units. Provide a publicly available report on the results of these meetings
- Continue to provide publicly available reports on progress of repairs of all generation units currently offline, especially Costa Sur Unit 5, with thorough explanation for any delays.

Respectfully submitted,

Ruth Santiago RUA No. 8589 Apartado 518 Salinas, PR 00751 T: 787-312-2223 E: rstgo2@gmail.com

/s/ Pedro Saadé Lloréns

Pedro Saadé Lloréns RUA No. 4182 Condado 605 – Office 616 San Juan, PR 00907 T: 787-397-9993 E: pedrosaade5@gmail.com

Laura Arroyo RUA No. 16653 Earthjustice 4500 Biscayne Blvd. Ste 201 Miami, FL 33137 T: 305-440-5436 E: larroyo@earthjustice.org

Jordan Luebkemann* Florida Bar. No. 1015603 Earthjustice 111 S. Martin Luther King Jr. Blvd. Tallahassee, FL 32301 T: 850-681-0031 E: jluebkemann@earthjustice.org <u>/s/Rolando Emmanuelli Jiménez</u>

Rolando Emmanuelli-Jiménez 1st Cir. #7707 USDC: 214105

/s/Jessica Méndez-Colberg

Jessica Méndez-Colberg 1st Cir. # 1185272 USDC: 214105

Email: <u>rolando@bufete-emmanuelli.com</u> jessica@bufete-emmanuelli.com <u>notificaciones@bufete-emmanuelli.com</u>



472 Tito Castro Ave. Marvesa Building, Suite 106 Ponce, Puerto Rico 00716 Tel: (787) 848-0666 Fax: (787) 841-1435

Raghu Murthy^{*} Earthjustice 48 Wall Street, 19th Floor New York, NY 10005 T: 212-823-4991 E: rmurthy@earthjustice.org

*The Puerto Rico Supreme Court is currently not accepting *pro hac vice* applications during its closure due to the Covid-19 pandemic. Once the Court reopens, *pro hac vice* applications will be submitted, if appropriate. Counsel Raghu Murthy and Jordan Luebkemann have been granted permission to appear before the Puerto Rico Energy Bureau *pro hac vice* previously in another docket [CEPR-AP-2018-0001].

CERTIFICATE OF SERVICE

I hereby certify that on May 8, 2020, we have filed this Motion via the Energy Bureau's online filing system, and sent to the Puerto Rico Energy Bureau Clerk and legal counsel to: <u>secretaria@energia.pr.gov</u>, <u>astrid.rodriguez@prepa.com</u>, jorge.ruiz@prepa.com, <u>n-vazquez@aeepr.com</u>, <u>c-</u> <u>aquino@prepa.com</u>, and <u>kbolanos@diazvaz.law</u>.

Respectfully submitted on this day May 8, 2020.

<u>/s/Ruth Santiago</u> Ruth Santiago RUA No. 8589 Apartado 518 Salinas, PR 00751 T: 787-312-2223 E: rstgo2@gmail.com

Laura Arroyo RUA No. 16653 Earthjustice 4500 Biscayne Blvd. Ste 201 Miami, FL 33137 T: 305-440-5436 E: larroyo@earthjustice.org

EXHIBIT A

Declaración de Angel Figueroa Jaramillo

GOVERNMENT OF PUERTO RICO PUBLIC SERVICE REGULATORY BOARD PUERTO RICO ENERGY BUREAU

IN RE: REQUEST FOR PROPOSALS FOR TEMPORARY EMERGENCY GENERATION

CASE NO. NEPR-AP-2020-0001

SUBJECT: CERTIFICACIÓN APOYANDO RADICACIÓN SUPLEMENTARIA

DECLARACIÓN DE ANGEL FIGUEROA JARAMILLO EN APOYO A LA RADICACIÓN SUPLEMENTARIA DE LOS PETICIONARIOS

Yo, Ángel Figueroa Jaramillo, mayor de edad, soltero, presidente de la Unión de Trabajadores de la Industria Eléctrica y Riego (UTIER), y vecino de Carolina, bajo juramento legalmente prestado, declaro lo siguiente:

- 1. Mis circunstancias personales son las detalladas anteriormente.
- 2. Comencé a trabajar en la Autoridad de Energía Eléctrica (AEE) en el año 1988. Trabajé en la Central Hidro Gas como ayudante de soldador y mecánico en la reparación y conservación de las unidades hidro-eléctricas, pero principalmente en las turbinas de combustión interna hasta el 1994. En aquel entonces, comprendían de 21 turbinas de combustión interna y después se redujeron a 19 cuando se modernizaron las instaladas en Mayagüez.
- Fui parte del Comité de Querellas establecido conforme al Convenio Colectivo desde el 1994 hasta el 1996, y fui el secretario del Comité Negociador de la UTIER en la negociación que culminó en el 1999.

- 4. Ocupé la Secretaría de Educación y Propaganda en el 2000 y fui electo Vicepresidente en 2002, donde trabajé en la negociación e implementación de diferentes acuerdos, tales como los trabajos de lavado de caldera, remoción de material de aislación en las Centrales Generatriz a raíz de la estipulación firmada en 2004. Además, negocié la reclasificación de los puestos de Electricista de Centrales Generatrices a principios del 2000.
- 5. Como Vicepresidente de la UTIER, formé parte del comité negociador que culminó con el Convenio Colectivo del 2008 y en la negociación que comenzó en el 2012.
- Soy el actual presidente de la UTIER, posición que obtuve en las elecciones del sindicato en el 2008, y he sido reelecto en el 2011, 2014, 2017 y recientemente en el 2019.
- 7. Como parte de mis funciones, me relaciono diariamente con todos los aspectos operacionales, financieros y técnicos de la AEE y participo directamente en la formulación de la política sindical de la UTIER en su relación con la AEE.
- Además, soy Síndico de la Junta de Síndicos del Sistema de Retiro de los Empleados de la Autoridad de Energía Eléctrica desde el 2015 y he sido reelecto en el 2016 y junio del 2019.
- 9. He sido parte de diferentes esfuerzos multisectoriales en Puerto Rico e internacionales tales como la Mesa de Diálogo Energético y soy miembro electo del Consejo de Dirección de la Asociación del Derecho a la Energía con sede en Francia. Además, formo parte del colectivo "Queremos Sol". En estas gestiones, me he relacionado directamente con los asuntos de política pública sobre a la energía renovable y el futuro

de la AEE como entidad sustentable y que satisfaga las necesidades del Pueblo de Puerto Rico a costos razonables.

- 10. Participé y escuché vía telefónica lo expresado en la vista técnica celebrada por el Negociado de Energía el día 30 de abril de 2020 en el caso de epígrafe sobre la solicitud de propuestas de nuevos generadores temporeros realizada por la alta gerencia de la AEE.
- 11. A la luz de la información suministrada por la AEE y el estado de lo trabajos de reparación y mantenimiento de las diferentes unidades de la flota generatriz, la contratación de generación temporera propuesta por la AEE es totalmente innecesaria y un derroche de los escasos recursos de la AEE.
- 12. La AEE falló en justificar adecuadamente la propuesta de generación temporera al recurrir a medias verdades y omisiones sustanciales:
 - a. Sobre el impacto del COVID-19 en los procesos de reparación de Costa Sur, tengo conocimiento personal de que se están tomando medidas preventivas para evitar contagios y que esto no está causando un retraso a las reparaciones en marcha. Actualmente, se está trabajando en la Unidad 2 de la central Aguirre y en las Unidades 5 y 6 de la Central de Costa Sur.
 - b. No es cierto que las unidades que están fuera de servicio, como la Unidad 5, estén deteriorándose y puedan tener problemas operacionales al momento de ser incorporadas como ha sucedido en la Unidad 2 de Aguirre, porque esta última fue totalmente abandonada por casi 15 meses en todas las medidas que se utilizan para salvaguardar equipo y componentes de la unidad. En cuanto a

la Unidad 5 de Costa Sur, se establecieron todas las medidas y protocolos para proteger la integridad de la unidad por el tiempo que ha estado fuera de servicio.

- c. Sobre la Unidad 2 de Aguirre, al presente se encuentra prendida la caldera con 200 libras de PSIG y el pasado 5 de mayo se puso a rodar la turbina. Continuarán haciendo pruebas en días subsiguientes. Por tanto, no es cierto que estos trabajos están atrasados, pues el día de la conferencia técnica estos trabajos ya estaban prácticamente terminados. Si no hay ningún contratiempo, estaría en servicio en aproximadamente una semana. Esta unidad añadiría 450 MW al sistema.
- d. Sobre la Unidad 1 de la Central Cambalache es pertinente informar que en el 2017, después del huracán María, la compañía Hughes Technical Services realizó una evaluación para ver qué hacía falta para arreglarla y su costo. La compañía cotizó \$16 millones por la reparación. Luego de esto, en el 2019, la compañía General Electric cotizó los componentes para una Unidad NM, que ya incluye el "upgrade", por \$15 millones que puede producir hasta 90 MW. Este año, y a modo de emergencia, se contrató a la compañía Action Enviromental para "sanitizar" la unidad completa para iniciar el proceso de evaluación nuevamente con el propósito de ver qué equipos auxiliares se necesitaban para poner la unidad a funcionar con la propuesta de GE. Sin embargo, hace dos semanas, y de forma abrupta, todo se canceló.
- e. La AEE no presentó información sobre todas las alternativas de generación incluyendo las "peaking units" que podrían estar disponibles con una inversión mínima y en tiempo razonable. La AEE las usa también en caso de emergencias,

después de los huracanes típicamente, para suministrar energía a una región porque el sistema de transmisión, o la generación de la base, se ha dañado, mediante la creación de pequeñas micro redes. El 1 de junio de 2020, entraremos en la temporada de huracanes y las 8 unidades descritas deben ponerse en servicio de inmediato. A saber:

- i. Unidades de 20 MW que no están disponibles porque las abandonaron, hoy requieren de mantenimiento incluyendo limpieza, instrumentación, control, eléctricos y mecánicos incluyendo reparación estructura y albergue/techos y saneamiento de áreas. Se requiere hasta máximo de 180 días para devolver a servicio:
 - 1. Palo Seco 1-2 (fuera de servicio tarda menos de un mes)
 - 2. Aguirre 1-1 (Fuera de servicio)
 - 3. Aguirre 1-2 (entró en línea hace dos meses)
 - 4. Jobos 1-1 (fuera y entra en dos semanas)
 - 5. Vega Baja 1-1 (fuera y en pruebas en una semana)
 - 6. Costa Sur 1-2 (Fuera de servicio por reparación mayor)
 - 7. Yabucoa 1-2 (En pruebas entregada hace un mes)
 - 8. Costa Sur 1-1 (la comienzan a reparar el lunes y terminan en aproximadamente un mes)

Total: 160 MW

- f. Todas estas unidades, además de servir para emergencia y tener una respuesta de entre 9 a 15 minutos y sin "time-out period" por cada disparo (vuelven y arrancan), también resulta que regulan carga, frecuencia y voltaje en las líneas, por lo que son fundamentales para el sistema. Ese no es el caso de las que quiere alquilar la AEE.
- g. Todas estas unidades ya están conectadas al sistema, por lo que la interconexión no es un problema. Por el contrario, conectar unidades de nueva generación podría ser un problema al tener que realizar el proceso de sincronización y

conseguir puntos de conexión. La AEE no ha analizado esto ni ha explicado el proceso, el tiempo que requeriría y el costo.

- 13. Al día 5 de mayo, la demanda es de 2216 MW. La Reserva en rotación es de 432 MW. La Reserva controlada es de 225 MW. Por lo que existe suficiente margen para la operación sin necesidad de dichas nuevas unidades de generación temporera.
- 14. Por otro lado, el suceso de los temblores ocurridos el sábado, 2 de mayo de 2020, incluyendo el de magnitud 5.4 Md a las 7:13 A.M. con epicentro en Peñuelas, según datos de la Red Sísmica de Puerto Rico, no provocó daños a la Central de Costa Sur. De igual forma, la Central de EcoEléctrica, cuyo sistema se fue de línea automáticamente por motivos de seguridad, volvió a estar en servicio el mismo sábado, 2 de mayo de 2020, a eso de las 12:00 P.M. Por tanto, los sucesos del 2 de mayo en nada justifican la generación temporera que se propone. Esto fue admitido públicamente por la propia AEE.
- 15. Además, los temblores ocurridos el 2 de mayo de 2020, no provocaron cambios en la programación de reparación de la Unidad 5 de la central de Costa Sur.
- 16. Por último, es preocupante que estos procedimientos ante el Negociado de Energía se conduzcan recibiendo testimonio que no está bajo juramento. Esto no ofrece garantías de la veracidad y/o confiabilidad del testimonio de los oficiales de la AEE y lo que ocasiona es que se induzca a error a los Comisionados. Además, esto afecta la función reguladora del Negociado de Energía de Puerto Rico y perjudica los intereses del Pueblo de Puerto Rico y de los Peticionarios en este caso.

CERTIFICACIÓN

Y para que así conste, juro y suscribo esta declaración jurada cuyo contenido es la verdad según lo mejor de mis habilidades y conocimiento razonable, por lo que firmo, hoy 8 de mayo de 2020, en San Juan, Puerto Rico.

/s/ Ángel Figueroa Jaramillo

EXHIBIT B

Certification of Myrna Conty

GOVERNMENT OF PUERTO RICO PUBLIC SERVICE REGULATORY BOARD PUERTO RICO ENERGY BUREAU

IN RE: REQUEST FOR PROPOSALS FOR TEMPORARY EMERGENCY GENERATION CASE NO.: NEPR-AP-2020-0001

SUBJECT: CERTIFICATION IN SUPPORT OF PETITIONERS' SUPPLEMENTAL FILING

CERTIFICATION OF MYRNA CONTY IN SUPPORT OF PETITIONERS' SUPPLEMENTAL FILING

I, Mrs. Myrna Conty, also known as Gladys Myrna Conty Hernández, of full age and sound mind, certify as follows:

- 1. I am the coordinator of the Coalición de Organizaciones Anti Incineración, Inc. ("COAI"), and a member of Amigos del Río Guaynabo ("ARG"), the Alianza Energía Renovable Ahora (AERA), and the Alianza Queremos Sol.
 - a. COAI is a coalition of citizens and more than 35 organizations concerned about waste incinerators in Puerto Rico, especially the solid waste incinerator proposed by Energy Answer-Arecibo, LLC, in Arecibo. COAI promotes clean energy and opposes the generation of energy with incineration. COAI is an intervenor in the ongoing Integrated Resource Plan still pending before the Energy Bureau.
 - b. ARG is an environmental and community organization created for the defense of the natural resources of Puerto Rico, especially water resources. ARG is an intervenor in the ongoing Integrated Resource Plan still pending before the Energy Bureau.
 - c. AERA is composed of the Local Environmental Organizations that have collectively intervened in the pending Integrated Resource Plan proceeding before the Energy Bureau. AERA advocates for a swift and equitable transition to renewable energy generation in Puerto Rico, and in order to protect the public from future natural disasters and to comply with Puerto Rico Law 17-2019 and Law 33-2019.
 - d. Alianza Queremos Sol is a multi-sector coalition that has developed a plan for 100% sustainable, self-sufficient energy generation in Puerto Rico, using renewable resources—primarily distributed solar generation—and energy efficiency. Queremos Sol advocates for a transparent, local, and equitable energy grid, with an emphasis on public participation and accountability.

- 2. These organizations, and myself individually, have a substantial interest in this docket and its ultimate outcome. The Energy Bureau's rulings and PREPA's actions based on those rulings will significantly affect the nature of the energy system that is being studied in the IRP docket.
- 3. As these organizations have made clear through testimony and other filings in the IRP proceeding, the composition of the Puerto Rico electricity grid has immediate impacts on the public's physical and environmental health, preparedness and resilience for future nature disasters, economic well-being. The public has a right to be involved in decisions that implicate their rights.
- 4. Whether or not PREPA is ultimately allowed to spend an enormous amount of money on temporary, presumably fossil-fueled generation, also goes directly to the heart of whether PREPA is likely to comply with Laws 17-2019 and 33-2019, which require the utility to meet an accelerated renewable portfolio standard, beginning with 20% renewable electricity by 2022 and 40% by 2025.
- 5. However, in 2019, PREPA served only 2.3% of energy from renewable sources. This shows how critical it is that the Energy Bureau not permit PREPA to waste either its scarce time nor financial and human resources on anything other than investments in renewable resources—including in the context of PREPA's alleged shortfall in electricity capacity.
- 6. On behalf of these organizations, I am compelled to share the public outrage for the scandalous and unlawful procedures through which PREPA has solicited 500 MW of unneeded "temporary" electricity generation.

PREPA's RFP Would Waste an Enormous Amount of Public Money.

- 7. PREPA plans to spend \$70M monthly, up to a total of \$1.260B over 18 months on temporary emergency generation.
- 8. PREPA claims that FEMA and private insurance will pay a large part of this sum, but as of April 30th had failed to provide proof of that to the Energy Bureau or the public. Even in the best case scenario where those sources pay as much as PREPA claims, that would still leave the public on the hook for \$220.5M with an already bankrupt public corporation.¹
- 9. We are also expected to take PREPA at its word that after 18 months these peakers will be returned. Instead, we should remember that PREPA also acquired "temporary" generating units after Hurricane María that have now become permanent. PREPA cannot be allowed to use this "emergency" to illegally acquire new gas units outside of the IRP docket that are not necessary.
- 10. PREPA should be using this money instead to invest in renewables and energy efficiency, not more expensive, climate-worsening, imported fossilfuels.

¹ PREPA indicated that only 82.5% of the costs would ultimately be recovered from FEMA and private insurance, leaving the public to come up with the remaining 17.5% of the temporary units' \$1.26B cost over 18 months.

PREPA's RFP Continues its Bias Against Renewables.

- 11. PREPA has already shown an aggressive bias against renewable energy sources during the IRP by:
 - a. overestimating costs for distributed and utility scale solar, while underestimating the costs for methane and gas generating units;
 - b. assuming that only thermal units could supply critical loads;
 - c. ignoring battery storage as a replacement for thermal reserves; and
 - d. advocating for a gas-centric preferred plan, even though a grid based on distributed generation would save billions in planned transmission spending.
- 12. The RFP continues this trend by limiting renewables and storage installation to certain specific locations.
- 13. Even during the April 30 Technical Conference, PREPA employees rejected multiple suggestions from the Energy Bureau's consultants that battery electric storage resources could be connected to the grid at sites that PREPA identified for emergency generation peakers. Instead, PREPA personnel indicated that only after they had determined that PREPA's generation capacity had returned to normal, would it be possible to even consider interconnecting battery storage at those sites.
- 14. At the same time, PREPA CEO Jose Ortiz has made it clear that, due to the COVID-19 pandemic, no interconnections of distributed renewables will take place. If PREPA is so concerned about a potential generation shortfall, they should not be delaying solar arrays that are ready at this very moment to provide services to the grid. That PREPA continues to advocate for new temporary generation while ignoring **existing** renewable resources further shows this bias.

The Public Has Been Unlawfully Excluded from Participation in This Proceeding.

- 15. Robust and meaningful public participation in issues regarding the energy system is so important that the people of Puerto Rico called on their representatives to enact Law 17-2019. That law states the it shall be the policy of Puerto Rico to "To promote transparency and citizen participation in every process related to electric power service in Puerto Rico."
- 16. This law was passed after the devastating loss of electricity for almost one year following Hurricane María, and after countless scandals of PREPA mishandling the electricity system. Its purpose is to actually involve the public and to protect them from the kind of decisions that led to our current unreliable, dirty, and expensive electricity system.
- 17. The Local Environmental Organizations who intervened in the IRP docket have raised this issue countless times before the Bureau: in our petition to intervene in the IRP, in in motions relating to PREPA's refusal to hand over

required information and requesting that the IRP proceeding be conducted in the native language of the Puerto Rican people—Spanish.

- 18. The same exclusionary tactics are being used against us in this docket.
- 19. In this new docket, PREPA has again shown its contempt for the public by unlawfully treating the RFP as wholly confidential for months, so that the public, who are the ones affected directly, could not even know the parameters that bidders were given to structure their proposals.
- 20. PREPA also opposed the motion of the LEOs to intervene in this docket, which directly threatens to undo the purpose of the IRP docket, if PREPA acquires new gas peaker units outside the bounds of that proceeding and later is successfully able to keep them—just as they did after Hurricane María.
- 21. In addition to denying the public full participation through any intervention, the Energy Bureau has further restricted the Public from accessing information.
- 22. The Bureau granted PREPA's request to treat the RFP as confidential, and has not required PREPA to share those documents with interested parties or the public.
- 23. The public was also not able to sufficiently participate in the April 30 Technical Conference. Although the Bureau allowed the public to listen to the Technical Conference, it provided very short notice of this opportunity. The Notice of the Technical Conference was emailed after working hours, at around 7:55 P.M. on April 29th, and required individuals to register by 8:30 A.M. the following day to be given the call-in information.
- 24. The public was not allowed to speak or ask questions during this conference, so there was no way to advocate for or defend the interest of the public.
- 25. Worse still, while the Bureau arranged for Spanish-to-English translation of PREPA's witnesses, for the convenience of English-only participants, the Bureau failed to provide any English-to-Spanish translation of the call, making the contents inaccessible to many of those who were even able to register for the call.
- 26. As the Local Environmental Organizations have previously pointed out, 70% of our population feels more comfortable speaking Spanish, especially concerning technical matters. When matters are under discussion that affect us so deeply in terms of our health, safety, and finances, they must be discussed in Spanish, or simultaneously translated to Spanish. That the matters before the Energy Bureau are "technical" makes this *more*, not less important. Anything less than full Spanish language proceedings or *two-way* translation conducted in *real* time, does not adequately inform the public and allow the participation our Legislative Assembly mandated in Law 17-2019.
- 27. As a Puerto Rican citizen and a PREPA customer, I should not have to keep asking to be allowed to participate in things that will affect me so much. That is why the Legislative Assembly passed Law 17-2019 in the first place.

CERTIFICATION

I, <u>Myrna</u> Conty , of legal age, resident of Puerto Rico, CERTIFY that the contents of my affidavit are known to me and are the truth according to the best of my abilities and reasonable knowledge. The information has been gathered in good faith; but I cannot guarantee the truthfulness of information gathered from third parties.

CONTROL.

Myrna Conty

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EXHIBIT C

Declaration of Agustin A. Irizarry-Rivera

GOVERNMENT OF PUERTO RICO PUBLIC SERVICE REGULATORY BOARD PUERTO RICO ENERGY BUREAU

DECLARATION OF AGUSTÍN A. IRIZARRY RIVERA IN SUPPORT OF PETITIONERS' SUPPLEMENTAL FILING

I, Agustín A. Irizarry-Rivera, of legal age, engineer by profession and professor in the Electrical and Computer Engineering Department at the University of Puerto Rico Mayaguez Campus, and resident of San Germán, Puerto Rico, declare the following:

BACKGROUND & QUALIFICATIONS

1. I obtained my bachelor degree, Magna Cum Laude, at the University of Puerto Rico, Mayagüez Campus (UPRM) in 1988; a Masters at the University of Michigan, Ann Arbor in 1990; and a Ph.D. at Iowa State University, Ames in 1996 all in electrical engineering. I have been a licensed professional engineer in Puerto Rico since 1991, and a member of the Institute of Electrical and Electronics Engineers (IEEE). Since 1997, I have been a Professor at the Electrical and Computer Engineering (ECE) Department at UPRM where I teach graduate and undergraduate courses such as: Electric Systems Analysis, Fundamentals of Electric Power Systems, Power System Analysis, Electric Machines, Electrical Systems Design, Advanced Energy Conversion, Power Systems Dynamics and Control and Transmission and Distribution Systems Design.

- 2. I have been elected member of the Electrical and Computer Engineering Department Personnel Committee and the School of Engineering Personnel Committee in three occasions and have served as President of both Committees twice. I have been elected as Academic Senator to represent the School of Engineering in the Academic Senate. Additionally, I have served as Assistant Dean of Academic Affairs UPRM and Associate Director for Academic Affairs of the Electrical and Computer Engineering Department at UPRM.
- 3. I have conducted research in the topic of renewable energy and how to adapt the existing power grid to add more of these resources in our energy portfolio. I had a research internship at Plataforma Solar de Almería, Tabernas, Spain from 2008 to 2009 to study concentrated solar thermal systems. I contributed to the development of dynamic models to simulate the interaction between these plants and the electric grid. I have served as a consultant on renewable energy and energy efficiency projects to Puerto Rico's government agencies, municipalities, private developers, and consulting firms, both in and outside Puerto Rico. I have also served as an

expert witness in civil court cases involving electric hazard, shock or electrocution.

- 4. I am an author or coauthor of over 50 refereed publications, including two book chapters¹, and have organized local and international conferences such as the Tenth International Conference on Probabilistic Methods Applied to Power Systems (PMAPS 2008) in Rincón, Puerto Rico. PMAPS Conferences provide a regular forum for engineers and scientists worldwide to interact around the common theme of power engineering decision problems under uncertainty.
- 5. I have also received several awards and honors: Distinguished Engineer 2013 from Puerto Rico's Professional Engineers Society (CIAPR) and Distinguished Electrical Engineer 2005 from the Electrical Engineering Institute of CIAPR in recognition of services rendered to the profession and outstanding professional achievements in electrical engineering, the 2009 Distinguished Alumni Award from UPRM Alumni Association, the 2004 Professional Progress in Engineering Award from Iowa State University, in recognition of outstanding professional progress and personal development in engineering as evidenced by significant contributions to the theory and practice of engineering, distinguished service rendered to the profession, appropriate community service, and/or achievement in a leadership

¹ See complete list in my Curriculum Vitae. A true and accurate copy is attached as <u>Exhibit 1</u>.

position and the 2003-2004 ECE Outstanding Faculty Award from UPRM's School of Engineering.

- 6. In May 2012, I was elected, by the consumers, to the Board of Directors of the Puerto Rico Electric Power Authority, in the first election of this kind in Puerto Rico, to represent the interests of consumers. I was President of the Board's Audit Committee and an active member of the Engineering and Infrastructure, Legal and Labor Affairs and Consumer's Affairs Committees. In 2013, Board Members elected me as Vice President of the Board and I served in this capacity until September 2014 when my term expired.
- 7. I am a member of the Board of Directors, in the Interest of Consumers, of PREPA Holdings, LLC, a company registered in Delaware, whose sole owner is PREPA. PREPA Holdings owns PREPANET, a communications network infrastructure provider that uses an optical network platform in Puerto Rico to provide wholesale telecommunication services.

PREPA HAS FAILED TO ENSURE THAT THE TEMPORARY GENERATION UNITS WILL PROVIDE ADEQUATE FREQUENCY REGULATION AND VOLTAGE CONTROL

8. I have reviewed the Declaración De Ángel Figueroa Jaramillo En Apoyo A La Radicación Suplementaria De Los Peticionarios. President Figueroa-Jaramillo highlights a critical point in Paragraph 12(g). Costa Sur Units 5 and 6, prior the shutdown, did not only provide capacity and energy but also provided other critical services to the electric grid. For instance, Costa Sur units 5 and 6 are old and large but they regulate frequency, provide voltage support and are capable of load following, and do so effectively. These are ancillary services. Ancillary services are those functions performed by the equipment and people that generate, control, and transmit electricity in support of the basic services of generating capacity, energy supply, and power delivery. The temporary generators described in the RFP may not provide these ancillary services because they are not able to do so or because these functions were not included in the contracted service.

- 9. PREPA's Request For Proposals <u>does not require</u> that the temporary generation obtained through the RFP replace the ancillary services provided by Costa Sur 5 and 6. In fact, PREPA's Request For Proposals only mentions those services in passing in a single, nonbinding sentence in the RFP: "PREPA prefers that the generating units may actively participate in primary and secondary frequency regulation."²
- 10."Prefer" and "may" are not good enough. The Bureau needs to confirm whether or not temporary generation units will provide these critical services before a contract for emergency generation is approved. The proposed contract terms do not provide any payment for ancillary services, which strongly implies that the temporary generators cannot or will not provide those services.³

² PREPA April 13, 2020 Motion to Submit PDF pp. 12, 283.

Id. ³ PDF pp. 110-111, 254-255

- 11. PREPA has not proven that temporary generation is necessary to replace Costa Sur Units 5 and 6, for either capacity, energy, or ancillary services. Even if there was a need for resources for ancillary services, President Figueroa Jaramillo makes it clear that repairing existing units would be a better option than renting temporary generation.⁴
- 12. Another way to provide ancillary services, not addressed in this RFP, is through battery storage. During the Integrated Resource Plan evidentiary hearing, Eng. Paredes explained that battery storage can provide ancillary services, and that from 1994-2001, PREPA actually used the Sabana Llana battery system successfully for daily frequency control and spinning reserve.⁵ During the April 30th conference call, Bureau consultants highlighted the concern that temporary generation may actually crowd out battery storage resources, exacerbating any issue PREPA may have with ancillary services.
- 13. PREPA's failure to address ancillary services is another reason to reject this RFP, and to reject contracts for any temporary generation units that fail to provide such services.
- 14. This discussion has occurred before at PREPA, specifically during the decision to restore Palo Seco into service. In that situation, as here, PREPA failed to appreciate the importance of using generation resources to provide

⁴ Declaración De Ángel Figueroa Jaramillo En Apoyo A La Radicación Suplementaria De Los Peticionarios, para. 12(g)

⁵ Negociado de Energía en vivo, Evidentiary Hearing / CEPR-AP-2018-0001, YouTube (Feb. 6, 2020), https://youtu.be/HO40ImpqKe8?t=1847. See also PREB Energy Storage Study at 3.

ancillary services to the grid. In rebuttal to PREPA, CIAPR explained to a joint House and Senate committee that it was critical for generation resources to provide these services reactive power (to support voltage levels) and frequency regulation:

The "imbalance" he refers to, he said, has to do with the grid having low inertia, which affects the system's ability to regulate itself.

"Inertia is provided by the number of generators online. To have healthy inertia in synchronous systems of a power network, there must be the capacity to maintain a frequency of 60 hertz [Hz]," Vázquez explained.

The importance of having a capacity greater than 60 Hz is so the system can withstand sudden changes in generation or failures.⁶

15. UTIER appeared before the committee as well and supported CIAPR's

position. Ultimately, the authorities agreed with CIAPR and UTIER.

Inertia response, frequency regulation and other ancillary services were of

primary importance on the decision to restore the Palo Seco units.

16. Petitioners' submissions to this docket to date provide numerous reasons

that the Energy Bureau must reject PREPA's proposal to spend \$70M on

temporary generation. I agree with those submissions, and I further add

that PREPA's RFP fails to ensure that temporary generation resources will

provide ancillary services.

⁶ Colegio De Ingenieros Y Agrimensores De Puerto Rico, "Ponencia sobre el Rol y Relevancia de la Central Palo Seco en el Sistema Eléctrico de la AEE", November 28, 2017. A true and accurate copy is attached as <u>Exhibit 2</u>. <u>See also</u> Caribbean Business, "Puerto Rico Engineers Assoc. says San Juan plant must be powered up to stabilize grid", December 1, 2017. <u>https://caribbeanbusiness.com/puerto-rico-engineers-assoc-says-san-juan-plant-must-be-powered-</u> up-to-stabilize-grid/

CERTIFICATION

I, Agustín A. Irizarry Rivera, of legal age, engineer and resident of San Germán, Puerto Rico, CERTIFY that the contents of my declaration are known to me and are the truth according to the best of my abilities and reasonable knowledge. The information has been gathered in good faith; but I cannot guarantee the truthfulness of information gathered from third parties.

Today, March 7, 2020, in San Germán, Puerto Rico.

Agustín A. Irizarry-Rivera, Ph.D., P.E.

Dr. Agustín A. Irizarry Rivera

Professional Engineer License 12342

P.O. Box 1016 Hormigueros, Puerto Rico 00660 Phone (787) 448-2553

EDUCATION

- Ph.D., Iowa State University, Ames, IA, 1996
 Dissertation Title: "Risk-based operating limits for dynamic security constrained electric power systems." Advisor: Dr. James D. McCalley, committee members: Dr. V. Vittal, Dr. V. Ajjarapu, Dr. G. Sheblé, Dr. H. T. David.
- MSEE, University of Michigan, Ann Arbor, MI, 1990
- BSEE, Magna Cum Laude, University of Puerto Rico, Mayagüez, PR, 1988

POST DOCTORAL TRAINING

(9/08 - 6/09) Researcher at Plataforma Solar de Almería (PSA), Tabernas, Spain. The PSA is the premiere European research and development laboratory for solar thermal concentration systems.

Integration of standard power system models, for the electric network, generator-turbine and controls, with thermo hydraulic models of a solar thermal power plant with no energy storage to provide a comprehensive, albeit simplified, dynamic model set to simulate and study the solar power plant/electric network interaction.

ACADEMIC WORK EXPERIENCE

- (7/05 present) Professor, (6/00 6/05) Associate Professor and (1/97 6/00) Assistant Professor of Electrical Engineering at the University of Puerto Rico, Mayagüez (UPRM). During this time Dr. Irizarry Rivera has taught:
 - 1. INEL 3105 Electric Systems Analysis I
 - 2. INEL 4075 Electrical Engineering Fundamentals
 - 3. INEL 4103 Electric Systems Analysis III (Introduction to Electric Power Systems)
 - 4. INEL 4405 Electric Machines
 - 5. INEL 4407 Electrical Systems Design I
 - 6. INEL 4415 Electric Power Systems Analysis
 - 7. INEL 4048 Engineering Practice
 - 8. INEL 4998 Undergraduate Research
 - 9. INEL 5406 Transmission and Distribution Systems Design
 - 10. INEL 5495 Design Projects in Electric Power Systems: Design of the Distribution System for an Eolic Generation Park.
 - 11. INEL 5496 Design Projects in Power Electronics: Design, Simulation, Fabrication and Test of Brushless Commutation for Permanent Magnets DC Motors.
 - 12. INEL 5995 Special Problems Environmental and Infrastructure Impact of Eolic Generation
 - 13. INEL 6025 Advanced Energy Conversion
 - 14. INEL 6027 Electric Power Systems Dynamics and Control
 - 15. INEL 6028 Optimization and Operation of Electric Power Systems
 - 16. INEL 6077 Over Voltage Phenomena in Electric Power Systems
 - 17. INEL 6995 Special Topics in Electrical Engineering: Reactive Power
 - 18. INEL 6995 Special Topics in Electrical Engineering: Power System Distribution

- President (8/16 present and 1/11 8/12) and (08/10 12/10) Member, School of Engineering Personnel Committee
- President (8/16 present and 8/06 06/07) and (08/09 08/12) Member, Electrical and Computer Engineering Department Personnel Committee
- (8/06 5/07) President, ADHOC Committee to Evaluate Proposals for a New UPRM Class Schedule
- (8/05 8/06) Elected Academic Senator UPRM.

Duties included: Coordinator of the ADHOC Committee to Design Instruments to Evaluate the Chancellors' Performance, Coordinator of the ADHOC Committee to Evaluate Proposed Academic Work Schedules for the Mayagüez Campus, Member of the Courses Committee.

• (2/00 – 8/00) Assistant Dean of Academic Affairs UPRM.

Duties included: supervisor of the Registrar Office and the Admissions Office, coordinator of the registration process for the whole Campus, author of the Academic Calendar proposal, coordinator of the Students Academic Progress Committee, supervisor of the Courses Central Archive keeper and coordinator of the Campus Early Admission Program.

 (10/00 – 01/02) and (8/99 – 2/00) Associate Director for Academic Affairs – Electrical and Computer Engineering Department, UPRM.

Duties included: Graduate Programs Director, updating the faculty recruitment plan, coordinator of the curriculum revision and accreditation processes, evaluate the creation of new academic programs, coordinator and supervisor of the Department registration process, co-author of proposals to bring external funding to the Department, in charge of promoting and facilitating scientific research in the Electrical and Computer Engineering Department.

ACADEMIC INTERESTS AT GRADUATE LEVEL:

- ✓ Renewable/alternate energy sources such as; photovoltaic, eolic, waves and solar thermal and their integration to the grid
- ✓ Electric power system dynamics and operation
- ✓ Power systems risk assessment

EXAMPLES OF FUNDED RESEARCH and EDUCATION PROJECTS

GEARED (Grid Engineering for Accelerated Renewable Energy Deployment) – (2013-2018) A \$929,000 project (UPRM budget out of \$6.9 million for the Consortium) to develop and run a Distributed Technology Training Consortium in the Eastern United States, led by the Electric Power Research Institute (EPRI) in collaboration with four U.S. universities (University of Puerto Rico Mayaguez, Georgia Institute of Technology, Clarkson University, University of North Carolina at Charlotte) and seventeen utilities and system operators. The Consortium will leverage utility industry R&D results with power engineering educational expertise to prepare power engineers in management and integration of renewable energy and distributed resources into the grid.

Streamlined and Standardized Permitting and Interconnection Processes for Rooftop Photovoltaic (PV) in Puerto Rico (2012-2013) (Investigator) A \$301,911 project sponsored by the US Energy Department that seeks to improve the PV energy market of rooftop systems up to 300 kW in Puerto Rico. The project strives to create not only a standardized framework for PV deployment, but also streamlined: organized, lean permitting and interconnection processes where most residential and small commercial PV systems can be installed safely and quickly.

Design of a Renewable Energy Track within the Electrical Engineering Program at UNAPEC, Dominican Republic (2011-2012) A \$29,000 award to design a Renewable Energy Track within the existing Electrical Engineering Program of UNAPEC.

IGERT: Wind Energy Science, Engineering and Policy (WESEP) (2011-2015) A \$171,600 subaward from Iowa State University, the lead Institution, to fund master students doing research in wind technology, science, and policy as they relate to accomplishing three objectives: (a) increase the rate of wind energy growth; (b) decrease the cost of wind energy; and (c) extend penetration limits.

Center for Resources in General Education (CIVIS) – (2008-2016) A 2,500,000 (total for UPRM), approximately \$500,000 for Engineering, education project to strengthen and further develop general education objectives at UPRM. Dr. Irizarry is the coordinator for the CIVIS supported UPRM Energy Systems Instrumentation Lab.

Achievable Renewable Energy Targets For Puerto Rico's Renewable Energy Portfolio Standard (2007-2009) A \$327,197 project sponsored by the Puerto Rico Energy Affairs Administration (Administración de Asuntos de Energía), to produce an estimate, based in realistic boundaries and limitations, of renewable energy available in Puerto Rico for electricity production. The renewable energy resources studied were: biomass - including waste-to-energy, micro hydro, ocean - waves, tides, currents and ocean thermal, solar - photovoltaic and solar thermal, wind – utility as well as small wind, and fuel cells. The purpose of producing these estimates was to establish adequate targets, as a function of time, for Puerto Rico's Renewable Portfolio Standard.

Colegio San Ignacio - Ejemplo de Sostenibilidad (2007-2008) A \$73,332 project to match the energy needs of Colegio San Ignacio with its available renewable energy sources. Demonstration projects with a strong educational component will be proposed to the School to be designed, installed and operated on the Scholl Campus with the participation of the School Faculty and students. The philosophy behind the program will be one of sustainable development.

Programa Panamericano de Capacitación en Ingeniería de Potencia Eléctrica (2006-2008) A \$97,370 educational project to deliver a Web-broadcast master program in electric power engineering to engineers at UNAPEC University in the Dominican Republic. Courses in this program responded to the reality and necessities of the Dominican Republic electric power industry and aims for sustainable development.

Caguas Sustainable Energy Showcase, Phase I (2006-2007) A \$90,055 project sponsored by the Municipality of Caguas, Puerto Rico to assess the current electric energy consumption profile, by sector; residential, commercial, industrial and governmental, of Caguas and to propose achievable goals (percentages of demand), by sector, to be satisfied using renewable energy sources.

Failure Probabilities for Risk-Based Maintenance and Parameter Estimation of Synchronous Machines (2003-2004) A \$99,444 project sponsored by the National Science Foundation (NSF) to estimate parameters and failure probabilities for synchronous generators. The main outcomes of this work were the application of useful alternate robust estimation techniques and the identification of failure modes for risk-based maintenance of generators.

Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks (2002-2005) A \$499,849 project sponsored by the National Science Foundation (NSF) and the Office for Naval Research (ONR) to develop a model for the next generation power network using a distributed concept based on scalable coordination by an *Intelligent Power Router* (IPR). Our goal was to show that by distributing network intelligence and control functions using the IPR, we will be capable of achieving improved survivability, security, reliability, and re-configurability. Our approach builds on our knowledge from power engineering, systems, control, distributed computing, and computer networks.

Puerto Rico Wind Resource Assessment - Phase I: Partnership formation and prospective site identification (2002-2003) A \$32,465 project sponsored by the Puerto Rico Energy Affairs Administration to increase the knowledge of wind resources in Puerto Rico. We assessed wind velocity probabilities at sites that may be used to install wind farms. The criteria to select the prospective sites was not convenience of data gathering, such as existing towers or existing wind recording stations, but land availability for establishment of a wind farm, road access, available electric grid connections, zoning regulations and indicators of potential wind resource such as existing wind data, topography, wind-deformed vegetation or eolian landforms.

Puerto Rico SMES Project Phase I - Evaluation Study (1997-1999) A \$579,188 project sponsored by FOMENTO's Science and Technology Board to determine the energy requirements (size) of an energy storage unit to provide Puerto Rico's electrical system with rapid response spinning reserve in order to prevent blackouts under generation deficiency conditions.

EXAMPLES OF FUNDED TECHNOLOGY TRANSFER PROJECTS

Wind Resource Assessment in Caguas (2010) A technology transfer project, derived from **Caguas Sustainable Energy Showcase, Phase I** (see below).

Inspección de Instalación de Calentadores de Agua Solares y Generación Fotovoltaica Suplementaria para la Urbanización Villa Turabo en Caguas (2010) A technology transfer project, derived from **Caguas Sustainable Energy Showcase, Phase I** (see below).

Sustainable Energy Projects for Bayamón's Sustainability Master Plan (2009) A technology transfer project. Duties included: assist Bayamón's staff to define the scope of renewable energy projects. Pre-design a Photovoltaic Parking Roof for the Sports Complex Onofre Carballeira Umpierre, write the RFP sent to companies, evaluate the design submitted by companies that responded to the RFP, design performance criteria for the construction, test, and delivery phases of the project and evaluate the performance of the company/companies during the construction, test, and delivery phases of the project.

Ahorro Energético vía Calentadores de Agua Solares y Generación Fotovoltaica Suplementaria para la Urbanización Villa Turabo en Caguas (2007) A \$37,800 technology transfer project, derived from Caguas Sustainable Energy Showcase, Phase I (see below), to produce an estimated 25% energy savings in 100 residences at Villa Turabo, Caguas via solar thermal water heaters and supplemental photovoltaic electricity generation.

INTERNATIONAL CONFERENCES AND WORKSHOPS COORDINATION

 (06/06 - 06/10) Member of the Probabilistic Methods Applied to Power Systems International Society (PMAPS IS) The PMAPS IS, incorporated in Canada, is the governing body of the PMAPS Conferences. From 06/06 thru 05/08 Dr. Irizarry Rivera was the General Chair of the coming PMAPS 2008 Conference and his primary responsibility was to organize the PMAPS 2008 Conference. From 05/08 thru 06/10 Dr. Irizarry Rivera is the General Chair of the previous PMAPS Conference and his primary responsibility is to manage the selection of a venue for PMAPS 2012.

- (06/06 05/08) General Chair of the 10th International Conference on Probabilistic Methods Applied to Power Systems (PMAPS 2008) Rincón, Puerto Rico, May 25-29, 2008. The PMAPS Conferences fill a needed role in the power engineering community by providing a regular forum for engineers and scientists worldwide to interact around the common theme of power engineering decision problems under uncertainty.
- (01/06 05/06) Chair of the Sustainable Energy Workshop "De Acuerdo con la Energía Sostenible y Ahora ¿Cómo llegar allí?" at the University of Puerto Rico Mayagüez, May 22 and 23, 2007.

OTHER RECENT PROFESSIONAL EXPERIENCE

ELECTRIC POWER INDUSTRY

(09/14 – date) Member of the Board of Directors – PREPANet, LLC. A network infrastructure provider that uses an optical network platform in Puerto Rico to provide wholesale telecommunication services. Member Representing the Interest of Consumers.

(06/12 – 09/14) Member of the Board of Directors - Puerto Rico Electric Power Authority (PREPA). Elected Member Representing the Interest of Consumers.

- Vice-President of the Board
- President, Board Committee for Audits
- Member, Board Committee on Electric Power System State and Improvements
- Member, Board Committee on Labor and Legal Affairs
- Member, Board Committee on Customer Services

EXPERT WITNESS IN CIVIL COURT

- 1. (09/15 06/16) Expert witness Case Number: A2CI2014-00122, VIP Energy Consultants Corp. y VIP Energy USA vs. Centro Diagnóstico y Tratamiento de San Sebastián.
- 2. (02/10 06/12) Expert witness A DP 2007-0085 Héctor Soto Villanueva et al. vs. Puerto Rico Electric Power Authority et al. Aguadilla Court House, Aguadilla, Puerto Rico.
- (07/09 06/12) Expert witness Civil case number 09-cv-01340 (SEC) Leticia Figueroa Villegas et al. vs. Autoridad de Energía Eléctrica et al. United States District Court for the District of Puerto Rico, San Juan, Puerto Rico.
- 4. (07/09 06/12) Expert witness Civil case number EDP 2009-0097 (402) Luz Eneida Marcano Díaz et al. vs. Autoridad de Energía Eléctrica et al. Caguas Court House, Caguas, Puerto Rico.
- 5. (07/09 06/12) Expert witness Civil case number EDP 2009-0022 Eduardo Nieves et al. vs. Autoridad de Energía Eléctrica et al. Caguas Court House, Caguas, Puerto Rico.
- 6. (05/07 06/12) Expert witness Civil case number ADP 2003-0130 José A. Rosario Cordero vs. Municipio de Aguadilla, et al. Aguadilla Court House, Aguadilla, Puerto Rico.
- 7. (08/05 06/12) Expert witness Civil case number A BCI2006-0085 Fabián Crespo Muñiz et al. vs. Autoridad de Energía Eléctrica et al. Aguada Court House, Aguadillla, Puerto Rico.

- (07/09 04/11) Expert witness Civil case number 09-cv-1844 (CCC) Francisco Antonio Frías Pujols et al. vs. Puerto Rico Electric Power Authority - United States District Court for the District of Puerto Rico San Juan, Puerto Rico
- 9. (06/07 06/08) Expert witness Civil case number ISCI 2006-00937 (206) Emilio Malavé Ortiz y Enid Rivera Román vs. Autoridad de Energía Eléctrica Mayagüez Court House, Mayagüez, Puerto Rico.
- 10. (09/05 05/08) Expert witness Civil case number I DP2002-0257 Marilyn Meléndez Vélez et al. vs. Autoridad de Energía Eléctrica et al. Mayagüez Court House, Mayagüez, Puerto Rico.
- 11. (10/04 06/12) Expert witness Civil case number DKPD-2002-0610 (1008) Naomi Malavé Conde, et al. vs. Distribuidora de Provisiones y Comestibles, Inc., Bayamón Court House, Bayamón, Puerto Rico.
- 12. (12/02 06/12) Expert witness Civil case number DKDP2002-0460 (1008) Dalia E. Rivera Ortiz, et al. vs. Autoridad de Energía Eléctrica. Bayamón Court House, San Juan, Puerto Rico.
- 13. (06/01 06/12) Expert witness Civil case number K DP2002- 0108 (503) Maribel Lozada Rodríguez vs. Autoridad de Energía Eléctrica. San Juan Court House, San Juan, Puerto Rico.
- 14. (11/03 11/07) Expert witness Civil case number DKDP2003-578 (1001) Francisco Colón Calcador vs. Autoridad de Energía Eléctrica. Bayamón Court House, San Juan, Puerto Rico.
- 15. (06/02 01/04) Expert witness Civil case number K DP2002-1088 María Jiménez Carrión vs. Municipio de San Juan. San Juan Court House, San Juan, Puerto Rico.
- 16. (2/01 02/03) Expert witness Civil case number E DP1997-0275 (402) Gerardo Pérez Viera vs. Autoridad de Energía Eléctrica y otros. Caguas Court House, Caguas, Puerto Rico.
- 17. (7/00 1/02) Expert witness Civil case number F DP1999-0011, Pablo Sánchez Rosa y otros vs. Cooperativa de Seguros Múltiples y otros. Carolina Court House, Carolina, Puerto Rico.
- 18. (5/98 10/98) Expert witness Civil Case number K DP1995-0084, María Elena Ravelo Egaña vs. Autoridad de Energía Eléctrica. San Juan Court House, San Juan, Puerto Rico.

ELECTRIC POWER GRID MANAGEMENT EVALUATION

 (05/07 – 06/09) Consultant – Engineering evaluation of power system transmission and distribution limitations for Cunningham Lindsey International, Inc. provided technical advice associated to a claim of increased operational costs due to restrictions on a power system operation.

RENEWABLE ENERGY

- 1. (05/15 present) Consultant Engineering services (assist in the definition of the project, predesign, drafting of "Request for Proposals", evaluation of proposals and definition of performance criteria) in a 199 kW photovoltaic project for Rico Banana Inc., Guayanilla, Puerto Rico.
- (04/16 05/16) Consultant Engineering services (assist in the definition of the project, project inspector) in a 300 kVA, three-phase, pole-mounted substation for Rico Banana Inc., Guayanilla, Puerto Rico.
- (07/15 12/16) Consultant Engineering services (assist in the definition of projects, pre-design, drafting of "Request for Proposals", evaluation of proposals and definition of performance criteria) in energy efficiency and photovoltaic systems, Municipio Autónomo de Bayamón.

- 4. (01/11 05/12) Consultant Wind Energy Resource Assessment for New Era Eolic LLC, Puerto Rico.
- 5. (07/10 08/11) Consultant Engineering supervision of residential photovoltaic installations in Urbanización Villa Turabo, Municipio Autónomo de Caguas.
- (07/09 08/10) Consultant Engineering services (assist in the definition of the project, pre-design, drafting of "Request for Proposals", evaluation of proposals and definition of performance criteria) in a 250 kW photovoltaic project on the Onofre Carballeira Sports Complex, Municipio Autónomo de Bayamón.
- 7. (08/07 08/08) Consultant Engineering design of residential photovoltaic generation for one hundred (100) dwellings in Urbanización Villa Turabo, Municipio Autónomo de Caguas.
- 8. (10/06 12/06) Consultant Provided technical advice in sitting and interconnection issues for potential wind energy projects for UPC Wind.
- (06/04 06/05) Consultant to, and Partner of, ecoEnergy Provided engineering services and technical advice in wind data analysis, sitting, preliminary wind turbines selection, interconnection issues and preliminary power purchase agreement negotiations for potential wind energy projects in Puerto Rico.
- 10. (4/01 07/02) Consultant Provided engineering services and technical advice in wind data analysis, sitting, preliminary wind turbines selection, interconnection issues with a proposed desalination plant and drafting of "Request for Information" and "Request for Proposals" documents for the Puerto Rico Energy Affairs Administration.

PEER REVIEWED PUBLICATIONS:

- 1. E. O'Neill-Carrillo, I. Jordan, A.A. Irizarry-Rivera, and R. Cintrón, "The Long Road to Community Microgrids," IEEE Electrification Magazine. Vol. 6, No. 4, pp. 6-17, December 2018.
- A. Irizarry-Rivera, K.V. Montano-Martinez, S. Alzate-Drada, F. Andrade, "A Case Study of Residential Electric Service Resiliency thru Renewable Energy Following Hurricane María", Mediterranean Conference on Power Generation, Transmission, Distribution and Energy Conversion (MEDPower), Dubrovnik (Cavtat) Croatia, November 12-15 2018.
- 3. S. Alzate-Drada, K.V. Montano-Martinez, A. Irizarry-Rivera, F. Andrade, "Advanced Metering Applications in Microgrids: A hardware in the Loop (HIL) Electric Power Setup", Mediterranean Conference on Power Generation, Transmission, Distribution and Energy Conversion (MEDPower), Dubrovnik (Cavtat) Croatia, November 12-15 2018.
- K.V. Montano-Martinez, S. Alzate-Drada, A. Irizarry-Rivera, F. Andrade, "Characteristics of Residential Battery Storage System for Better Integration with Electric Distribution System", Mediterranean Conference on Power Generation, Transmission, Distribution and Energy Conversion (MEDPower), Dubrovnik (Cavtat) Croatia, November 12-15 2018.
- 5. Carlos Vélez-Rivera, Emmanuel Arzuarga-Cruz, Agustín A. Irizarry-Rivera and Fabio Andrade, "Global Data Prefetching using BitTorrent for Distributed Smart Grid Control", Proceedings of the Forty-eight Annual North American Power Symposium, Denver, Colorado, September 18-20, 2016.

- José R. Matagira-Sánchez and Agustín A. Irizarry-Rivera, "Feasibility Study of Micro Pumped Hydro for Integration of Solar Photovoltaic Energy into Puerto Rico's Electric Grid", Proceedings of the Fortyseventh Annual North American Power Symposium, University of North Carolina Charlotte, Charlotte, North Carolina, October 4-6, 2015.
- 7. Laura M. Adarme-Mejía and Agustín A. Irizarry-Rivera, "Feasibility Study of a Linear Fresnel Concentrating Solar Power Plant located in Ponce Puerto Rico", Proceedings of the Forty-seventh Annual North American Power Symposium, University of North Carolina Charlotte, Charlotte, North Carolina, October 4-6, 2015.
- 8. Mónica I. Mercado-Oliveras and Agustín A. Irizarry-Rivera, "Residential Grid-tied Photovoltaic Energy System Design in Puerto Rico", Proceedings of the Forty-seventh Annual North American Power Symposium, University of North Carolina Charlotte, Charlotte, North Carolina, October 4-6, 2015.
- 9. Armando L. Figueroa-Acevedo and Agustín A. Irizarry-Rivera, "Variability Assessment of Solar and Wind Resources in Puerto Rico", Proceedings of the Thirteenth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Durham, UK, July 7-10, 2014.
- 10. Agustín A. Irizarry-Rivera, Efraín O'Neill-Carrillo and E. Jiménez-Toribio, "Puerto Rico Small Hydro Report", Status of the Caribbean Chapter on World Small Hydropower Report, International Network for Small Hydropower, Lara Jin Qiu-ting Esser (Editor), 2014.
- 11. Agustín A. Irizarry-Rivera, Manuel Rodríguez-Martínez, Bienvenido Vélez, Miguel Vélez-Reyes, Alberto R. Ramirez-Orquin, Efraín O'Neill-Carrillo and José R. Cedeño, "Chapter 3 Intelligent Power Routers: Distributed Coordination for Electric Energy Processing Networks", In J. Momoh, L. Mili (Editors) *Operation and Control of Electric Energy Processing Networks*, John Wiley and Sons/IEEE Press, 2010.
- 12. José A. Colucci Ríos, Efraín O'Neill-Carrillo and Agustín A. Irizarry-Rivera. "Renewable Energy in the Caribbean: A Case Study from Puerto Rico", In E. Laboy, F. Schaffner, A. Abdelhadi (Editors) *Environmental Management, Sustainable Development and Human Health*, Taylor and Francis Press, 2009, pp 291.
- 13. Efraín O'Neill-Carrillo, Marla Pérez-Lugo, Cecilio Ortiz-García, Agustín A. Irizarry-Rivera and José A. Colucci-Ríos, "Sustainable Energy: Balancing the Economic, Environmental and Social Dimensions of Energy," Proceedings of the IEEE Energy 2030 Conference, November 2008, Atlanta, Georgia.
- 14. Efraín O'Neill-Carrillo, Agustín A. Irizarry-Rivera, José A. Colucci-Rios, William Frey, Cecilio Ortiz-García and Marla Pérez-Lugo, "Advancing a Sustainable Energy Ethic Through Stakeholder Engagement," Proceedings of the IEEE Energy 2030 Conference, November 2008, Atlanta, Georgia.
- 15. Efraín O'Neill-Carrillo, Marla Pérez-Lugo, Cecilio Ortiz-García, Agustín A. Irizarry-Rivera and José A. Colucci-Ríos, "Sustainability, Energy Policy and Ethics in Puerto Rico", Proceedings of Energy and Responsibility: A Conference on Ethics and the Environment, April 10-12, 2008, Knoxville, Tennessee.
- 16. José A. Colucci Ríos, Agustín A. Irizarry-Rivera and Efraín O'Neill-Carrillo, "Sustainable Energy for Puerto Rico", Proceedings of the 2007 Energy Sustainability Conference, June 27-30, 2007, Hilton Long Beach, California, USA.
- Agustín A. Irizarry-Rivera, Manuel Rodríguez-Martínez, Bienvenido Vélez, Miguel Vélez-Reyes, Alberto R. Ramirez-Orquin, Efraín O'Neill-Carrillo and José R. Cedeño, "Intelligent Power Routers: A Distributed Coordination Approach for Electric Energy Processing Networks", International Journal of Critical Infrastructures, Vol. 3 No 1/2 pp. 20-57, 2007.

- 18. Efraín O'Neill-Carrillo and Agustín A. Irizarry-Rivera, "Socially-Relevant Capstone Design Projects in Power Engineering," Proceedings of the IEEE/PES Power Systems Conference and Exposition, October 2006, Atlanta, GA.
- 19. Luis O. Jimenez, Efrain O'Neill, William Frey, Rafael Rodríguez-Solis, Agustín A. Irizarry-Rivera, and Shawn Hunt, "A Learning Module of Social and Ethical Implications for Electrical and Computer Engineering Capstone Design Courses", Proceedings of the Thirty-sixth Annual Frontiers in Education Conference, San Diego, California, October 28-31, 2006.
- 20. Efraín O'Neill-Carrillo, Eddie Marrero, Agustín A. Irizarry-Rivera, "Integrated Laboratory Experiences in Power Engineering Courses," Proceedings of the International Conference on Engineering Education, July 2006, San Juan, Puerto Rico.
- 21. Efraín O'Neill-Carrillo, Agustín A. Irizarry-Rivera, Jorge A. Cruz-Emeric, "Curricular Revisions in Electrical Engineering at UPRM," Proceedings of the Thirty-fifth Annual Frontiers in Education Conference, Indianapolis, Indiana, October 2005.
- 22. Carlos A. Ramos-Robles and Agustín A. Irizarry-Rivera, "Economical Effects of the Weibull Parameter Estimation on Wind Energy Projects", Proceedings of the Thirty-seventh Annual North American Power Symposium, Ames, Iowa, October 23-25, 2005.
- 23. Linda Monge-Guerrero and Agustín A. Irizarry-Rivera, "A Degradation Model of Synchronous Generator Stator Insulation to Compute Failure Probabilities", Proceedings of the Thirty-seventh Annual North American Power Symposium, Ames, Iowa, October 23-25, 2005.
- 24. Jennifer Jiménez-González and Agustín A. Irizarry-Rivera, "Generation Displacement, Power Losses and Emissions Reduction due to Solar Thermal Water Heaters", Proceedings of the Thirty-seventh Annual North American Power Symposium, Ames, Iowa, October 23-25, 2005.
- 25. Héctor R. Zamot, Efraín O'Neill-Carrillo and Agustín A. Irizarry-Rivera, "Analysis of Wind Projects Considering Public Perception and Environmental Impact," Proceedings of the Thirty-seventh Annual North American Power Symposium, Ames, Iowa, October 23-25, 2005.
- 26. Carlos A. Ramos-Robles and Agustín A. Irizarry-Rivera, "Development of Eolic Generation Under Economic Uncertainty", Proceedings of the Eighth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Ames, Iowa, September 13-16, 2004.
- 27. Carlos M. Torres-Ortolaza and Agustín A. Irizarry-Rivera, "Failure Modes and Failure Probability of Intelligent Power Routers", Proceedings of the Eighth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Ames, Iowa, September 13-16, 2004.
- Agustín A. Irizarry-Rivera, Manuel Rodríguez, Miguel Vélez-Reyes, José R. Cedeño, Bienvenido Vélez Efraín O'Neill-Carrillo and Alberto Ramírez, "Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks", Proceedings of the 2003 EPNES Workshop, Orlando, Florida, October 23-24, 2003.
- 29. Tania Martínez-Navedo and Agustín A. Irizarry-Rivera, "Voltage Stability Assessment of an Island's Power System as a Function of Load Model", Proceedings of the Thirty-fifth Annual North American Power Symposium, University of Missouri-Rolla, Rolla, Missouri, October 20-21, 2003.
- 30. Agustín A. Irizarry-Rivera. "Benefits of Storing Electric Energy from Wind in Puerto Rico", Proceedings of the Caribbean Colloquium on Power Quality (CCPQ), Dorado, Puerto Rico, June 24-27, 2003.

- 31. Efraín O'Neill Carrillo, Miguel Vélez Reyes, Agustín A. Irizarry-Rivera and Eduardo Marrero. "The Power of Undergraduate Research", IEEE Power and Energy Magazine, Volume 1, Number 4, July/August 2003.
- 32. Agustín A. Irizarry-Rivera and J.D. McCalley. "Risk of Insecurity", Proceedings of the Euro Conference on Risk Management in Power System Planning and Operation in a Market Environment (RIMAPS 2001), Porto, Portugal, September 8-11, 2001.
- 33. Efraín O'Neill Carrillo, Agustín A. Irizarry-Rivera and Miguel Vélez Reyes. "Curriculum Improvements in Power Engineering", Proceedings of the Thirty-first ASEE/IEEE Frontiers in Education Conference, Reno, Nevada, October 10-13, 2001.
- 34. A.A. Irizarry-Rivera, Wenceslao Torres and Efran Paredes. "Evaluation and Technology Review of Energy Storage for the PREPA System", Proceedings of the Electric Energy Storage Applications and Technologies Conference, Orlando, Florida, September 18-20, 2000.
- 35. A.A Irizarry-Rivera. "Teaching Electric Power System Analysis Using Visually Attractive Tools," Proceedings of the Twenty-ninth ASEE/IEEE Frontiers in Education Conference, San Juan, Puerto Rico November 10-13, 1999.
- 36. A.A Irizarry-Rivera, Manuel A. Pérez Quiñonez and Rudolph P. Darken. "Using Virtual Worlds to Explore Electric Power Grids and Plants," Proceedings of the Twenty-ninth ASEE/IEEE Frontiers in Education Conference, San Juan, Puerto Rico November 10-13, 1999.
- L.C. González-Carrasquillo and A.A. Irizarry-Rivera. "Calculation of Capacity Value of a Wind Farm in Puerto Rico's Electric Power System," Proceedings of the Sustainable Applications for Tropical Island States (SATIS '99) Conference, San Juan, Puerto Rico, August 25-27, 1999.
- 38. A.A. Irizarry-Rivera and Ivette Malpica Crespo. "Monolineal Animado y Equivalente del Sistema Eléctrico Existente en Puerto Rico: Una Herramienta de Enseñanza," Memorias del IX Simposio de Ingeniería Eléctrica, Universidad Central de las Villas, Santa Clara, Cuba, February 24-27, 1999.
- 39. E. Paredes-Maisonet and A.A Irizarry-Rivera. "Energy Storage Systems to Mitigate Frequency Decline under Generation Deficiency Conditions," Proceedings of the Thirtieth Annual North American Power Symposium, Cleveland State University, Cleveland, Ohio, 1998.
- 40. M. Rodríguez-Fernández and A.A Irizarry-Rivera. "Overview of the Dynamic Performance of a Small Electric Power System in the Presence of Eolic Generation," Proceedings of the Thirtieth Annual North American Power Symposium, Cleveland State University, Cleveland, Ohio, 1998.
- 41. Jiménez-Dávila and A.A Irizarry-Rivera. "Establishment of a Lightning Location System in Puerto Rico," Proceedings of the Thirtieth Annual North American Power Symposium, Cleveland State University, Cleveland, Ohio, 1998.
- 42. L.C. González-Carrasquillo and A.A Irizarry-Rivera. "A Procedure to Determine Wind Power Capacity Value and its Future Application to Puerto Rico's Electric Power System," Proceedings of the Thirtieth Annual North American Power Symposium, Cleveland State University, Cleveland, Ohio, 1998.
- 43. J.D. McCalley, A.A. Fouad, V. Vittal, A.A. Irizarry-Rivera, B.J. Agrawal and R.G. Farmer. ``A Risk-Based Security Index for Determining Operating Limits in Stability Limited Electric Power Systems," IEEE Transactions on Power Systems, Volume 12, Issue 3, Aug. 1997, pp. 1210-1219.

- 44. A.A. Irizarry-Rivera, J.D. McCalley and Vijay Vittal. ``Computing Probability of Instability for Stability Constrained Electric Power Systems," Electric Power Systems Research Journal, Volume 42, Issue 2, August 1997, pp. 135-143.
- 45. A.A. Irizarry-Rivera, J.D. McCalley and V. Vittal. ``Limiting Operating Point Functions and their Influence on Probability of Instability," Proceedings of the Fifth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Vancouver, British Columbia, Canada, September, 1997.
- 46. Z. Zhu, S. Zhao, J.D. McCalley, V. Vittal and A.A. Irizarry-Rivera. ``Risk-Based Security Assessment Influenced by Generator Rejection," Proceedings of the Fifth Probabilistic Methods Applied to Power Systems (PMAPS) International Conference, Vancouver, British Columbia, Canada, September, 1997.
- 47. Nguyen, A.A. Irizarry-Rivera, J.D. McCalley and V. Vittal. ``Survey Development for Assessing Impact of Power System Disturbances," Proceedings of the Fifth Annual Midwest Electro-Technology Conference, Iowa State University, Ames, Iowa, 1996.
- 48. A.A. Irizarry-Rivera and J.D. McCalley. ``A Cartesian Product Approach to Determine the Probability of Instability for Stability Limited Electric Power Systems," Proceedings of the Twenty-seventh Annual North American Power Symposium, Montana State University, Bozeman, Montana, 1995.
- 49. A.A. Irizarry-Rivera, J.D. McCalley, V. Vittal, and A.A. Fouad. ``A Risk-Based Electric Power System Security Index: Moving from Frequency to Probability of Instability," Proceedings of the Fourth Annual Midwest Electro-Technology Conference, Iowa State University, Ames, Iowa, 1995.
- 50. A.A. Irizarry-Rivera and J.D. McCalley. ``A Security Assessment Approach for Stability-limited Electric Power Systems Using a Risk-based Index," Proceedings of the Thirty-second Annual Power Affiliate Meeting, Iowa State University, Ames, Iowa, 1995.
- 51. J.D. McCalley, A.A. Fouad, V. Vittal, A.A. Irizarry-Rivera, B.J. Agrawal and R.G. Farmer. ``A Probabilistic Problem in Electric Power System Operation: The Economy-Security Tradeoff for Stability Limited Power Systems," an invited paper, Proceedings of the Third International Workshop on Rough Sets and Soft Computing, San Jose State University, San Jose, California, 1994.

SELECTED PRESENTATIONS:

- 1. A.A. Irizarry-Rivera. "Renewables and the Power Sector: Renewable Integration into the Existing Grid, Workforce Development", New England Power Seminar, Avon Old Farms Hotel, Avon, Connecticut, September 21-25, 2015.
- 2. A.A. Irizarry-Rivera. "Update on Renewables: Context, Solar PV on Islands, Renewable Integration into the Existing Grid, Workforce Development", New York Power Conference, New York Sciences Academy, 7 World Trade Center, Manhattan, New York City, New York, May 14, 2015.
- 3. Armando Figueroa, A.A. Irizarry-Rivera. "Requisitos de Reserva Operacional de un Sistema de Potencia Eléctrica con Significativa Generación Renovable", Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), Viernes 360-Centro de Convenciones, San Juan, Puerto Rico, May 16, 2013.
- 4. A.A. Irizarry-Rivera, E. O'Neill-Carillo. "Streamlined and Standardized Permitting and Interconnection Processes for Rooftop Photovoltaic Systems in Puerto Rico", Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), Casa Capitular Calle Obispado, Mayagüez, Puerto Rico, May 14, 2013.

- 5. A.A. Irizarry-Rivera. "¿Cuál Crisis Energética? El uso racional de la energía y renovables", Convención de la Sociedad de Planificadores de Puerto Rico, Sede del Colegio de Arquitectos y Arquitectos Paisajistas, Calle del Parque 255, San Juan, Puerto Rico, November 14, 2012.
- 6. A.A. Irizarry-Rivera. "Generación Eólica: El Debate de Comida vs. Energía", Escuela de Leyes, Pontificia Universidad Católica de Ponce, March 20, 2012.
- 7. A.A. Irizarry-Rivera. "Concentrated Solar Thermal Electricity Production: Principles, Resource and Technology", Brickell Avenue Business Interruption and Energy Conference (BABIEC), JW Marriot, Miami, October 27-28, 2011.
- 8. A.A. Irizarry-Rivera. "Wave to Wire: An Overview of Electricity Generation from Waves; Resource, Technology, System Integration and Economics", New York Power Conference, Downtown Conference Center at Pace University, Manhattan, New York City, New York, May 19, 2011.
- A.A. Irizarry-Rivera. "The estate vs. the citizens: Crisis (mis)management in education and energy", Lucidity and Engagement: The UPR Strikes (2010-2011) and Academic Activism in Puerto Rico (Part 2), A panel session in the American Ethnological Society (AES) and the Society for Urban, National and Transnational Anthropology (SUNTA) Meeting, Caribe Hilton Hotel, San Juan, Puerto Rico, April 15, 2011.
- 10. A.A. Irizarry-Rivera. "Recurso Solar en Puerto Rico y la Tecnología Solar Térmica para la Producción de Electricidad", Universidad Interamericana Recinto de Guayama, April 8, 2011.
- 11. A.A. Irizarry-Rivera. "A usar el español en la investigación tecnológica: reflexión de un ingeniero a su regreso de Andalucía", Universidad de Puerto Rico, Mayagüez, Octuber 12, 2010.
- 12. A.A. Irizarry-Rivera. "Achievable Renewable Energy Targets for Puerto Rico", Universidad Interamericana Recinto de Guayama, April 15, 2010.
- 13. A.A. Irizarry-Rivera. "Renewable Portfolio Standards", Convención Anual Colegio de Químicos de Puerto Rico 2007, Puerto Rico Conventions Center, August 10, 2007.
- 14. A.A. Irizarry-Rivera. "Alternativas Energéticas Sostenibles. Energía Solar: Termal y Fotovoltaica", Convención Anual Colegio de Ingenieros y Agrimensores de Puerto Rico 2007, Cambio Climático: Ingeniería, Agrimensura y Sostenibilidad, Hotel El Conquistador, Fajardo, Puerto Rico, August 3, 2007.
- 15. A.A. Irizarry-Rivera. "Energía Eólica, Conservación y el Ejemplo de Caguas", Noveno Congreso de Investigación y Creación Académica de la Universidad de Puerto Rico en Ponce, Teatro General UPR Ponce, May 11, 2007.
- 16. A.A. Irizarry-Rivera. "Energía Eólica", Mega Viernes Civil, Seminario de Diseño y Construcción Verde del Instituto de Ingenieros Civiles, Colegio de Ingenieros y Agrimensores de Puerto Rico, Centro de Convenciones de Puerto Rico, May 18, 2007.
- 17. A.A. Irizarry-Rivera. "Generación Eólica y Solar: Fotovoltaica, Termal", Tercera Reflexión Ambiental, Foro de Desarrollo de Energía Sustentable, Teatro de la Universidad de Puerto Rico, Río Piedras, April 18, 2007.
- A.A. Irizarry-Rivera & Gerson Beauchamp "Generación Fotovoltaica para Puerto Rico", Workshop sponsored by the Alianza Ciudadana para Educación en Energía Renovable (ACEER), Centro Cultural de Mayagüez, April 21, 2007.

- 19. A.A. Irizarry-Rivera. "Costo de la generación eólica y ahorro por desplazamiento de generación", Conference sponsored by the Puerto Rico Chamber of Comerce, Hotel Condado Plaza, San Juan Puerto Rico, February 21, 2007.
- 20. A.A. Irizarry-Rivera. "Energía eléctrica en Puerto Rico: generación, transmisión y conservación", Workshop sponsored by the Alianza Ciudadana para la Educación en Energía Renovable (ACEER), Centro Cultural de Mayagüez, February 3, 2007.
- 21. A.A. Irizarry-Rivera and E. Juan-García "Electrical Shock and Trauma: Causes, Mechanisms of Injury and Case Studies", Workshop sponsored by the Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), CIAPR Mayagüez, November 8, 2005.
- 22. A.A. Irizarry-Rivera. "Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks: Second Year Progress Report", Electric Power Networks Efficiency and Security (EPNES) Workshop, sponsored by the National Science Foundation (NSF), Mayagüez, Puerto Rico, July 12-14, 2004.
- 23. A.A. Irizarry-Rivera. "Environmental Impact of Eolic Power", Sustainable Energy Workshop sponsored by the Instituto de Ingenieros Electricistas del Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), CIAPR Headquarters, May 19, 2004.
- 24. A.A. Irizarry-Rivera. "Electricity Hazards", Energy Systems Seminal Series (ES³) Electrical and Computer Engineering Department, University of Puerto Rico, Mayagüez, March 30, 2004.
- 25. A.A. Irizarry-Rivera, M. Vélez Reyez and E. O'Neill-Carrillo. "Risk-Based Maintenance and Parameter Estimation of Synchronous Machines", Power System Engineering Research Center (PSERC) Industrial Advisory Board Meeting, December 10-12, 2003.
- 26. A.A. Irizarry-Rivera. "Future Power Systems", Industry University Symposium on Electrical Engineering, sponsored by the Instituto de Ingenieros Electricistas del Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), CIAPR Headquarters, November 14, 2003.
- 27. A.A. Irizarry-Rivera. "Electric Power from the Wind", Energy Systems Seminal Series (ES³) Electrical and Computer Engineering Department, University of Puerto Rico, Mayagüez, October 30, 2003.
- A.A. Irizarry-Rivera. "Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks: First Year Progress Report", Electric Power Networks Efficiency and Security (EPNES) Workshop, sponsored by the National Science Foundation (NSF), Orlando, Florida, October 23-24, 2003.
- 29. A.A. Irizarry-Rivera. "Eolic Generation", Energy Forum sponsored by the Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), Hotel Wyndham El Conquistador, August 1st, 2003.
- 30. A.A. Irizarry-Rivera. "EPNES: Intelligent Power Routers for Distributed Coordination in Electric Energy Processing Networks", Modernizing the National Grid Workshop, sponsored by the National Science Foundation (NSF), New Orleans, Louisiana, November 18-19, 2002.
- 31. A.A. Irizarry-Rivera. "Puerto Rico SMES Project", Puerto Rico Chamber of Commerce and Guests, Puerto Rico Chamber of Commerce Headquarters, Old San Juan, Puerto Rico, January 28, 1998.

GRADUATE THESES and PROJECTS SUPERVISED:

- 1. Carlos García. "Ocean Wave Energy into Electricity Using Point Absorbers in the North Coast of Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, In progress.
- 2. Karen Montaño. "Characteristics of Electric Batteries for Residential Use and Better Integration with the Electric Distribution System", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2018.
- 3. Laura Adarme. "Feasibility of Linear Fresnel Solar Thermal Generation in Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2018.
- 4. José Matagira. "Feasibility of Micro Pumped Hydro Storage for Photovoltaic Energy", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2016.
- 5. Luis de Jesús. "Design and Characterization of Fresnel Solar Concentrator for Solar Thermal Drying of Coffee in Puerto Rico", ME Report, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2014.
- 6. Armando Figueroa. "Requisitos de Reserva Operacional de un Sistema de Potencia Eléctrica con Significativa Generación Renovable", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2013.
- 7. Felipe Hernández. "Feasibility of Dish/Stirling Solar Thermal Generation in Puerto Rico and in the Dominican Republic", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2012.
- Franchesca Aponte. "Ocean Wave Energy into Electricity Using Offshore Wave Energy Devices in the North Coast of Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2009.
- 9. Magaby Quintero. "Ocean Wave Energy into Electricity Using Shoreline Devices in Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2009.
- 10. Miguel Rios. "Small Wind / Photovoltaic Hybrid Renewable Energy System Optimization", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2008.
- 11. Linda Monge. "Effect of Distributed Energy Storage Systems in Voltage Stability of an Island Power System", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2006.
- 12. Jennifer Jiménez. "Benefits of Electric Generation Displacement Using Solar Thermal Water Heating", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2005.
- 13. Carlos Ramos. "Determination of Favorable Conditions for the Development of a Wind Power Farm in Puerto Rico", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2005.
- 14. Carlos Torres. "Failure Probability of Intelligent Power Routers", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2005.
- 15. Orlando Leal Flores. "Analysis and Simulation of EM Fields of a Permanent Magnets DC Linear Motor used to Propel a Magnetically Levitated Train", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2004.
- 16. Tania Martínez Navedo. "Voltage Stability Assessment of an Island Power System as a Function of Load Model", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2002.

- 17. Jorge Valenzuela Valenzuela. "Development of Small Signal Analysis Tools to Study Power System Dynamics Using Simulink", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2001.
- 18. Ismael A. Jiménez Dávila. "Calibration of Magnetic Finder System for Lightning Location Using AM Carrier Signals", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2000.
- 19. Francisco Quiles Torres. "Identifying Electrical Needs and Implementing Improvements on the Main Power Substation of a Manufacturing Plant", ME Project, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2000.
- 20. Luis C. González Carrasquillo. "A Procedure to Determine Wind Power Capacity Value and its Future Application to Puerto Rico's Electric Power System", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 2000.
- 21. Efran Paredes Maisonet. "Determination of Required Rapid Response Spinning Reserve to Avoid Under frequency Load Shedding under Generation Deficiency Conditions in Puerto Rico's Electric Power System", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 1999.
- 22. Mireya Rodríguez Fernández. "Power System Dynamic Analysis for the Integration of Wind Farms to Puerto Rico's Electric Grid", MS Thesis, University of Puerto Rico-Mayagüez, Mayagüez, Puerto Rico, 1999.

HONORS AND OTHER PROFESSIONAL ACTIVITIES:

- Recipient "Ingeniero Electricista Distinguido 2013" (Distinguished Electrical Engineer 2013) from the Mayagüez Chapter of the Puerto Rico Professional Engineers Society (Capítulo de Mayagüez del Colegio de Ingenieros y Agrimensores de Puerto Rico) - In recognition of services rendered to the profession, achievements in engineering education and his performance as Vice-President of the Puerto Rico Electric Power Authority Board of Directors.
- Recipient "2010 Distinguished UPRM Alumni" from the University of Puerto Rico Mayagüez Alumni Association.
- Recipient "Ingeniero Electricista Distinguido 2005" (Distinguished Electrical Engineer 2005) from the Electrical Engineering Institute of the Puerto Rico Professional Engineers Society (Instituto de Ingenieros Electricistas del Colegio de Ingenieros y Agrimensores de Puerto Rico) - In recognition of services rendered to the profession and outstanding professional achievements in the field of electrical engineering.
- Recipient "2004 Professional Progress in Engineering Award" (PPEA) from Iowa State University

PROFESSIONAL PROGRESS IN ENGINEERING AWARD - Established in 1988

In recognition of outstanding professional progress and personal development in a field of engineering specialization as evidenced by significant contributions to the theory and practice of engineering, distinguished service rendered to the profession, appropriate community service, and/or achievement in a leadership position. There shall also be evidence of recognition through citations and acceptance of achievements by colleagues, and of the promise of continued progress and development.

- Recipient "2003-2004 Electrical and Computer Engineering Outstanding Faculty Award" from the School of Engineering, Mayagüez, Puerto Rico
- Recipient ``Iowa State University Research Excellence Award" for Ph.D. dissertation
- Registered Professional Electrical Engineer in Puerto Rico (6/91) and Member of the "Colegio de Ingenieros y Agrimensores de Puerto Rico"
- Magna Cum Laude BSEE, University of Puerto Rico, 1988
- Member Institute of Electrical and Electronic Engineers (IEEE) Power Engineering Society and Faculty Advisor of the Power Engineering Society Student Chapter at the University of Puerto Rico Mayagüez
- Advocate American Wind Energy Association
- Engineering Futures Facilitator and Member of Tau Beta Pi the National Engineering Honor Society. (06/98 – 06/08) Principal Faculty Advisor of Puerto Rico's Tau Beta Pi Alpha Chapter, (06/08 present) Faculty Advisor of Puerto Rico's Tau Beta Pi Alpha Chapter

SERVICES RENDERED TO THE PROFESSION

- Member of the Energy Committee of the Puerto Rico Engineers and Surveyors Association (CIAPR, from the Spanish "Colegio de Ingenieros y Agrimensores de Puerto Rico").
- Member of the AD HOC Committee for Renewable Energy and Climate of the Puerto Rico Engineers and Surveyors Association (CIAPR, from the Spanish "Colegio de Ingenieros y Agrimensores de Puerto Rico").
- Instructor of Continuous Education Courses at the Puerto Rico Engineers and Surveyors Association (CIAPR, from the Spanish "Colegio de Ingenieros y Agrimensores de Puerto Rico")
- Member of the AD HOC Committee to Evaluate the Technical Administration of the Puerto Rico Electric System by the Puerto Rico Electric Power Authority during the Tropical Storm (TS) Jeanne of September 15, 2004 The official state inquiry by the CIAPR into what caused a general electric blackout in the Island of Puerto Rico during Tropical Storm Jeanne. It is part of the CIAPR public responsibility to conduct such inquiries when technical matters are in dispute. Responsibilities included: analysis of technical evidence, as submitted by PREPA, of the power system state and behavior as TS Jeanne crossed over Puerto Rico, the formulation of a hypothesis to explain such behavior, and to judge the decisions made on the administration of the power system during the storm.

EXAMPLES OF UNDER GRADUATE RESEARCH and DESIGN PROJECTS:

1. **Design of the Distribution System for an Eolic Generation Park**. The complete design of the Distribution System for an Eolic Generation Park. This included the decision to install an aerial or underground system and specification of: transformers, conductors, protection system, grounding system, conduits, junction boxes, lighting protection and design of the substation to connect the eolic park with the local electric utility. Other requirements included: estimate of materials and construction costs, a construction and project management schedule and analysis to determine the required reactive compensation. Students: Franchesca Aponte Santiago, Dumeng Roman Johana,

Melissa Hernandez Bernier, Erika Padilla Ocasio, Magaby Quintero Lopez, Marilyn Ramirez Alvarado, Sharlene Rivera Gonzalez, Rodolfo Morales Medina and Giancarlo Santos Santiago.

- 2. Environmental and infrastructure impact of eolic generation in Puerto Rico. The study of key aspects of eolic generation and their environmental impact with emphasis in: noise, electromagnetic interference, avian issues and aesthetic considerations. Student studied the infrastructure impact of eolic generation projects specifically on roads, sea ports and sea bottom. Students were aware of socio-economic and political considerations and implications on eolic generation projects. Students: Camille T. Ocasio, Verónica Narváez and David Marrero.
- 3. Design Projects in Power Electronics: Design, Simulation, Fabrication and Test of Brushless Commutator for Permanent Magnets DC Motors. Project involved the preliminary design of a brushless commutator including computer simulations of the proposed circuit, identification of components to be used including component costs and manufacturer data, necessary tools and materials needed to construct and test the commutator, and detailed work schedule of the steps needed to complete the design and prototype construction tasks. A working prototype and documented results of tests performed to the prototype to ensure its compliance with design specifications was required. Proposed modifications to solve any problems found during testing, computer simulations of the proposed modifications to the commutator circuit were also required. Students: Noel G. Figueroa Urdaz, Camille Guzmán Torres, Lourdes Orona Jiménez, José J. Rodríguez Alvarez, Reyes M. Ruiz Donate, José L. Valenzuela Rivera and Miguel D. Vázquez Peña.
- 4. Development of an Animated One-line Equivalent of Puerto Rico's Existing Electric Power System. Project involved the use of the commercially available PowerWorld Simulator, a user-friendly, highly interactive package for engineering analysis, to develop a one-line equivalent of Puerto Rico's existing electric power system. The animated and graphical one-line equivalent of Puerto Rico's electric system is geographically accurate as well as electrically equivalent to the generation and transmission (115 kV and above) of the Puerto Rico Electric Power Authority (PREPA). This equivalent has being used by engineering students to study the behavior of Puerto Rico's electric power grid under a variety of system conditions. It will also provides an excellent teaching tool to demonstrate the principles of electric power flow, voltage profiles and their relation to reactive power, economic dispatch and steady-state system security. Students: Ivette Malpica
- 5. Using Virtual Worlds to Explore Electric Power Grids and Plants. Virtual worlds provide the capability of visiting spaces difficult to explore because of: time constraints, natural hazards, and cost of accessibility or access restrictions. Electric power system courses are constrained to show primary components of a power system using drawings and photos. Development of virtual worlds tailored to suit the topic being discussed is an attractive solution. Student may browse around the system learning as they go along. They provide motivation and the electric utility may use these tools to familiarize new personnel with their system and inform and educate non-technically trained decision-makers using accurate and visually attractive presentations. Two undergraduate students participated in the project developing virtual worlds of a power plant. Students: Iomar Vargas and Emmanuel Arzuaga.

OTHER PROFESSIONAL EXPERIENCE

 (2006) Implementation Specialist – Alliance for the Strengthening of Mathematics and Science Teaching (AFAMaC): An Alliance among the Puerto Rico Department of Education and University of Puerto Rico Mayagüez (UPRM) to professionally advance Mathematics and Science school teachers of 7th, 8th and 9th grade in three Educational Districts; Mayagüez, Moca and San Sebastian. The primary goal of the project is to improve knowledge and practice of Mathematics and Science teachers thru summer and weekend long internships at the UPRM taking courses that will focus on content (Math, Physics, Chemistry, Geology, Basic Engineering, and Information Technology) rather than teaching methods.

- (01/03) Consultant Engineering evaluation of electrical installation at a private residence in Mayagüez, Puerto Rico. Identified electrical design deficiencies and failures to comply with the National Electric Code.
- (05/98 08/98) Consultant Electric Energy Audit and Consumption Estimates for a small Hotel in Aguadilla, Puerto Rico. Analyzed electric bills and estimated energy consumption of the Hotel including internal generation to settle a billing dispute between the Hotel Management and the Puerto Rico Electric Power Authority.
- (02/98 04/98) Consultant Redesign the electric distribution system of a Trailer Camp Facility in La Parguera, Puerto Rico.
- (1/94 5/96) Computer Network System Administrator at Iowa State University, Ames, Iowa Performed software and hardware system administration for UNIX workstation network serving 50 users.
- (7/93 10/96) Research Assistant at Iowa State University, Ames, Iowa
 - Developed a risk-based method to assess security and determine operating limits for electric power systems, a project sponsored by Electric Power Research Institute (EPRI).
 - Utilized state of the art industry-grade power systems software applications (power flow, stability, etc).
 - Performed large scale system studies of WSCC network
 - Supervised two undergraduate students in their undergraduate research projects
- (8/90 6/93) Assistant Researcher at the University of Puerto Rico, Mayagüez, Puerto Rico

Administered the optics and laser facilities of the Physics Department and supervised authorized personnel in the operation of the equipment

• (9/89 - 2/90) Research Assistant at the University of Michigan, Ann Arbor, Michigan

Developed a novel and simple technique to create an optical source capable of providing high peak power at a desired frequency or a short pulse with a tunable, spectrally pure frequency

- Summer Intern at Aluminum Company of America, ALCOA Center, Pennsylvania
 - (5/90 7/90) Characterized electromagnetic field properties of electromagnetic acoustic transducers and eddy current sensors
 - (5/89 8/89) Implemented the Digital Holographic Interferometry Technique for surface displacement measurements
 - (6/88 8/88) Implemented the Synthetic Aperture Focusing Technique for ultrasonic testing using an HP1000 computer
 - (6/87 8/87) Designed, fabricated and analyzed electromagnetic acoustic transducers

ADDITIONAL EDUCATIONAL INFORMATION:

Graduate Coursework:

23 hours in Power Systems, 23 hours in optics, 12 hours in electromagnetics, 9 hours in Control Systems, 12 hours in Math and 9 hours in probability and statistics.

Salient Ph.D. Research Contributions:

- Developed a method that allows risk-based security assessment in an operating environment considering any type of security violation.
- Developed, using probability theory, expressions to calculate the conditional probability of insecurity given a fault occurs for thermal overloads and transient instability.
- Developed a method to generate risk-based operating limits in terms of parameters available to system operators, illustrated using nomograms based on risk rather than deterministic limits. The change from deterministic to risk-based operating limits is transparent to system operators since they just see new nomograms or tables.
- Investigated the effect of conventional protection systems on risk of an operating point.

Participated in investigation of the effect of special protection schemes on risk of transient instability.

COLEGIO DE INGENIEROS Y AGRIMENSORES DE PUERTO RICO



Comisión Conjunta Para las Alianzas Público Privadas de la Asamblea Legislativa

VISTA PÚBLICA Ponencia sobre el Rol y Relevancia de la Central Palo Seco en el Sistema Eléctrico de la AEE

28 de noviembre de 2017

Muy buenos días, Señor Presidente y Miembros de la Comisión de Conjunta Para las Alianzas Público Privadas de la Asamblea Legislativa. Comparece ante ustedes, el Ing. Pablo Vázquez Ruiz, Presidente del Colegio de Ingenieros y Agrimensores de Puerto Rico (en adelante, Colegio). Me acompaña el Ing. Roberto Volckers Esteves, Ingeniero Licenciado, miembro del Colegio, Asesor de la Empresa *Integrated Engineering Group*, e ingeniero jubilado de la AEE luego de una distinguida carrera en la Agencia en la cual se destacan las posiciones de Jefe de la División Operaciones y Director del Sistema Eléctrico de la AEE. A su distinguida carrera en el servicio público se añade un honorable servicio en las fuerzas armadas, como veterano del conflicto de Vietnam y como miembro de la Guardia Nacional de Puerto Rico hasta septiembre del 2001.

Nuestra comparecencia responde a la solicitud del Honorable Lawrence Seilhamer Rodríguez, Vicepresidente del Senado, mediante carta del 16 de noviembre de 2017. La solicitud del senador era para un informe detallado sobre el rol o la relevancia de la Central Generatriz Palo Seco en el sistema eléctrico de la Autoridad de Energía Eléctrica (AEE). Entendimos que para confeccionar un informe de tal naturaleza iba a ser necesario obtener información técnica y de planificación estratégica que es de carácter interno de la AEE, asunto que tomaría tiempo que no tenemos disponible ante la urgencia de este tema y el calendario para esta vista pública. En su lugar, escogimos desarrollar y presentar esta ponencia basada en la pericia y vasta experiencia de miembros de nuestro Colegio, muchos de ellos jubilados de la AEE, que han estado ávidos a servir al país durante esta emergencia y que así ha quedado demostrado por los esfuerzos de nuestro Colegio en hacerlos disponibles. Es de conocimiento público que, mediante carta del 11 de octubre de 2017, el Colegio hizo disponibles nuestros voluntarios a la AEE para diversas áreas de restauración del servicio. Es también conocido por todos que el Senado de Puerto Rico escuchó nuestra oferta y nos convocó a aportar al país en el tema de Palo Seco cuando nos insertamos en la opinión pública el pasado 15 de octubre de 2017, levantando la voz de alerta sobre las razones para tener fuera de servicio un sistema de generación vital para la zona metropolitana ante una situación de emergencia como la que hemos vivido. Cabe señalar que el Colegio intervino en la discusión pública única y exclusivamente en el mejor interés del país y solo cuando estuvo disponible información técnica de nuestra competencia que analizamos cuidadosamente y para la cual emitimos una opinión objetiva e imparcial. Nuestra postura al respecto era en defensa de una reevaluación de la decisión tomada por la AEE de cerrar la operación de la Central Palo Seco por seis meses, según anunciado, mientras se llevaban a cabo las reparaciones Ponencia CIAPR Rol y Relevancia Central Palo Seco Página 2



recomendadas por el informe de la empresa *Island Structures Engineering, LLC*. Establecimos que el informe no anticipaba o recomendaba categóricamente un cierre de operaciones de la central y pensábamos que las reparaciones críticas podían hacerse en un tiempo menor al anunciado. Nuestra visita a la Central como parte de la evaluación del Senado el pasado 19 de octubre de 2017 confirmó nuestra postura y así lo reflejamos en nuestro informe a este honorable Cuerpo el 22 de octubre de 2017. Destacamos aquí que, hasta el día de hoy, no se ha provisto información técnica alguna que contradiga los hallazgos del Colegio y que, por el contrario, el supuesto de una posible operación simultánea con el proceso de reparaciones quedó corroborado por el propio contrato que firmara la AEE con Alstom Caribe para dichas reparaciones. Esto último fue hecho público por la prensa del país el pasado 17 de noviembre de 2017.

Dicho lo anterior como preámbulo al asunto de esta ponencia procedemos entonces con la misma:

Como sabemos, por disposición de su ley orgánica, Ley 319 del 15 de mayo de 1938, según enmendada, el CIAPR es asesor del Gobierno en asuntos relacionados a la ingeniería y agrimensura en PR. Nos sentimos horados de proveer este servicio al Senado de Puerto Rico y al país, a través del Memorando de Entendimiento que firmáramos con ustedes el 18 de octubre de 2017, específicamente sobre lo concerniente a la Central Palo Seco a través de la Comisión Conjunta para las Alianzas Público Privadas de la Asamblea Legislativa.

El demostrar el rol o relevancia que tiene la Central Generatriz de Palo Seco en la operación del Sistema de Eléctrico de PR, puede ser tan profundo como para los fines que se requiera la información. Partimos de la premisa que, en esta ocasión, se trata de ilustrar a los distinguidos legisladores que forman parte de esta Comisión y al Pueblo de Puerto Rico sobre la ventaja de tener en servicio las unidades generatrices que forman parte de esta Central Generatriz y su beneficio en el proceso de recuperar el servicio de energía eléctrica luego de los daños ocasionados por el huracán María. No obstante, nos interesa además proveer una perspectiva general de la importancia estratégica que reviste esta planta en el servicio eléctrico a corto y mediano plazo, aunque no tengamos data específica y actualizada sobre el proceso de planificación de la AEE.

Es importante que comencemos explicando que los sistemas eléctricos se planifican, diseñan y construyen siguiendo estándares nacionales, códigos aplicables a la industria, información de planificación del país, y las condiciones técnicas presentes, entre otras consideraciones. Las unidades generatrices se ubican estratégicamente en lugares específicos que garanticen la continuidad, eficiencia, y confiabilidad aún bajo condiciones operacionales adversas. Además, dependiendo de los recursos económicos disponibles al momento, se proveen los niveles de redundancia adecuados para garantizar la mayor confiabilidad posible cuando ocurran eventos adversos. Usualmente las líneas de transmisión que interconectan estas unidades generatrices con los centros de cargas son los que añaden niveles de <u>redundancia</u> al sistema eléctrico. A mayor la diversificación en la ubicación de las unidades generatrices a las zonas de consumo de carga, mayores serán la eficiencia operacional y la confiabilidad y más costo efectiva la producción de energía.

Ponencia CIAPR Rol y Relevancia Central Palo Seco Página 3



En el caso del Sistema Eléctrico de PR, hay que considerar que este tiene una característica particular que lo hace diferente al de los países o estados continentales y es muy importante que ustedes, señores legisladores, entiendan claramente. Nuestro Sistema Eléctrico es uno aislado. No tenemos un sistema o país vecino que nos pueda suplir energía eléctrica bajo ciertas condiciones comerciales. Los sistemas aislados como el nuestro, requieren que se adopten condiciones operacionales más conservadoras que en los países o estados continentales, ya que se requiere ser autosuficientes para suplir la demanda en todo momento. Esto es, cuando surgen eventos de mayor demanda (momentos de consumo pico), cuando se realiza mantenimiento, cuando ocurren mal funcionamiento de algunos de sus equipos, entre otras razones. Por ello existen unidades con diferentes tipos de tecnologías, diferentes usos, diferentes características, y diferentes ubicaciones.

En los sistemas eléctricos existen unidades conocidas como unidades de operación base, otras de operación pico y otras de operación durante emergencias. Algunas unidades, por sus características y tamaños, pueden ser utilizadas tanto en operación pico, como en emergencias. Por otro lado, existen líneas de transmisión con diferentes niveles de voltajes que interconectan estratégicamente las estaciones de generación de energía o centrales generatrices, con las áreas de grandes bloques de consumos de energía. Algunas de estas, son líneas principales de transmisión, las cuales tienen capacidad para transmitir grandes cantidades de energía, y otras líneas cuyo uso es para conducir menor cantidad de energía, ya que las condiciones normales del sistema eléctrico no requieren que discurran grandes cantidades de energía a través de ellas. Por ello existen líneas que, aunque son de niveles de voltaje similares no tienen la misma capacidad de transmisión.

En el caso específico de Puerto Rico, su sistema eléctrico se diseñó y construyó bajo unas premisas de desarrollo económico que no se sostuvieron por mucho tiempo. Esto es, que el mayor consumo de energía ocurriría en el sur, y por lo tanto fue donde se instaló la mayor capacidad de generación. La realidad es que el 70% del consumo ocurre el norte del país, mientras que la mayor parte de la capacidad de generación se encuentra ubicada en sur de la isla. Esto hace que haya más dependencia de las líneas de transmisión del sur al norte, haciendo más importante y relevante la disponibilidad de las unidades generatrices ubicadas en norte del país.

Con esta explicación general de nuestro sistema eléctrico, podemos mencionar algunas condiciones por las cuales se hace más relevante las unidades 1, 2, 3, y 4 de la Central Palo Seco. A continuación, algunas de las condiciones principales que hacen de la Central Palo Seco, una de suma relevancia:

- 1. Ubicación geográfica estratégica. Las unidades generatrices de la Central Palo Seco están ubicadas en el norte de la Isla, cercanas a donde ocurre el mayor consumo de energía.
- 2. La infraestructura del Sistema Eléctrico localizados en el Complejo Generatriz de Palo Seco es mucho más que 4 unidades generatrices. El Complejo Generatriz Palo Seco es una instalación de producción de energía eléctrica ubicada estratégicamente para, entre otras



cosas, garantizar la confiabilidad del sistema eléctrico de PR. Este complejo incluye la siguiente Infraestructura:

a. Cuatro unidades generatrices con operación base (Unidades 1, 2, 3 y 4). Esto significa que fueron planificadas para estar en operación la mayor parte del tiempo, con excepción del tiempo requerido para dar mantenimiento o alguna condición operacional del sistema eléctrico o de las unidades mismas que impida la operación de alguna de sus unidades.

Unidades 1 y 2 – Fueron comisionadas para operación comercial a finales de los años 50's (aprox. 1958 y 1959 respectivamente). Son unidades generatrices cuya capacidad de carga es 85 MW (85,000 KW) cada una. Sus calderas fueron manufacturas por la compañía Combustion Engineering y sus Turbogeneradores por General Electric, Inc.

Unidades 3 y 4 – Fueron Comisionadas para operación comercial a principios de los años 60's (aprox. en 1964 y 1965 respectivamente). Su capacidad son 216 MW (216,000 KW) cada una. Sus calderas fueron manufacturadas con la Compañía Combustion Engineering y sus turbogeneradores por la compañía Westinghouse, Inc.

- b. Seis turbinas de Combustión para operación en periodos pico o en emergencias cada unidad tiene capacidad de 22 MW (22,000 KW). Estas unidades se utilizan durante periodos cortos en momentos donde ocurren los picos de demanda de energía o durante emergencias. Estas unidades son las que producen la energía para iniciar el arranque de las unidades grandes de operación continua u operación base, como se les llama en el negocio de producción de energía. En el caso de las seis unidades de combustión de Palo Seco, estas sirven como unidades de arranque (*black start*) de las unidades base tanto de la Central Palo Seco, como de las unidades de la Central San Juan en Puerto Nuevo. Al momento de redactar este informe, solo tres de estas unidades de operación pico estaban en operación.
- c. Moderno Patio de Interruptores de 115kV y 38 Kv con tecnología GIS (*Gas Insulated Substation*) Estos patios son los que permiten interconectar la generación de la Central Palo Seco con la Central San Juan y los Patios de Interruptores de Bayamón TC (*Transmission Center*) y Monacillos TC.
- d. Fincas de Tanques de Combustibles son los que permiten almacenar combustible paras las unidades tanto de operación base como operación pico. Esto son derivados del petróleo # 6 (bunker C) y Destilado # 2 (Diesel) respectivamente. Estos tanques pueden almacenar combustible tanto para uso de las unidades de la Central Palo Seco, como para las unidades de la Central San Juan. Es un gran activo para las operaciones de la AEE.



- e. Planta de tratamiento de aguas de proceso Planta desmineralizada para agua que posteriormente es convertida a vapor.
- f. Planta de tratamiento de aguas usadas industriales Planta para tratar aguas industriales.
- 3. Tecnología de operación de las unidades 1, 2, 3 y 4. Estas son unidades diseñadas para operación base. Esto significa que están diseñadas para estar la mayor parte del tiempo en operación. Incluso, una gran parte de su mantenimiento puede ofrecerse en forma segura con las unidades en servicio, ya que muchos de sus componentes son redundantes.
- 4. Las unidades generatrices 1, 2, 3 y 4 son totalmente independientes, y cuando haya alguna condición que las requiera fuera de servicio, permite que las restantes continúen en operación normal. Son muy pocas las razones que requieren más de una unidad fuera de servicio en forma simultánea. Ejemplo de lo anterior, es cuando ocurre algún problema en los sistemas comunes como es el agua de mar que se utiliza para enfriar los condensadores y algunas interconexiones entre sistemas que ha realizado el propio personal de la AEE para añadir flexibilidad en su operación.
- 5. Siendo Unidades de operación base, su eficiencia operacional (eficiencia termal), suele ser mejor a las de las unidades pico, y además utilizan un combustible significativamente más económico. El resultado neto de estas dos características es que el costo de producción de las unidades bases es significativamente menor. En el caso de las unidades 1-4 de la Central Palo Seco, los costos de producción serían por lo menos a la mitad de los costos incurridos por los generadores de emergencias alquilados a *Weston Solutions*, según la información difundida públicamente sobre estos.
- 6. Las unidades de operación base son unidades que tienen una capacidad mayor a las unidades de operación pico. Sin embargo, las unidades de operación pico puede ser puesta en servicio en un tiempo significativamente menor que las unidades de operación base, pero son de mucho menos capacidad, de eficiencia más baja y costos de producción más altos. Es por esta razón que tan pronto el consumo de energía alcance unos niveles la operación aceptable, lo correcto, seguro y efectivo es suplir la energía con las unidades de operación base.
- 7. Las unidades 1, 2, 3 y 4 de Palo Seco tienen una capacidad extraordinaria de aportar carga reactiva. Esta es la energía para mantener los niveles de voltaje de un sistema. A modo de ejemplo unidad de operación base puede producir una carga reactiva significativamente mayor. A modo de ejemplo las unidades de Palo Seco pueden producir la siguiente carga:
 - a. Unidades 1 y 2 85 MW y 75 MVAR cada una.



b. Unidades 3 y 4 – 216 MW y 200 MVAR cada una.

Si se compara con una unidad de operación pico, estas solo pueden aportar 22 MW y 20 MVAR cada una. La capacidad de ofrecer carga reactiva (MVARS) es el mayor atractivo para mantener estas unidades en servicio, ya que ofrece mayor flexibilidad al sistema eléctrico.

Como adelantamos, en PR aproximadamente el 70% de la carga está en el norte y el mayor porciento de generación se produce en el Sur. El tener la carga del norte mayormente dependiendo de la conexión de líneas de 230kV que discurren del sur al norte y pocos generadores en línea en el norte capaces de aportar carga reactiva (MVARS), se produce una limitación en la producción de Megavatios (MW) en las unidades del sur al éstas tener que aportar mayor carga reactiva (MVRS) hacía el norte. Para poder satisfacer la demanda reactiva que es requerida en el norte se requiere reducir la producción de energía para poder sostener los niveles de voltaje o de lo contrario se producirán bajos voltajes de magnitudes tan bajas que será necesario relevar carga (dejar clientes sin servicio en forma programada). Aunque existen otras formas de mejorar los niveles de voltajes mediante el uso de bancos de capacitores, sabemos que en el área norte muchos se estos no están en servicio. Recomendamos que estos se habiliten a la brevedad posible.

- 8. La aceleración en el deterioro físico de las unidades es otro factor por considerarse y hacen relevante que las unidades de Palo Seco se deban poner en servicio a la brevedad posible. Las unidades base suelen deteriorarse más, cuando están fuera de servicio, si no se sigue un proceso adecuado de almacenaje.
- 9. Vida útil de las Unidades aunque estas unidades son tecnologías de diseños de finales de los 50's (Unidades 1 y 2) y los 60's (unidades 3 y 4), las mismas se han renovado con componentes muchos más modernos. Algunos de estos de los años 2002-2014. Existen programas de ingeniería conocidos como Programas de Extensión de Vida Útil, utilizadas en la industria eléctrica. La AEE tiene la información precisa de los componentes rehabilitados con sus respectivas fechas y las inversiones hechas. Entendemos que estas unidades tienen una vida útil remanente considerable, suficiente para planificar, desarrollar y comisionar las unidades sustitutas. Es importante mantener las mismas hasta que las sustitutas estén en operación confiable.
- 10. Sabemos que el lugar donde ubica la Central Palo Seco es uno considerado bajo diferentes escenarios en el plan de modernizar la infraestructura de producción de energía de PR. La reglamentación ambiental considera como niveles máximos permitidos, las emisiones totales durante los cinco años previos a la solicitud de un nuevo permiso. El mantener estas unidades fuera de servicio restringe significativamente los niveles máximos de emisiones que se pueden autorizar por las agencias reguladoras en un nuevo permiso, lo cual limitará la capacidad de una nueva central generatriz. El Plan Integrado de Recursos adoptado por la AEE contempla



la construcción de una nueva unidad generatriz de operación base en el lugar donde ubican las unidades 1 y 2. <u>El mantener estas unidades generatrices fuera de servicio tiene el efecto de reducir significativamente los límites de permisos de esta nueva unidad.</u>

11. Además de las condiciones antes mencionadas, existen grandes beneficios en la operación del sistema eléctrico de PR cuando se mantienen estas unidades de la Central Palo Seco en servicio. A continuación, algunos de ellos:

Inercia en Sistemas Sincrónicos de una Red de Potencia: La inercia es provista por la cantidad de generadores en línea. Para tener una inercia saludable en sistemas sincrónicos de una red de potencia, tiene que haber capacidad de sostener una frecuencia de 60Hz manteniendo una estabilidad cuando surgen averías o salidas súbitas de generadores (disparos). Lo que tenemos actualmente en el norte es un desequilibrio entre los generadores en servicio y la carga, donde la carga domina. Esto representa un sistema de baja inercia por los pocos generadores en línea con relación a la carga. Los generadores aportan la inercia, y al tener pocas de estas en servicio y un sistema de mucha carga, durante averías o disparo de unidades generatrices, las restantes unidades no pueden frenar el impacto por la poca inercia que pueden aportar, resultando en apagones indeseados. Si ponemos las unidades de Palo Seco en servicio, subimos la inercia, equilibramos la razón entre generadores y carga, manteniendo una mayor estabilidad. Es decir, mantenemos la frecuencia en 60 Hz, y así no se permite alcanzar la zona de inestabilidad lo cual se entiende es la causal de los eventos ocurridos recientemente.

Además de los aspectos mencionados que hacen de las unidades de la Central Generatriz Palo Seco unas relevantes, hacemos algunas recomendaciones que pueden ayudar en la operación del Sistema Eléctrico durante el proceso previo a alcanzar la estabilidad deseada:

1. Activación del Programa de Brown Out:

Este sistema permite bajar el voltaje de servicio a nivel de los clientes para poder aumentar el voltaje a nivel de las líneas de transmisión y evitar hasta cierto punto la limitación de las unidades del sur. Recomendamos se verifique su disponibilidad y funcionamiento ya que es el paso anterior a tomar para proceder con una suspensión de servicio.

2. Análisis de Estabilidad en el Sistema Eléctrico:

Sugerimos que tanto el personal de Planificación y Protección Ambiental como el de Administración de Energía, ambos bajo la AEE, realicen estudios de estabilidad por separado y corroboren todo lo señalado y recomendado en este escrito. Se sugiere que lo hagan tomando en consideración las unidades de Palo Seco fuera de servicio y así puedan corroborar las mejoras que se producen con ellas en servicio. <u>El Colegio de Ingenieros y Agrimensores recomienda que se</u> Ponencia CIAPR Rol y Relevancia Central Palo Seco Página 8



pongan las unidades de Palo Seco en servicio lo antes posible tomando en consideración el informe sobre la condición estructural en Planta de Palo Seco realizado y entregado anteriormente. Así la AEE podrá seguir conectando cargas adicionales al Sistema Eléctrico de forma estable y con los niveles de voltajes correctos.

3. Rehabilitación de líneas de 230 kV:

La rehabilitación de las líneas de 230 kV es imprescindible para alcanzar los niveles de redundancia que garantizan la estabilidad del Sistema Eléctrico. Recomendamos que la prioridad sea de las líneas que discurren desde los Complejo Generatriz Aguirre y de Costa Sur, ya que por especificación de doble conductor son líneas que manejan grandes bloques de carga desde el complejo de mayor capacidad de generación. No obstante, esto no debe sustituir la puesta en marchas de las unidades generatrices de Palo Seco. Estas líneas deben ser opciones de redundancia.

Esperamos que con esta información hayamos aportado positivamente en los objetivos de esta distinguida Comisión Conjunta de la Asamblea Legislativa. Estamos disponibles para contestar algunas preguntas y/o aclarar dudas.

Respetuosamente sometido.

Ing. Pablo Vázquez Řuiz, PE, MBA Presidente

EXHIBIT D

Public Comment Submission of Gloria Fontánez

From: Gloria Fontanez <<u>gloria.amapola68@gmail.com</u>> Date: May 7, 2020 at 10:20:33 PM EDT To: Laura Arroyo <<u>larroyo@earthjustice.org</u>> Subject: GENERADORA

En estos días he recibido información, en realidad muy poca, sobre los generadores que instalarán en la isla Uno de ellos estará ubicado en Candelero, Humacao. Yo, como residente del Bo. Candelero me opongo al mismo, porque considero que el costo de \$70 millones al mes, en la isla, es un costo exagerado cuando podrían explorar otras alternativas. Exijo a la AEE y al negociado de energía nos informen el porqué de esta decisión y le hable con claridad al pueblo de Puerto Rico.

Cordialmente,

Gloria E. Font'anez Marcano

EXHIBIT E

Generation v. Peak Demand

							Peak		
							Demand,		
							Accounting		
							for Large		
	Installed	<u>Maximum</u>		<u>Total</u>	<u>Total</u>	<u>Summer 2020</u>	<u>Customer</u>	Reserve	<u>Reserve</u>
	Generation	Capacity		Installed	<u>Maximum</u>	Projected Peak	<u>Self-</u>	<u>Margin</u>	<u>Margin</u>
Power Plant	<u>(MW)</u>	<u>(MW)</u>	Date Online	Generation	<u>Capacity</u>	Demand	Generation	<u>(MW)</u>	<u>(%)</u>
Generation System as of									
4/29/20	3812	2897		3812	2897	2448	2214	683	24%
Vega Baja 1-1	21	18	4/15/2020	3833	2915	2448	2214	701	24%
San Juan 8	100	50	4/24/2020	3933	2965	2448	2214	751	25%
San Juan CC 6	220	120	4/24/2020	4153	3085	2448	2214	871	28%
San Juan 7	100	70	4/28/2020	4253	3155	2448	2214	941	30%
Jobos 1-1	21	18	4/30/2020	4274	3173	2448	2214	959	30%
Mayaguez 4	55	50	5/4/2020	4329	3223	2692	2458	765	24%
Aguirre Steam 2	96	50	5/6/2020	4425	3273	2692	2458	815	25%
Aguirra Hidrogas 2-1	21	21	5/7/2020	4446	3294	2692	2458	836	25%
Palo Seco Hidrogas 1-2	21	19	5/8/2020	4467	3313	2692	2458	855	26%
Aguirre 2	450	300	5/13/2020	5390	3613	2692	2458	1155	32%
Costa Sur GT	42	42	6/6/2020	4509	3655	2768	2534	1121	31%
Yabucoa 1-2	21	19	6/6/2020	4530	3674	2768	2534	1140	31%
Costa Sur Unit 5	410	369	8/15/2020	4940	4043	2809	2575	1468	36%
Costa Sur Unit 6	410	369	10/1/2020	5350	4412	2586	2352	2060	47%
Cambalache 1	83	83	TBD	5433	4495				
Aguirre CC Stag 2 (2-2)	50	50	TBD	5483	4545				
Mayaguez 2	55	55	TBD	5538	4600				
Palo Seco Hidrogas 2-2	21		Long Term						
Palo Seco Hidrogas 3-1	21		Long Term						
Palo Seco Hidrogas 3-2	21		Long Term						
Palo Seco 2	85		Long Term						
San Juan Steam 10	100		Long Term						

